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28 July 1955

MEMORANDUM FOR: THE RECORD

SUBJECT:

ADDENDUM TO SUBPROJECTS 8 and 10

1. The purpose of this addendum is to set forth the mutual administrative responsibilities of the contractor and sponsor.

2. The above subprojects represent the research programof located at the Boston, Massachusetts, covering the period of 9 June 1953 through 15 September 1955.

- has requested the Hospital to submit to them a summary accounting of monies received from the Fund. Also, they requested the return of any unexpended funds received under a grant from the Fund.
- 4. Title to any permanent equipment purchased by funds granted the Hospital shall be retained by the Hospital in lieu of higher overhead rates.
- 5. It was mutually agreed that documentation and accounting for travel expenses which are reimbursable by the Hospital shall conform with the accepted practices of that Institution.

6. It was agreed that technical reports reflecting the progress of the research program shall be submitted at mutually acceptable intervals.

SIDNEY COTTLIEB

Chief

TSS/Chemical Division

APPROVED:

Chief, TSS

Distribution: Orig. & 2 - TSS/CD



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T33-771-54

25 September 1953

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TSS/CD

4-2524-10

Room 2409 - Qtra. Eye

155-7

B 1 No. 260

MATORILORO TERT BUTYL ALCOHOL

1216-770

100 gross

1.50

Order From:

B

Notes

CERTIFICATE

March 2, 1954

This is to certify that I have today received Cashier's check No. M138328 of the in the amount of \$26,333.33.



March 2, 1954

This is to certify that I have today received Ceshier's check No. M138329 of the in the amount of \$526.67.



		MEMORANDUM RECEIPT	FEB 1 8 1954
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TO	-66		FRANCE OF RECIPIENT OATE RECEIVED

5 February 1954

CHIEF, FINANCE DIVISION

VIA:

753/Budget Officer

SUBJECT:

Invoice No. 2, Subproject 8, Project MULINA

Divoice Eo. 2 for Subproject 8 of Project NATIGIRA is Ettacked. It is requested that payment be endo by two checks in tho amounts of \$26,333.33 and \$526.67 made out to The checks should be sent to thier, co/This, through Tas/Indicat Cfficer.

> SIDARY GOTTLIEB Chief Chemical Division, 733

Attaclmente: Invoice Cortifications

Distribution:

Addressee - Orig. & 1

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. In the amount of s 公公67



CERTIFICATIONS

(1) "It is hereby certified that this is Invoice No. 2 applying to subproject 0 of Project MONTAN, that technical performance by the is satisfactory, that the work is being accomplished in accomplance with the mutual agreement reached with the mutual agreement reached with the motivation and that payment thereof has not yet then made.

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			·	٠.	•.	• •				Chiec.	CD/TSS"	

(2) "It is bareby cortified that this invoice applies to subproject 8 under Project MAVAILA which was duly approved and that the project is being carried out in accordance with the DO/P Ecororadum to DUI dated 3 April 1953 one the DOI remoration to DD/A dated 13 April 1963. Payment is authorized and requested.

FEB 8	1954	ying i	While	
Teter		70 30 A	reh Director	A

(3) "It is berely cartified that the acces of the progress of subproject 8 of Project Middish has been approved.

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Dates			/
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I CERTIFY_THAT_FUNDS ARE AVAILABLE:

COLIGATION SETURISHED TO 12 44 2

CHARGE TO AUDITUT No. 3-2502-10

AUTHORIZING OFFICER



Feb. 1, 1954

C B

B Payment due for grant to \$26,333.33

B Service charge of 2% for TOTAL....\$26,860.00

0

Inv. #2



August 31, 1953

This is to certify that I have today received

Teshier's check No. 1133785 of the

in the amount of \$13,166.67.

August 31, 1953

This is to certify that today I have received Cashier's check No. M133785 of the in the amount of \$263.33.

N.D.

MEMORANDUM RECEIPT

28 August 1953

10:

FROM: Budget Office, TSS

SUBJECT: Two checks



I hereby acknowledge receipt of the following:

Check # M133786 in the amount of \$263.33 and check # M133785 in the amount of \$13,166.67 as payment for invoice # 1, Subproject 8

Project MKULTRA.

Please return _____ signed copy(les) of this receipt

FORM NO. 36-66

STERRIFURE OF RECIPIENT

OATE RECEIVED

MEMORANDUM RECEIPT

TO:

FRAM: Budget Office, TSS

SUBJECT: Two checks

I hereby acknowledge-receipt-of the following:

Check # M133786 in the amount of \$263.33 and check # M133785 in the amount of \$13,166.67 as payment for invoice # 1, Subproject 8 Project MKULTRA.

Please return_____ signed copy(les) of this receipt

FORM NO. 38-66

Signature DE RECEIVEU

DAY RECEIVEU



19 August 1953

KEMORANDUM FORE CHIEF, FINANCE DIVISION

VIA

res/purget Officer

SUBJECT:

Invoice No. 1, Subproject 8, Project MENLERA

Invoice No. 1 for Subproject 8 of Project MKULTRA is attached.

It is requested that payment be made by two checks in the amounts of \$13,166.67 and \$263.33 male out to The checks should be sent to Chief, CD/F33, through T33/Bulget Officer.

GIDNET GOVERNED Chief Chemical Division, TSS

Attachments: Invoice Certifications

Distribution:

Addresses - Orig. & 1

Comptroller - 1

Exec. George

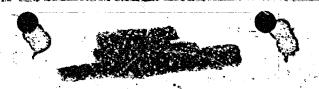
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T53/CD - 2

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CERTIFICATIONS

(1) "It is hereby certified that this is Invoice No. 1 applying to subproject 8 of Project MAULTRA, that technical performance by is catiofactory, that the work is being accomplished in accordance with the mutual egreement reached with that this bill is just and correct and that payment thereof has not yet been made.

chief, cd/12a"

(2) "It is hereby certified that this invoice applies to subproject 8 under Project MRUMRA which was duly approved and that the project is being carried out in accordance with the DD/2 memorandum to DCI dated 3 April 1953 and the DOI memorandum to DO/A dated 13 April 1953. Payment is authorized and requested.

"It is hereby certified that the scope of the program of subproject 8 of Project MANITA has been approved.



9 June 1953

henothedia fort constroller -

ATTEMPTON

Vinance Division

SU3.TCT1

Project MKULTAA, Subproject 8

C-112

Under the authority granted in the newbrandum dated 13 April 1953 from the DII to the DD/A and the further authority granted in the memorandum dated 17 April 1953 from the DD/A to the Comptroller on the subject, "DD/P-TOS Project MAULARA", subproject 8 has been approved, and \$40,290.00 of the over-all Project MAULARA funds have been obligated to cover the subproject's expenses.

Chemical Division, Til

CHYOTHYA INTUDAY I I DZGRZYJO ZAN GJIA APPROVED FOR COLLECTION OF FUNDS:

Magairen Director



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korearch Chairman

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Date:

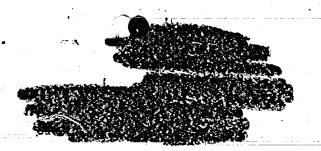
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August 18, 1953

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COMMENT

Inv#1



DRAFT A
9 June 1953

MEMORANDUM FOR THE RECORD

SUBJECT:

Project MKULTRA, Subproject 8

1. Subproject 8 is being set up as a means to continue the present work in the general field of L.S.D. at until 11 September 1954.

2. This project will include a continuation of a study of the biochemical, neurophysiological, sociological, and clinical psychiatric aspects of L.S.D., and also a study of L.S.D. antagonists and drugs related to L.S.D., such as L.A.E. A detailed proposal is attached. The principle investigators will continue to be a study of the principle investigators will continue to be a study of the principle investigators will continue to be a study of the biochemical, and drugs all of

3. The estimated budget of the project at will serve as a cut-out and cover for this project and will furnish the above funds to the sas a philanthropic grant for medical research. A service charge of \$790.00 (25 of the estimated budget) is to be paid to the for this service.

4. Thus the total charges for this project will not exceed \$40.290.00 for a period ending September 11, 1954.

hospital) are cleared through TOP SECRET and are aware of the true purpose of the project.

Chemical Division/TSS

APPROVED:

Chief, Chemical Division/TSS

PROTRAM

PROGRAM APPROVED AND RECOMMENDED:

APPROVED FOR OBLIGATION OF FUNDS:

Research Asi waln

Reserved Director

Date: June 16.1453.

Date:

Attachment: Proposal

Original Only.

PA CTUS FOR CONTINUATION OF RECE ON PROJECT ILL CH L.S.D. - d-LYSEROIC ACID DISTRYLAMIDE TARTRATE.

To include Study of L.S.D. Antagonists and Related Drugs Such as L.A.E. - Lysergic Acid Ethylamide.

The prospectus for next year is in general a continuation of the L.S.D. project along similar lines to that of this year. Each aspect of the project (biochemical, neurophysiological, sociological, clinical psychiatric) to be continued.

The principal addition in the broad areas of study is that of a psychological section which consists of work not outlined in last year's protocol but which nevertheless has been going on during the year and has brought forth substantial findings sufficient to point out the necessity both of its continuation and expansion.

Each scientific aspect of the project has led to the development of procedures and methods which are now of proved usefulness in the study of lywergic and other similar drug reactions. It is the further application of the methods which have been developed during the past year of experimentation that will be one of the principal focuses of next year's work.

These methods will be applied to the study of related chemicals such as L.A.E. and any other drugs which make their appearance, and to the study of other drugs in conjunction with L.S.D. with the goal of ascertaining antagonistic effects.

these methods to the study of patients with functional psychoses not attributable to drug reactions. This will not only test the applicability of the methods on a broader basis but will demonstrate more precisely the degree to which the findings of the studies of the lysergic psychosis can be applied to understanding schizophrenia and other functional psychoses.



The past year's research has dealt to a great extent with determining the symptoms produced by different desages of L.S.D. and the degree to which these symptoms can be determined by the social situation in which the subject finds himself and by the basic personality and social attributes of the subject himself. For the study of the use of other drugs in conjunction with L.S.D. to ascertain antagonistic effects it becomes necessary to develop more precise measurements of L.S.D. effect than any which we have had heretofore. This constitutes an escentially new field of investigation, namely that of developing quantitative measurements of lysergic effect.

From our background of clinical and social observations of the lysergic psychosis which have been carried on throughout the past year, more precise and objective instruments of measurement will be developed along the following lines: physiological measurements such as polygraph changes and sensitivity to specific physical ctimuli such as flashing light; psychological measurements of persistence, motivation lack, distractibility, memory, reality perception, richness of associations; sociological and social psychological measurements such as quality and quantity of verbal production in different structured social situations such as problem solving group discussion and occupational task situations; psychiatric determinations of mental status (which is essentially a continuation of the present method of clinical evaluation).

Elechemical Studies Fart I.

These studies were carried out at the

Director:

L.S.D. as a stress agent upon the adrenal cortex.

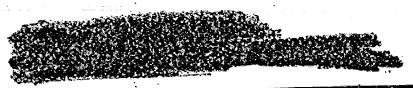
Twelve volunteers were chosen. On the control day, merely the urines were collected at pre-determined intervals, and at 3.00 o'clock in the afternoon, an injection of ACTH, 25 mg., was given to test the responsivity of the adrenal cortex.

The urine was examined as to volume; rate per minute; and, chemically, as to the content of Greatinine (determined in grams per 24 hours); 17-Ketosteroids (determined by milligram per hour); Sodium (determined by milligram per hour); Potassium (determined by milligram per hour); Uric Acid (determined by milligram per minute); Phosphates (determined by milligram per minute).

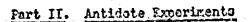
On the experimental day, the volunteers received L.S.D. early in the morning at a definite hour. The urine again was collected at exactly the same time intervals as on the control day.

Three control experiments were carried out in which glucose was given together with L.S.D.

From the data of the chemical determinations collected, no definite conclusions can be drawn at the present time. Some of the results were not consistent. There seems to have been some technical difficulties, such as errors possibly made by the subjects themselves with regard to the exact time, hour and minute, when they discarded the first morning urine, and also possibly some errors in chemical determinations. However, from the overall picture of the data which lend themselves to evaluation, the impression was gained by as well as by that L.S.D. seems to cause an inhibitory effect upon the adrenal cortex. It is felt that it is of utnost importance to continue these chamical determinations. Some slight changes in the technique are contemplated in order to establish data which will allow a greater consistency, and therefore, better correlation.







A number of antidota experiments were carried out and more are contemplated for the future.

In the course of these experiments, the impression was gained that the molecular structure of the agent used had a definite relationship with regard to the effect of L.S.D. In some instances, the effect of L.S.D. seemed to have been enhanced, as for instance the experiments with ergotamine, while definite neutralizing effects with other agents were not yet established.

Part III. Lycergic Acid Ethylanide

A new drug, L.A.E., became available for us and we propose to investigate it more thoroughly in the coming year. This drug was developed at the List name is Lysergic Acid Ethylaside. This chemical is closely related to L.S.D. the difference being merely that one ethyl group, Colig has been substituted by hydrogen (A) atom.

prom the preliminary report of the way as given in doses out on 28 normal persons and some paychotics. The drug was given in doses of 0.5 to 0.7 milligrams by subcutaneous injection. With this amount, normal individuals experienced a schizophrenia-like condition which was characterized by adynamy, indifference, impaired volition, and phenomena of depersonalization.

In schizophrenics, LAE counteracted paranoid hallucinatory excitation. That is to say, the schizophrenics did not lose their paranoid delusions or hallucinations, but became indifferent to them; a phenomenon which appeared to the investigator as similar to the effect of prefrontal lobotomy, and therefore, he considered the effect of IAE as that of a reversible "chemical lobotomy".

On the pasts of their observations, the investigators considered.

LAE as a new kind of "sedative"; a sedative which in its effect is notther related to the group of hypnotics and narcotics of the barbituric or morphine type, nor to the group of the sympathico- or parasympathicolytic chemicals.

The theoretical problem presents itself to the question as to how it is possible that a chemical which, in normal people brings about a disintegration into a schizophrenic-like condition; is, on the other hand, capable of tuning down or neutralizing the excitation of a schizophrenic psychotic.

Other problems present themselves, the most important of which will be the interaction of LAE and L.S.D. It is possible to think that LAE might have an antagonistic, if not to say an antidotic effect upon L.S.D.

Part IV. Physiological Studies

(Combined Faysio-psycho-sociological studies)

explored by use of the polygraph. This apparatus makes it possible to study many physiological parameters simultaneously. In addition a tope recording of the verbal interchange between the lysergized subject and the examiner is synchronized with the physiological record. Socionetric classification of interactions (Bales interaction method) is carried out also by an observer and recorded on the polygraph record.

Thus the polygraph procedure can be used to obtain information at the (a) physiological, (b) psychological and (c) sociological level - all funneled into one record.

Analysis is being developed along the following lines: (1) difference between the resting physiological values pro L.S.D. and during lysergic psychosis. (a) Difference between stress physiological values pre and during.

Two classes of stress are used (a) Essentially physical (ice application and flickering light) and (b) psychological stress (psychiatric interview and specific psychological test).

Further analysis related social classification of verbalization during the psychiatric interview with physiological factors. Thus it is possible to determine whether pulse, temperature, respiration, GSR, muscle activity, etc. vary as a function of positively oriented social verbalization, negatively oriented verbalization, or reutral. This study is done both before and during lysergic psychosis.

An interaction chronograph is now being developed by our electrical engineer which will do the following: (1) Record on polygraph paper when subject is talking and when examiner is talking. (2) Accumulate the talking time of each party on an electric clock which can be read at desired intervals. (3) Give crude estimate of decided strength of talking of either subject or examiner. During a lysergic psychosis it has been noted clinically that blocking of speech is one of the earliest signs of lysergic action. It has already been shown that verbal productivity drops during the lysergic psychosis.

Further psycho-physiological exploration which we think night hold promise would be to determine the nature and degree of psychological stress induced by flickering light in relation to the disorganizing and ebnormalizing effect of flickering light upon the E.E.O. It has been observed that a 15 per second low intensity flicker will produce a feeling of great tension or irritability in one subject whereas it will be calming and pseifying to another. This study is also to be done before and during lysergic psychosis.

A number of controlled experiments were carried out to test the autonomic nervous system under the influence of L.S.D. In some instances, colygraphic, electrocaccipalographic and electrocardiographic tracings were to

The number of experiments is not yet sufficient to enable us to arrive at definite conclusions. Some of the contemplated experiments, for administrative reasons, have not yet been carried out.

The autonomic nervous system was tested on subjects who had received L.S.D. orally, in the amount of one garma, one-half gamma, and one-quarter garma per kilogram body weight. The greatest number of experiments were carried out on subjects who had received merely one-quarter garma per kilogram body weight.

When L.S.D. in the amount of one gamma per kilogram body weight was given, the injection of Epinephrine, as compared to the control, showed a considerable inhibition. When one-quarter gamma per kilogram body weight of L.S. D. was given, a number of the subjects showed a definite inhibition of the autonomic nervous system on minimal amounts of Epinephrine and Macholyl. In these instances, Epinephrine was given in the amount of .025 cc. of a solution 1:1000, and Mecholyl was given in the amount of 2.5 mg. intranscularly, which is one-quarter of the ordinary amount of 10 milligrams. As we had anticipated, working with those minimal doses of L.S.D., as well as of Epinephrine and Mecholyl, no such inhibition was noted in some cases.

At a recent conference, it was decided that the future experiments should be carried out with L.S.D. in the amount of one-half gamma per kilogram body weight.

The experiments seen to be of significance inastuch as clinically, autonomic disturbances following the administration of L.S.D. are usually observed.

No experiments, for administrative reasons, have yet been carried out with vague stimulation and adrenolytic and vague-blocking agents.

has just been given a grant to study human subjects

at the (now collaborating with two laboratories to study chronically mentally ill patients' response to award conditioning in terms of their ability to develop desired behavior and to continuo such behavior over long periods of time.

As soon as this human laboratory is set up and reliable curves of , behavior developed in humans in collaboration with to test effect of lysergic acid on the behavior curves.

Part V. Clinical Psychiatric Studies

- (1) We will continue as in the past year to make a clinical psychiatric evaluation at the height of the reaction of all subjects who receive L.S.D.
- (2) We will make clinical psychiatric evaluations of the effect of drugs in combination with L.S.D. The goal in this aspect of the project is the evaluation of entagonistic effects.

Ideally we feel it is desirable to make several experiments on the same subject. For example: subject with L.S.D. alone; subject with drug under consideration alone; subject with one-half doses of L.S.D. and drug; subject with full doses of L.S.D. and drug; and probably subject with full doses of the other.

This ideal situation is, however, limited by the desire of the subject to have the experiment repeated on himself and past experience would indicate that very few subjects would subsit to more than two or three tests during the course of a year. As a result the combinations of drug and L.S.D. will be decided in each instance with reference to the availability of the subject and the maximum utilization of each individual experiment.

- (3) We are particularly interested in the psychiatric effects of chemical variants of lysergic acid of which L.A.E. is presently available.

 There is also interest in combinations of these chemical variants with other drugs, the goal, as in (2) being defined substances having antagonistic effects.
- (4) We have some interest in the administration of L.S.D. alone or in combination with drugs and other variants of L.S.D. molecule to patients with various psychiatric syndromes. The goal in this aspect of the work with various psychiatric syndromes. The goal in this aspect of the work which has wide ramifications is therapeutic psychiatric effects. The observations here as in the aspects above are in terms of variations in the clinical psychiatric picture.

Intensity of Symptoms: The clinical psychlatric pictures are graded according to intensity of symptoms or departure from normal as mild, moderate or severe. The intensity of individual symptoms are also graded on a scale of four - zero being within normal limits and four being the most severe. In certain instances the departure from normal is in a negative or minus direction as, for example, in the case of hunger where pathological absence of appoints might be rated in terms of a minus sign and pathological increase in appetite in terms of a plus sign.

Integration of clinical psychiatric findings and of findings of altered social behavior will be further developed. Only as the change in the lysergized subject's ability to function in varied social situations is related to the changes in his mental status can the basic dynamics of related to the changes in his mental status can the basic dynamics of psychoses be ascertained. So far the abnormalities determined by clinical psychoses be ascertained. So far the abnormalities determined by clinical psychiatric evaluation and those found in hour-to-hour accial observation have to some extent been viewed independently and extensive integrative analysis is required to combine those findings.

Psychological Studies Part VI.

The drau-a-person test (D.A.P.) should be continued as a regular part of the psychological program since it now appears to be a particularly fruitful approach in giving leads about the subject's self concept and his attitudes toward others in an indirect but meaningful way. It might be advisable to add to the more drawing technique a sat of routine questions or ask the subject to associate freely to the figure he has drawn. This would give some idea of richness of association in regard to people and in regard to his, own creations.

The T.A.T. should be continued and possibly enlarged to include ten cards. Intensive analysis of one case has shown that there has been a decrease in the number of words used when giving a story under L.S.D. in contrast to the number of words used in the normal state; the subject also spent less time on each picture. The richness of association could be investigated more thoroughly using this projective device by not only counting the words but making on analysis of the skeleton words (nouns and verbs) and descriptive phrases (adjectives and adverbs) in the two states and the hypothesis could here be formulated that under the lysergized state the subject would be less creatively productive and give less richiess in his stories.

It is suggested that since only three of the ten Rorschach cards are being given and since the Rorschach is apparently being used in full by another group, that we discontinue the partial Rorschach and work with other types of tests. It is suggested that in place of the Rorschach we use the Vigotsky. The test has, in the literature, a report of the performance of schizophrenics. This is essentially a test of abstraction and in the administration of it the examiner can easily insist on or demand verbal reports of the ideation and the hypothesizing that is going on while trying to do the

This particular test seems to be one which is a challenge to
those people of superior intelligence and is one which also creates a somewhat
natural stress situation. Because of the formulation and rejection of
hypotheses which is involved in the situation of this test the subject's
ability to concentrate and function in a stress situation can be observed.
His ability to shift his thinking and his ability to respond to the examiner
who can increase or decrease the stress situation by behavior and comments
can also be observed. It seems as though this test may provide a great wealth
of material which should allow for correlation with behavioral observations
made in other than the testing cituation.

It will be the examiner's responsibility on this test to successfully be an "annoyer" or successfully keep the subject working when he can no longer tolerate the frustration experience in itself. Since this is a motor task, discharge of tension through overactivity could be observed. Fercentual distortions could also be asked about after the test is completed. It would be important to ask at the end of this test if the subject could review his mental processes on this task which is intangible and where it is obvious that there is a solution and an answer. Whether he blanes the examiner for his difficulty, blanes himself, shows withdrawal or hostility in response to stress and so on could be estimated or evaluated more directly.

experiment. This is resentially because of the apparent inability of the present younger generation to deal with proverbs and their apparent lack of contact with them in their everyday living. Since abstraction problems can be dealt with in the Vigotsky both in a verbal and non verbal level, it would seem advisable that the remaining time which is probably all that the psychologist will be given be devoted to a more specifically perceptual test such as the Bender-Gestalt in which the subject is required to reproduce geometric designs

Beyond the drawing of this test it might be possible also to use it for richness of association in that the subject would be asked to tell as many things as each design made them think of, or one could see how many words was suggested to the subject by the given design in one minute of time.

There will be a problem especially with the Vigotsky about giving the test to the person in the normal state before he has had L.S.D. since once this test has been solved it is no longer a challenge to any individual. It is suggested that for this test the subjects all be given it first while under L.S.D. and then have them take it a second time in their normal state at which time intensive investigation be made of their feelings, attitudes, reactions, etc.

Part VII. Sociodynamic Studies

1. Comparative Studies Using the Interplay Categories as Basic Tool of Research

During the past year the inteplay extegories have been applied primarily at a time when distortions occur within the limit of social situations met or sought out by the subject. Further extension of the application of this method are to include symptom changes of the subject as related to interpersonal relationships and wider variety of social situations.

Some of the situations in which further study is indicated care:

- 1. Group problem-solving situations. Lysergic subjects are nexted to work on problems of social and ethical nature, and their general conduct is to be measured by such instruments as Bales Interaction Process Analysis and the Interaction Chronograph, in addition to the nine interplay catagories.
- 2. Subjects put to bed and given supportive nursing and modical care.
- 3. Subjects engaged in physical and sports activity.
- * Described in cusrierly reports.

In conjunction with these studies we wish to apply the interplay categories in a comparative exploration of therapeutic techniques with lysergized subjects, and normal psychotics. Judging by the many extant inconclusive and often contradictory reports on psychotherapeutic techniques, an intensive study of the psychotherapeutic situation, with the sid of the interplay categories, is needed. Little is known, for example, of how adequately or how closely therapists' self-expectation about their roles as therapists are set in an actual therapeutic interview. Moreover, with this method, the sequential pattern of therapeutic attitudes and verbal conduct can be explored.

2. Comparative Analysis of L.S.D. and Psychotic Distortions

a further extension of the analysis of visual distortions in L.S.D. subjects is planned to include investigation of distortions which occur in psychotic patients. Further investigations seem indicated to determine the similarity, frequency of occurrence, and the conditions leading to and existing at the time when distortions occur in psychotics and L.S.D. subjects. Such a study is expected to lead to a much needed understanding of the meaning of these distortions to the patient and their importance in psychiatric interpretation and treatment.

3. Continuation and Extension of Methods of Fersonality Evaluation

The relatedness profile (see Quarterly Report #2) focuses on the dominant kind of relatedness, the level of participation and the degree of stress experience in the six "people eress." The clinical social summary scores the quality of the individual's general relatedness pattern in terms of "spontaneity vs. control" and so forth (Quarterly Report #2). A report of the use of the profile and clinical analysis will appear in the third quarterly report. Evaluations and analysis during the past year have been

essentially a comparison between the basic personality and the social behavior before and at the height of the L.S.D. reaction.

Apart from extending this type of analysis to the total available number of eases, further studies of this nature are sixed at elucidating more clearly the psycho-social alterations of the L.S.D. subject's conduct on a chronological hour-by-hour (and perhaps even minute-by-minute) basis. It is expected that this procedure would give a more intensive dynamic appraisal of the sequence of symptoms. The findings from the application of these methods will be integrated both with each other and with clinical and psychological findings.

4. A Comparative Study of the Pragmatics, Syntactics and Semantics in L.S.D. and Genuine Psychosis

In working with L.S.D. subjects much difficulty has been encountered in attempting to find words which adequately communicate the feelings and experiences of the subject. This is equally true with the psychotics. For example, words such as "strange", "weird", "tangible", "suspended" and so forth communicate very little to a basic understanding of the deterioration of thought and emotional process which is taking place in the individual. Unless feelings are translated into a vocabulary of motives which is meaningful both to the subject, experiencing the feelings and to the other trying to understand the feelings, the barrier to communication continues to exist and little aid can be given. The taskiest before us here is to understand ways in which these feelings can be more adequately and easily described and interpreted. To this end us propose to make an intensive linguistic analysis of the recorded therepeutic interview material. The approach is planned to be three-folds

1. Analysis of cramatics, that is, a study of the intentions, attitudes, and of the expressive behavior involved in communication.

- that is, a study of the relationship of words and sentences to each other. This will include a study of the degree of looseness, precision and fragmentation, and the selectivity and flexibility of associations (according to established laws of association.)
 - 3. Analysis of semantics, that is, a study of content meaning.

 This type of content analysis deals with the meaning of things and events and people, external to the subject, that is, what seems most significant to the subject about these things, whether they be presaic, conventional or imaginative, symbolic and interpretive.

In this type of analysis, we expect to be guided by the extant literature on this subject, in particular, a recent article on "Language Behavior in Manica" by M. Lorenz in the Archives of Meurology and Psychiatry, January, 1953.

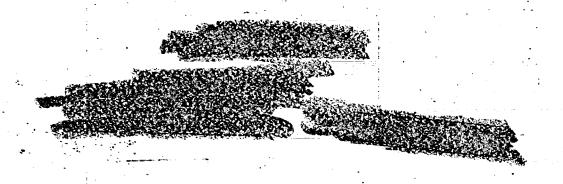
5. A Study of L.S.D. as a Useful Adjunct in the Hospital Training Program

Studies of the past year resulted in the accumulation of sufficient information to continue investigation in this area. Considerable data has been gathered on the effects of the L.S.D. experience of the personnel from the point of view of its capacity to increase their ability to understand and the point of view of its capacity to increase their ability to understand and eid patients. Detailed analysis of this information has yet to be made on the amount and kind of understanding and knowledge gained and how it is applied by personnel in patient care.



Two group experiences are planned for further study:

- 1. Group sessions will be held with personnel who have had the experience to determine the extent of the knowledge they have gained in the management of psychotic patients.
- 2. There will be group meetings in which personnel who have had L.S.D. and personnel who have not taken the drug will participate, the latter serving as controls. This is expected to prove useful in a general training program for personnel in patient management.



ESTIMATED EURGET

1. Salaries	* 4 000
A. Technical	\$ 6,000.
B. Professional	28,000.
C. Experimental Subjects	2,500.
2. Expendable Supplies	
A. Chemicals, Lrugs, et	
B. Records and Fhotogra	iphy 300.
c. Office Supplies	1 44
D. Reprints	200
3. Fermanont Equipment	500.
4. Travel	600.
	*39.500

The responsible researchers will continue es of

B Estimate for (29) 790.00

B Service Charge for TOTAL \$40,290.00

August 19, 1954



- C Dear
 - C This is to inform you that my former and number has been changed
 - C to Please so not try to reach me at the old number.

No collect calls will be accepted at this number.

Sincerely,

85698

INVOICE CRUTH SEEST

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ASSERTED. Project closed Sed MKULTICA 1.0

Project MOUNTA, Subproject 80

Date Initiated: 10 January 1958

Date Expires: 9 January 1962

Funds-current year: \$5,000

Purpose: To provide services of a very sensitive nature on request to conduct extraction and identification techniques of drugs, toxics and biological entities from human tissues. Acts as consultant on medico-legal problems related to detection of missles, etc.

Status: A continuing program. No long-range studies.



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2512	
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No.

2015

Cost_Account _

2125-1390-3902

Object Class _

Date	Remarks and References	Obligations Incurred	Obligations — Liquidated	Unliquidated Balance
MAY 1962	MKULTKA, Sub-Proj. 80 Auth 4 May 62	3,120.00		3,120,00
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	Mr. Car			
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Date: 4 May 1962

MEANMANDLAN FOR: The Comptroller

ATTINTION : Finance Division

SUBJECT

: NEWLITTA, Subproject

80

Opder the authority granted in his remarkable caped 13 open 1987 from the DTI to the DD/A, and the excession of this authority to subsequent remarania, Subproject 30 bas been approved and \$3,180.00 of the cost-oll froject butter finds town tree chlisted to rows the outprojectia expenses and should be correct to took reads: 2125-1390-3902

TSD/Bishegisal Aranch

APPROVED FOR CELECATION

I CERTIFY THAT ENDED ARE ANARADIA

DELICATION REFERENCE No. 2015 CHUCH TO ALLOTACIA NO. 2125-1390-3900

AUTHORITHG OFFICER

Distribution:

Criginal & 2 - Addresses

1 - TSD/FASS

2 - TSD/BB



10 January 1958

MEMORATUM FOR	Comptroller

APPENDION 1	Finance Division
SUBJECT 1	MILINA, Subproject No. 80

Under the authority granted in the Memorandum dated

13 April 1953 from the DOI to the DD/A, and the extension of
this authority in subsequent monorands, Subproject SO has
been approved and \$5,166.72 of the over-all Project MAULIFA

funds have been obligated to cover the subproject's expenses
and should be charged to Allotsent 8-2502-10-001.

Chief
TES/Cheaical Division

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OF PURDS:	
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18 1855 Surve 1 Lile 80

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17 March 1958

nemoration for: Chief, Pinance Division

AIX

1_TSS/Budget Officer

EUBJECT

1 MALITRA Subgroject No. 80, Invoice No. 1, Allotment 8-2502-10-001

1. Invoice No. 1 is attached covering the above suproject. Payment should be unde as follows:

> Cashier's check in the enount of \$4,968.00, drawn on a set well were the S

Cashier's cleck in the amount of \$193.72, drawn

Both checks should be made payable to the Handle ()

2. Please forward the checks to Chief, TSS/Checical Division, through TSI/Dudget Officer, by Friday, 28 Merch 1958.

3. This is a final involos. A total of \$5,166.72 was obligated under this subproject during fy 58. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

> Chief TSS/Chemical Division

Attechments Invoice & Certifications I CERTIFY TEMT FUNDS ARE AVAILABLE

AUTHOLIZING OFFICER

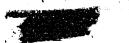
Distribution: Orig 4 2 - Addresses

1 - TSB/FASB V 2 - T\$3/CD

RECEDULE 1,

CHECK ON 18855 THE AMPLINT DE 5 1965

CHECK 12186 E AVI NT OF SILLY



CERTIFICATION

(3) It is hereby certified that the program under subprojects 39, 31 and 65 have been satisfactorily completed and returned unused funds. However, subproject 83, which is still continuing also refunded money. Therefore, it is requested that the assumts as shown below on Invoice Number 1 of subproject 124 by credited to the subprojects as shown below.

Project	Asount Kon	Allotaent
€39	\$1,356,26 143 1,077,52 638	5-2502-10-001 9-2502-55-902
₹65 ₹88	50.00 2664 1,690.00 119	8-2502-10-601 9+2502-55+902

Chief, TSD/Research Branch

Date:

Research Director

Onte t



27 January 1960

MEMORANDUM FOR: THE RECORD

SUBJECT : Action on MKULTRA Audit Exceptions - TSS/CD (MKULTRA 81)

The \$5,000.00 sent to 16 October 1958 has been accounted for in 3 overall Accounting (Project 61).

The remaining \$1,977.52 remains to be accounted for and CD has asked for an accounting in full.



Chief TSS/Chemical Division

Distribution:
Original Only

> accounting approved

2 Nov 5th was a

final accounting 52)

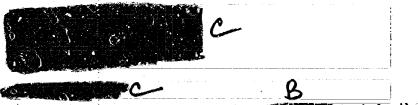
The above (\$1,977.52)

will be applied to a

will be applied to a

 $I_{\mathcal{A}}$

October 16, 1958



of \$5,000.00 made payable to

This sum represents payment for the work on the

Your signature is needed on the check before you give

it to the

Sincerely,

Assistant Treasurer.

e49 (__

Mnc.

RECEIPT

I hereby acknowledge receipt of the following:

Treasurer's Check No. 73902, in the amount of \$5000,00 drawn on the dated September 30, 1958,

C Date: 10-9-58

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16 September 1958

MEMORANDUM	OR: COMPTROLLER
ATTENTION	: Finance Division
SUBJECT	: MKULTRA, Subproject 81, Additional Authorization No. 2

Under the authority granted in the memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda, Subproject 81 has been
approved and \$5,000.00 of the over-all MKULTRA project funds
has been obligated to cover the subproject's expenses. This
obligation of funds should be charged to Allotment 9-2502-15-902,

Chief TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:



CHARGE TO ALLES TO THE STATE OF
Research Director

210:

Distribution:

Orig & 2 - Addressee

TSS/OCE



22 September 1958

	man lower Office	
VIA .	: TSS/Budget Officer	
SUBJECT :	: MKULTRA, Subproject 81, Invoice #2	
:	Allotment 9-2502-15-902	
1. _1	nvoice No. 2 for the above subproject is attached.	
Payment should	d be made as follows:	
E on a	and made payable to the	
•	Please forward the check to Chief, TSS/Chemical	
nialalaa kkunu	th TSS/Budget Officer by Monday, 6 October 1958.	-
Diataton (groci		
<u> </u>	This is a final invoice. A total of \$5,000.00 was	
3	r this subproject during FY 59. However, since d that additional funds will be obligated for this	· · · · · · · · · · · · · · · · · · ·
3	r this subproject during FY 59. However, since	
3	r this subproject during FY 59. However, since d that additional funds will be obligated for this	

ANT THE DE \$500. Invoice & Certification HECK 13902 Distribution: Wrig & 2 - Addressee

202636 21-2-74-902-112-5,000,-1 600.1 100 119

Attachments:

Carl-

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×17591



For services

\$5,000.00

B

CERTIFICATIONS

(1) It is hereby certified that this is invoice #2 applying to Subproject 81 of MKULTRA, the performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applied to Subproject No. 81 of MKULTRA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:





16 September 1958

MEMOR AND UL	4 FOR COMPTROLLER
TTENTION	: Finance Division
UBJECT	MKULTRA, Subproject 31, Additional
	Authorization No. 2
Under th	e authority granted in the memorandum dated
3 April 1953 (1	rom the DCI to the DD/A, and the extension of
his authority i	in subsequent memoranda, Subproject 81 bas been
pproved and \$	5,000.00 of the over-all MKULTRA project funds
as been obliga	ated to cover the subproject's expenses. This
bligation of fu	ands should be charged to Allotment 9-2502-10-001.
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Researe Researe Date: Distribution: Orig & 2 - A 1 - T 2 - T	TSS/Chemical Division OR OBLIGATION The Director



MEMORANDUM FOR: THE RECORD

		Culturales Q1
SUBJECT	: Continuance of MKULTRA,	2nobrolect or

phase of the follow-up

The scope of the follow-up will remain

the same as described in the original memorandum setting up this

project. This subproject, however, supports only the psychological

examinations portion of the much larger follow-up study conducted

by the group and supported by funding sources other than

this Agency.

- expended in pilot interviews which established the usefulness and feasibility of these follow-up examinations. The additional cost of \$5,000.00 represents the annual salary of the speaking psychologist who will conduct the psychological examinations. The project will continue for one year beginning 15 September 1958.

 Charges should be made against Allotment 9-2502-15-902.
- 3. It is not anticipated that any permanent equipment will be purchased for this project. Travel under this project will be



reimbursed according to the

normal accounting practices.

ACCEPTAGE

TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

A Research Director

DATE: Sept. 15-1955.

Distribution:
Original only

ACCOUNTING



Funds Received:

Funds Expended:

Funds Expended:

Conference Expenses \$1,128.95
Conference Expense:

Culturcheon Cost 248.75
Travel
Recording Costs 102.00
Typing Costs 383.80
Printing 1,070.50 1.843.53

\$ 3,022.48

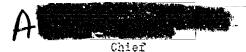
Balance of Funds Received

Total Follow Up and

Conference

\$1,977.52

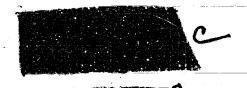
I have examined and approved the submitted examilatures.



TSS/Chemical Division

Date: 2 nov. 59

August 12, 1958



andloted please find the state of the control proposal.

reject. If this arount appears to be untain, place let up know.

Best regards from all of us.

Sincerely,

Assistant Treasurer

C

Enc.

RECIPT

I hereby acknowledge receipt of the following:

Treasurer's Check #159057, in the amount of \$5,000.00 drawn on the dated June 25, 1958,

Date:-

6-30-51

80. D 2665

8. 2501-11-101 Aligneth

81

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18 June 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

1 MKULTRA Subproject 81, Invoice No. 1
Allotment 8-2502-10-001

1. Invoice No. I for the above subproject is attached.

Payment should be made as follows:

Cashier's check in the amount of \$5,000.00, drawn on a land made payable to the

2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Wednesday, 2 July 1958.

3. This is a final invoice. A total of \$5,000.00 was obligated under this subproject during FY 58. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief: TSS/Chemical Division

Attachments:
Invoice & Certifications

Distribution:

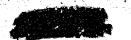
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1 - TSS/FASB

2665 5. 3522 11 11

- 1992-16 A

64



INVOICE

For services \$5,000.00

CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. Lapplying to Subproject 81 of MKULTRA, that performance has been satisfactory, that the services have been accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject 81 under MKULTRA which was duly approved and that the project is being carried out in accordance with the memorandum dated 12 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:



14 April 1958

MEMOR	ANDUM	FOR:	COMPTRO	LLER

ATTENTION

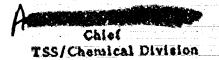
Fisance Division

SUBJECT

MKULTRA, Subpreject No. 81

Under the authority granted in the Memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda. Subproject \$1 has been
approved and \$5,000.00 of the over-all Project MKULTRA funds
have been obligated to cover the subproject's expenses and
should be charged to Allotment 8-2502-10-001.



of funds Die	and signed by A	OCERTIFY THAT FUNDS ARE AVAILAD OCHIGATION FEFERINGE NO. 266
9	h Director	AURICAGA O OFFICER
Date:	23,688	

1 - TSS/FASB



18 June 1958	1	3 3	un	a-1	9	5	8
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MEMORANDUM FOR: C	CHIEF, FINANCE DIVISION
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VIA

: TSS/Budget Officer

SUBJECT

: MKULTRA Subproject 81, Invoice No. 1 Allotment 8-2502-10-001

1. Invoice No. 1 for the above subproject is attached. Payment should be made as follows:

> Cashier's check in the amount of \$5,000.00, drawn on a grand made payable to the

- 2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Wednesday, 2 July 1958.
- 3. This is a final invoice. A total of \$5,000.00 was obligated under this subproject during FY 58. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

TSS/Chemical Division

THEORY SESSION THE AMOUNT DE S. SECOLE Attachments: CEDEIVELD 1888

Invoice & Certifications

Distribution: Orig & 2 - Addressee

Or Cash 1002665 600-1 2502-10-001 poor govern state

172

5,000.00



DRAFT 14 April 58

MEMORANDUM FOR: THE RECORD	Ser Province
SUBJECT : MKULTRA, Subproject 81	
1. The purpose of this project is to support a follow-up	
study of the examined by the	<u> </u>
project. The purposes of this follow-up study are:	
a) To observe the health, occupational, social, and	
personal adjustments of this special sample and to determine the	
degree of acculturation which has taken place during the 12-18	ودون جوندست مستعدد الماج بالمادات الأوفادات
months which will have elapsed since their original examination	
shortly after arrival in the United States.	
b) To provide criterion data for the predictions	Page of the second
generated by the state of the study.	
2. This project will be sponsored and administered by the	
Control of the such time as	
a permanent staff interviewer is employed, the Executive Secretary	
will be considered principal in-	
vestigator. Q	
3. This is a legitimate project, which is a logical	
Consequent to the prediction project but which is	
separately administered to avoid the risk of data contamination, there	
should be no need to make the follow-up interviewer witting of govern-	
ment interest.	





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- 4. The cost of the project for a period of one year beginning

 1 April 1958 is estimated to be \$5,000.00. Charges should be made

 against Allotment 8-2502-10-001.
- 5. It is not anticipated that any permanent equipment will be purchased for this project. Travel under this project will be reimbursed according to the manufacture accounting practices.



Chief TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:



-

Date: 23,955

Distribution:

Original only

Attachment:

Budget ___



BUDGET

Follow-up Interviewer	\$3,000.00
Interpreter	1,000.00
Travel, telephone	1,000.00

Total 5,000.00

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مسائلات

September 15, 1960

Memo to

Subject;

B

This is a memoradum for your file regarding the status of this project. The original grant to this project received from the Sponsor was \$15,000.00. The grant to the project directly was or F/B \$13.611.23. We forwarded 26,000 f on April 25, 1958 and the remainder,

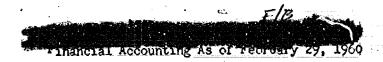
here in the bank account for the purpose of supplying further sums that may be necessary in the publication of the report.

Periodically, the Institute sends us an accounting that is up to date as to their expenditures on the \$13,611.23. The latest accounting showed a total of expenses through February 29, 1960 of \$12,406.26 using the official rate of to \$1.00.

Attached is a copy of the latest accounting.



March 15, 1960



:	US\$
Accounts	Amount
Study of literature	956.22
Construction Test battery and	
questionnaire	725.96
Pretest	560.24
Lefinite interview	19.02
Contactory of refugees	25.81
Field Study and translation of the	data1998.83
Team discussion	1184.44
Report	4968.30
Meetings of Research Staff	457.97
Publication Travelling and living expenses	1035.12
Unforeseen expenses	474.35

Total expenses as of the above date\$12,406.26

This is a true statement of the accounting as received by the and converted from at the rate of to \$1.00

I have examined and approved the submitted expenditures.

TSS/Chemical Division

1988 21 Systemotice 1860

January 26, 1960

Memo to

Subject: Financial Assempting

Attached is an up to date accounting from the above named project. The state and using to 1 approximately, the total expenditures in U. S. Dollars is \$11,459.45. There is a balance of \$2,151.78 which will probably be continued to be used for the formulation of the final report.

C

		¥		
Items	Estimate of costs Febr. 4th 1958	Total expen- ses on Nov. 30th 1959	Dec. 1st Dec. 31st 1959	Total expen- ses on Dec. 31st 1959
1. Study of literature	Aleganiay-		•	A CHARLES
2. Construction Test—battery and ques—tionnaire		n (1990)	•	* *************************************
3. Pretest	ti de la companya de	" AND THE REAL PROPERTY.	Manager case of	" ARREST CO.
4. Definite interview	* 42.5 **	n dans	•	_" *******
5. Contactory of regues	" ~ * * * * * * * * * * * * * * * * * *	" "		# # ## ## ### #### ###################
6. Field study and translation of the data	<u>"</u>	"	• <u></u>	n William 78
7. Team discussions	- " /			1 10
8. Report	" 1888	" (managed)		A CONTRACTOR OF THE PARTY OF TH
9. Meetings of Research Staff	"	"		" 4.33 (3.5) 1 33
O. Publication	" 4 PA		· Marini-recommendation of the Control	
1. Travelling and living expenses	" (1)	"		***************************************
12. Unforeseen expenses		- 45	-	II COMMAND
* 1		A STATE OF THE STA		
and the state of t	FB	F/B	F/B	F/gus 11453

I have exemined and common the submitted expendituirs



TS5/Chemical Division
Date: 12 Pelmany 1960

December 8, 1959



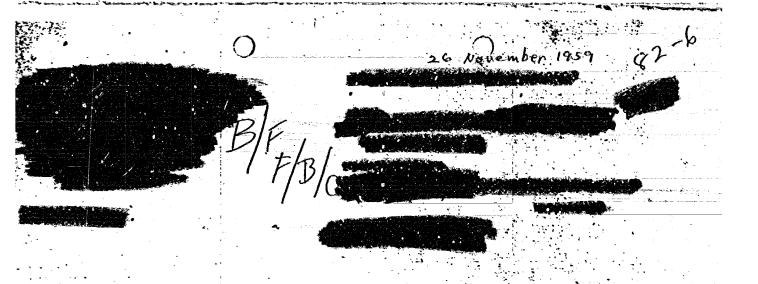
Dear Dr. C

Many thanks for your letter of November 26 and its enclosure. we appreciate receiving the financial accounting.

we are looking forward to receiving the final report.

Sincerely,

Executive Socretary_



Dear Mr

I have pleasure in sending you a financial account with regard to the project.

The account covers several stages of the research-work.
We apologize for not writing earlier.

We decided it would be better if we combined some of the items: during the fieldstudy for instance already translations.

Were made of interviews and tests.

The item "expenses not foreseen" was used to finance the general management of the research work. When the study was planned we did nog expect, that much, attention was to be payed to activities necessary to supervise and conduct the entire program.

At the moment we just started with the translations of the first parts of the report which took their final stape.

Yours sincerely,



;	Total	October 18ty expenses on . October 31st, October 31st	1050.										• * *				1 Splitted		at Divinión		
		d October 71st	1957-			· •			ج ا	1			• , - ` ` _				FIB		Palanny 1860		** ** ***
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82/

8~ t

November 11, 1958

E

Attention:

Mr. C

Dear in C

This will authorize you to send the sum of the following account:

F/B

This will further authorize you to charge our account for the equivalent assumt in U. S. dollars as well as your charges for airmail notification of this transaction.

Thank you for your cooperation in this matter.

Sincerely,

AND THE PARTY OF T

Treasurer

SAMPLE COMPANY

Assistant Treasurer

To . L

Alle C

November 11, 1958

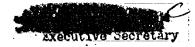


Dear Dr.

We are directing our bank to forward to your account the sum of which represents the final payment on the grant made to your organization by the

We wish to take this opportunity of wishing you well in the continuation of your research and will look forward to the results.

Sincerely,



Receipt is hereby acknowledged for Cast

01-28

8- 2502-10-001

CHARLEDARD CRITISATIONS CHARACTONS DATE HYMATAS AND PRIFESANTS SCHALLE IK USSEO LIQUIDAGEO 24 APR authorization Set 82 15 000.00 Sure 1 20 JUN 245



18 June 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

: MKULTRA Subproject 82, Invoice No. 1 Allosment 8-2502-10-001

1. Invoice No. 1 for the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$15,000.00 drawn nd made payable to the

2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Wednesday, 2 July 1958.

3. This is a final invoice. A total of \$15,000.00 was obligated under this subproject during FY 58. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

> Chief TSS/Chemical Division

Attachments: Invoice & Certifications REDENTED

Distribution:

Orig & 2 - Addressee

Dr 888 CO2145 600.1-2502-10-001 17.2 \$15,000.00
Cr Cash

15.000.00

08032



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7	INVOI	CE
for ser	rvices	\$15,000.00

	CERTIFI	CATIONS
i) It is	a hereby certified that this is	Invoice No. 1 applying to Subproject
2 of M cas ba	KULTRA, that performance we been accomplished in accomplished in accomplished in accomplished in accomplished in accomplished in accomplished and accomplished ac	has been satisfactory, that the serv- ordance with mutual agreements, that d receipts is on file in TSS/CD, that
	l is just and correct and that	payment thereof has not yet been
ade.		₩ Harana Har
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		.ē²
	•	Chief, TSS/Chemical Division
		• ,
ate:_		
2) It i	is hereby certified that this i	nvoice applies to Subproject 82
nder l	MKULTRA which was duly ap	proved and that the project is
eing c	arried out in accordance wit	h: the memorandum dated
2 Apri	II 1953 from the DCI to the DI	D/A, and the extension of this
uthori	ity in subsequent memoranda	
	•	
	•	
	•	
	:	,
		Research Director
Date:	•	
		
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14 April 1958

MEMORANDUM	FOR: COMPTROLLER	
ATTENTION	; Figence Division	
SUBJECT	1 MKULTRA, Subp	roject No. 82
Under th	e authority granted in th	e Mamorandum dated
13 April 1953 from	m the DCI to the DD/A,	and the extension of
this authority in	subsequent memoranda,	Subproject 82 bas
been approved as	ad \$15,000.00 of the over	-all Project MKULT
funds have been	obligated to cover the su	bpreject's expenses
and should be ch	arged to Alletment 8-250	2-19-001.

Chief TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

T CENTIFY THAT FUNDS AND AVAILABLES

AUTHOLIZING OFFICER

Distribution:

Orig & 2 - Addresses

DRAFT 1958

MEMORANDUM FOR: THE RECORD

SUBJECT

: Project MKULTRA, Subproject 82

the conduct of a study of refugees who were admitted.

The purpose of this subproject is to provide funds for the conduct of a study of refugees who were admitted.

As indicated in the attached proposal, the work will be carried out by Professor.

The find find for the subject were carried out between Professor and re-conferences on the subject were carried out between Professor.

The subject while is a subproved the project.

2. The primary reason for the necessity of conducting a further study of these refugees lies in the fact that those people who were admitted to the U.S. after the made up a highly selected group. Because of the immigration restrictions, this group consisted of the western-tied rightist elements who had never been accepted completely in the present society. As such, they had spent their lives being discriminated against and suspected by the communists in their own country. Knowledge of such individuals can contribute little toward an understanding of the dynamics of the

FB who were admitted On the other hand, those consisted of a countries such as to the various population and as such cross section of the included many ex-communists who had become disillusioned with the but who still have a basic stake in the regime and so 🌉 eventual conversion of their native country to a more acceptable political status. In short, these are the people who are basically interesting to the Agency. They will produce the patriots who will o continue the struggle against communism in one return to way or another.

- people concerned have indicated that they regard it as an important research project. They also pointed out that they had been asked by the to supply any possible help that they can in concerned with the Caspects of the how living in the project could very easily be made available for this purpose.
 - the fact that it will provide an entree into one of the foremost

 by chological research centers. Such a connection

 has manifold cover and testing possibilities as well as providing a

 base from which to take advantage of developments in that area of the

 world.
 - 5. This project will be handled as a research grant-in-aid
 from the

will be handled in accordance with the rules laid down by the accountancy department of the Evidence that the funds have been disbursed by the shall be considered sufficient accounting therefore.

- 6. The cost of this subproject will not exceed \$15,000.00 for a period of one year beginning 1 May 1958. Charges should be made against Allotment 8-2502-10-001.
- 7. After the project leaves the unclassified and no cleared or witting personnel will be involved in it.

Chief
TSS/Chamical Division

APPROVED FOR OBLIGATION OF FUNDS:

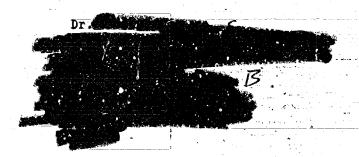
Research Director

Distribution:
Original only

Attachment: Proposal



FB. fabruary 4th, 1958,



Dear Dr.

On behalf of Professor who stays abroad at
this moment and will return only in a few weeks time I send you
two copies of our plan of a research project on the psychological
situation of the estimate of costs of
the project.

Professo as discussed this plan with the staff of our institute in such detail as is possible at this moment and he approves fully of the text I am sending you.

We present this plan to you with a request for your approvement and look forward to hearing from you.

Yours faithfully,
for Dr C

F/B 00

92' february 4th, 1958.

PLAN OF A RESEARCH PROJECT ON THE REFUGIES

have been admitted to the economy. The adaptation to the new social situation, however, causes sometimes difficulties.

F/B It is of great interest to make a study of the adaptation of the refugees to the new situation.

when coming to they probably built up a set of expectations concerning the situation they would find. These expectations probably were shaped by their personality structure, environmental influences (including cultural influences), amount and contents of information on the second countries - particularly

After their arrival in they probably faced a situation which in some or other way differed from what they had expected, i.e. there are a conflict between the expected situation and the perceived situation. This conflict may have led to different types of adaptive behaviour.

The question we should like to tackle is: What are the main problems of adaptation of the refugees, what stresses do they experience, in which ways do they try to solve their conflicts and which wif any - are the main modes of adaptation they display.

In doing this we plan to take into account the personality structure and environmental and cultural influences.

Particularly we shall try to ascertain what was the basic motivation for leaving the e.g. fear for punishment, the desire to work for labroad, sheer adventure. It also seems of great importance to first out if any of the refugees should be looked upon as maladjusted prior to their arrival in

A comparison of these maladjusted cases with the mentally healthy in terms of their adjustment to the conditions of life in the mentally healthy in terms of their adjustment of the expost facto type.

We intend to conduct this study with a limited number of refugees (some 70 or 80), so as to make possible a broad clinical approach. We shall not look for statistical representativeness, but shall only try to gather enough information to build comprehensive case studies. By studying and comparing

these we hope to find-common traits which can lead to formulation of hypotheses for further research on more extensive groups of refugees.

The instruments to be used are:

- 1. A battery of psychological tests. This will include the Wechsler-Bellevue, Roschach and T.A.T., as they are in dommon usage in this country and also have been used by our American colleagues. To this we may add the Lüscher Colour Preference-Test, The F-scale, and a personality-inventory of the M.M.P.I. of Maudsley type.
- 2. A non-directive interview which will be so structured so as to cover the areas of opinion, feeling and behaviour mentioned above. Both tests and interviews will be administered by apeaking social scientists (both psychologists and sociologists). As these specialists are generally engaged in relief work for compatriots in the towns they live in, they will do their interviewing and testing their groups in other towns. The interviewers as they are themselves, have left to before

x_x_x

We have had a few talks with social workers on the staff of the official refuges-organisations. They have formulated questions of great practical interest to their work. However, we feel that it is better first to gather more knowledge about the problems concerned before trying to lay down rules for social action.

ESTIMATE OF COSTS

				- Company of the Company	143	
ı.	Study of available literature and contacts		400			ř
II.	Construction of test battery and questionnaire					
	translation		, X			• • • • •
III.	Pretest of interview		N		برانتها	9
IV.	Construction of definite interview		, * H	· •		•
٧.	Finding of adresses, contacting of refugees		, n			-
VI.	Field study		****			ř
VII.	Translation of rield-study data					
AIII.	Teamliscussion on field study data		T/2	4		<u>-</u>
IX.	Preparing case-studies	/	115	1 === 1		
х.	First draft of final report	**	1	1 5 4		
XI.	Meetings of research team with scientific board of	<u> </u>		· · · · · · · · · · · · · · · · · · ·		
•	Inetitut		1	n 4		-
XII.	Final version of report; outlook on future research	oh ==		r d		_
XIII.	Publication	-		H SSSS S	HAIP-	
	Travelling and living expenses			n d		~
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XA.	5% Unforeseen expenses		r			
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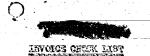
Estimated length of project: one year.

The basis of calculation of costs is in accordance with the rules laid down by the accountancy department of the as set up for scientific research out of foreign funds

Calculated by the official rate of exchange as per 1 February 1958,

1s-U.S. \$ 13.547,49.

FIB



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REMARKS:

Editorial Project

Expenses

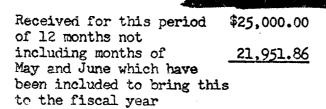
May 1, 1959 through June 30, 1960

14 months

Furniture and Fixtures	213.25
Salaries '	18,135.41
Taxes	575.56
Rent	1,725.00
Travel	914.52
Miscellaneous	11.25
Office Supplies	78.39
Communications	80.00
Brainwashing Bibliography	218.48

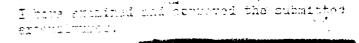
Total 14 month Expenditures \$ 21,951.86

I certify that this is a true statement of expenditures for this project for the period covered.



Balance to be used during Fiscal Year 1960-61

\$3,048.14





Date: 9/21/63

EDITORIAL PROJECT

EXPENDITURES May 1, 1959 through March 31, 1960

11 Months

Salaries		\$13,910.42
Equipment		213.25
Taxes		229.22
Rent & Willities		1,380.00
Travel		672.48
Office Supplies		33.23
Communications	40.00	
Miscellaneous		11.25
Total Expenditures		\$16,489.85

N. B. Office Supplies, Communications and Utilities for the most part were absorbed by the communications and Utilities for the most part

The anticipated expenditures for the 12th months are \$1,700.00.

Total anticipated expenditures for 12 months \$18,189.85.

Total Budget and funds received \$25,000.00

Less Expenditures 18,189.65

Balance to be carried over for fiscal May 1, 1960 to May 1, 1961.

1, 1961. \$ 6,810.15*

*This sum is left since the anticipated assistant for hired.

C was not

April 1, 1960

STATUS OF GRAPHOLOGY FUNDS

Total Funds available as of May 1, 1959

\$11,449.46

Funds Expended

4,446.55

Balance as of April 1, 1960

\$ 7,002.91

Anticipated Expenditures:

Publication of Graphology

\$3,000.00

Completion of First Phase

1,000.00

Phase two and three are indeterminate at this time

83-6 #2

December 28, 1959

C/F Dear

The Board of Directors of the sas approved your proposal for a new scientific graphological Review Foodety's check in the

amount of \$360.00 hich represents the semi-annual payment on the grant to you. The second payment will be made on or about July 1, 1960.

As previously mentioned, at the end of the first year, the Board of Directors will review your progress and at that time will determine further support.

The following conditions apply to the utilization of these funds:

- An annual and informal progress report to be submitted during the month of December.
- 2. An annual accounting of funds to be rendered for our records.
- 3. The Review shall contain the following notice

Other than the above conditions, it is required that funds be expended entirely for the publication designated and that no profits accrue to any individual.

The Board of Directors and the scientific advisors to the join me in wishing you well in this endeavor. Flease call upon us for any assistance that we may be able to provide.

Sincerely,

Executive Secretary

B

December 11, 1959

Memorandum to:

From:

Subject:

Graphological Review

Englaced is a managed from the above named

0

This is an invited proposal, the first that we have been able to stimulate despite the fact that we have been working in graphology for two years now. It is particularly appropriate to our needs in that A. It gives us contact with the entire traphology community and B. It achieves this relationship at a very modest cost on a participating basis.

I recommend that a supplement to our Handwriting Analysis Task Budget be made in the amount of \$3.500. This amount is larger than the estimated budget submitted because it is my opinion that as his work progresses under the stimulus our grant will provide, he will find he has not allowed sufficient funds to achieve his objectives.

Enclosure #1 is proposal. Enclosure #2 is our letter of committal which transmits a first payment on the grant in the amount of \$300.

My unorthodox action in making this transmittal was dictated by the small amount involved, by the deliberation and planning which has borne the approval and consent of our Directors and and by my strongly felt need to respond quickly to this proposal for public relations purposes. If, after consideration, you feel that this grant should not be made, there are sufficient administrative funds on hand to cover the first year's grant and these can be diverted from other projects.

RECEIPT

I hereby acknowledge receipt of the following:

Official Check #MT 118622 in the mount of \$25,000.00, drawn on dated May 19. 1959, and bayable to the

Date: 1200 21,195

- 83-9-

3131

9-2503-15-912

F3

6 1959

with # 3

12, MAY

Anne 3.

25 800.00

25,00.10



27 March 1959

MEMORANDUM FOR: THE COMPTROLLER

ATTENTION

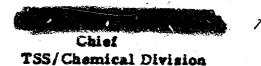
: Finance Division

SUBJECT

: MKULTRA, Subproject No. 83,

Authorization #3

Under the authority granted in the Memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 83 has been approved, and \$25,000.00 of the over-all Project MKULTRA funds have been obligated to cover the subproject's expenses and should be charged to Allotment 9-2502-75-902.



Approved for Obligation of Funds:

I CERTIFY THAT RUMDS ARE AVAILABLE:
SELECTION REFIRENCE NO. 3/30CHARGE TO ALLOTMENT No. 9-3500-75-902

AUTHORIZING OFFICER

Research Director

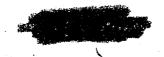
Date:

Distribution

Orig & 2 - Addressee

1 - TSS/FASB





8 May 1959

MEMORANDUM FOR: Chief, Finance Division

AIV

TSS/Budget Officer

SUBJECT

: MKULTRA, Subproject 83, invoice No. 3

Allotment 9-2502-75-902

1. Invoice No. 3 for the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$25,000.00, drawn on and made payable to the

- 2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Thursday, 28 May 1959.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief
TSS/Chemical Division

Attachments:
Invoice & Certifications

Distribution
Orig & 2- Addressee

TSS/FASB

12 MAY
1 CORREY THAY FIRIDS ARE AVAILABLE
DRIGATION REPERIOR NO. 3137
QUARGE TO ALLOIMENT No. 9-2503-75-792
ALTHORIZENG OFFICER

E

CHECK#1/2029N THE AMOUNT OF \$25.00 PRECEIVED. 21 MAY

INVOICE

For Services

\$25,000.00



CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. 3 applying to Subproject No. 83 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is filed in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject 83 under MKULTRA which was duly approved and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:



DRAFT 26 March 1959

MEMORANDUM FOR: THE RECORD

SUBJECT

Branch III.

: Continuation of MKULTRA,

Subproject No. 83

1. The purpose of Subproject No. 83 is to continue support of the editorial and technical survey activities of is assigned to the and is covered as an employee of the During B the past eighteen months his activities have been to make technical surveys of social and behavioral science matters of interest to TSS/CD/

- will continue to develop technical surveys on the controversial and misunderstood areas listed below:
 - a. A revision and adaptation of material already developed on deception techniques (magic, sleight of hand, signals, etc.)
 - b. Psychic phenomena and extrasensory perception
 - c. Subliminal perception
 - d. Hypnosis

etc.)

- e. "Truth serums"
- f. Expressive movements (body type, facial characteristics,

He will also assist the in editing the material they develop including annual reports, project summaries and conference notes.

Executive Secretary of the and will continue to work out of the soffices. Accounting for money spent will be included in the regular audit.

4. The total cost of this subproject will be \$25,000.00 for a period of one year beginning 1 May 1959. Charges should be made against Allotment 9-2502-75-902.

5. Las been cleared for access to Top Secret material by the Agency.

A

Chief TSS/Chemical Division

Approved for Obligation of Funds:

A

Research Director

Date: # 12163-1829,

Distribution:
Original only

83/83-13

May 12, 1959

Memorandum to

Subject:

Editorial Project

The balance of funds received for the Editorial Project which carried from May 1, 1958 through April 30, 1959 of #3,449.46 is retained and committed along with the \$8,000.00 supplement for graphology tests received in January 1959 for continuation of the work on graphology through the fiscal year 1960.

EXPENDITURES EXPENDITURES

May 1, 1958 through April 30, 1959

Salaries	\$17,797.30
Equipment	573.31
Taxes	283.04
Travel	1,012.32
Reference Library	60.00
Office Supplies	9•75
Graphology (C)	178.56
Miscellaneous (Incl. typing fees and rental on typewriter)	209.01
Total expenditures	\$21,388.29
Items Obligated from these funds and to be paid in May	
Rent - April 15/30 Taxes on 1st Quarter Unempl. Ins.	57.50 104.75
Total expenditures for year	\$21,550.54

Please note that no charge was made for telephone, electricity, and, although a small amount shows for Office Supplies, the vast amount of supplies and postage.

Cash Received for this project: \$ 15,965.89

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Cash densferred from

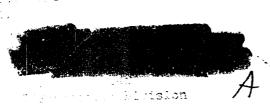
Expenditures

Balance

\$\frac{9,034.11}{25,000.00} \frac{21,550.54}{3,449.46}

Supplement received for Special Trial Tests

\$ 8,000.00





3/2/159

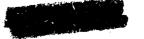
RECEIPT

I hereby acknowledge receipt of the following:

in the amount of \$8,000,00, drawn on lated January 13, 195

Date: January 26, 1954

91-88



29 December 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

: MKULTRA Subproject 83, Invoice No. (

Allotment 9-2502-75-902

1. Invoice No. 2 for the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$8,000.00, drawn on ind made payable to the

- 2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Tuesday, 2 January 1958.
- 3. This is a final invoice. A total of \$8,000.00 was obligated under this subproject during FY 59. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Acting Chief
TSS/Chemical Division

Attachments:

Invoice & Certifications

Distribution:

Orig & 2 - Addressee

1 - TSS/FASB

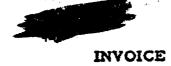
CHARGE TO ALLOW P-23502-75-912

AUT MAG OFFICER

CHECK# 29-359373 RECEIVED. 21 JAN

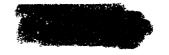
2/ Jan 59

A



For Services	\$8,000.00

	CERTIFICATIONS
No. 83 of MKULTRA, that being accomplished in acc- agenda of the payments an	that this is Invoice No. 2 applying to Subproject to performance is satisfactory, that services are cordance with mutual agreements, that a detailed ad receipts is filed in TSS/CD, that this bill is payment thereof has not yet been made.
Dotos	Acting Chief, TSS/Chemical Division
Date:	
MKULTRA which was duly out in accordance with the	that this invoice applies to Subproject 83 under y approved and that the project is being carried memorandum dated 13 April 1953 from the DCI unsion of this authority in subsequent memoranda.
	Research Director
Date:	





16 December 1958

MEMORANDUM FOR: THE COMPTROLLER

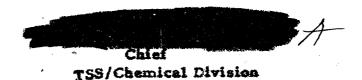
ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject No. 83

Under the authority granted in the Memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 83 has been approved, and \$8,000.00 of the over-all Project MKULTRA funds have been obligated to cover the subproject's expenses and should be charged to Allotment 9-2502-75-902.



Approved for Obligation of Funds:

Research Director

Date:

Distribution:

Orig & 2 - Addressee

I - TSS/FASB

18 De 1958

Support a special

research study of handwriting analysis.

(Continuing project)

Satisfactory

N/A

MEMORANDUM FOR: THE RECORD

SUBJECT : Supplementary Funds, MKULTRA, Subproject 83

1. The purpose of the supplement to this project is to support a special research study of handwriting analysis. Graphologists will categorize a number of handwriting specimens according to the degree to which these specimens tend to reveal personality dimensions.

Other experts in handwriting analysis, including graphologists, handwriting identification experts and experimental psychologists, will examine the above groups of handwriting specimens to determine any identifiable characteristics of the actual handwriting. Both the above phases will be repeated as a cross validation.

- 2. The original budget for this project did not cover the cost of this research phase. The specific direction of research could not be determined until completed the final stages of his survey of handwriting analysis. The attached supplementary budget includes estimated fees for graphologists and administration costs associated only with this research phase.
- 3. The total additional cost of this project will not exceed \$8,000.00, (thereby bringing to a total of \$33,000.00 funds obligated to 1 May 1959), to be charged against Allotment 9-2502-75-902.
 - 4. Other specifications for this project remain as stated in





the Memorandum for the Record dated 18 April 1958, Subject:

MKULTRA, Subproject No. 83.



TSS/Chemical Division

Approved for Obligation of Funds:

Fur Research Director

Date: 12 18 58

Attached:

Proposed Budget

Distribution:
Original only





SUPPLEMENTAL BUDGET, MKULTRA Subproject 83

Fees: Handwriting Experts		\$7,500.00
Travel		450.00
Mailing and miscellaneous		150.00
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CERTIFICATION

has been satisfact that \$9,034. If on subproject 57. T of subproject 57.	orily comple invoice #1 of his credit re	the program under subproject 57 ted. It is requested, therefore, subproject 83 be credited to presents the return of unused funds rged to Allotment 6-2502-10-001,
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		•
	•	
		Chief, TSS/Chemical Division
Date:		•
		Research Director

Date:

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REĆEIPT

Receipt is hereby acknowledged for Check No. FE12617, and dated June 25, 1958, drawn on the in the amount of \$15,965,89, payable to the

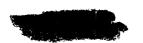
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21 April 1958

MEMORANDUM FOR: THE COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject No. 83

Under the authority granted in the Memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memorands. Subproject 83 has been approved, and \$25,000.00 of the over-all Project MKULTRA funds have been obligated to cover the subproject's expenses and should be charged to Allotment 8-2502-10-001.

Chief
TS3/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

Original signed by

Research Director

Date:

24,1358

Distribution:

Orig & 2 - Addresses

1- TSS/FASB

8.3-24



MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

: MKULTRA Subproject \$3, Invoice No. 1,

Allotment 8-2502-10-001

1. Invoice No. I for the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$15,965,89, drawn and made payable to the

- 2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Wednesday, 25 June 1958.
- 3. This is a final invoice. A total of \$25,000.00 was obligated under this subproject during FY 58. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief TSS/Chemical Division

California - i

Attachments:
Invoice & Certifications

Distribution:

Orig & 2 - Addressee

L - TSS/FASB

3644 5- 250 1-12-121





For services

\$15,965.89

CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. 1 applying to Subproject 83 of MKULTRA, that performance has been satisfactory, that the services have been accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject 83 under MKULTRA which was duly approved and that the project is being carried out in accordance with the memorandum dated 12 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:





11 June 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

TSS/Budget Officer

SUBJECT

: MKULTRA Subproject 83, Invoice No. 1.

Allotment 8-2503-10-001

1. Invoice No. 1 for the above subproject is attached. Payment should be made as follows:

Cashiania check in the amount of \$15,965.89, drawn and made navable to the

- 2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Wednesday, 25 June 1958.
- 3. This is a final invoice. A total of \$25,000.00 was obligated under this subproject during FY 58. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

TSS/Chemical Division

Attachments: Invoice & Certifications

Distribution: Orig & Z - Addressee PHECKIE 1247 LIM THE AMOUNT OF BACY (S. 32)

Dr 288 co2644 600.1 2502-10-001 17.2 \$25,000.00 Cr 236 001674 600.1 2502-10-001 17.2 9,

DRAFT A A 18 April 1958

MEMORANDUM FOR: THE RECORD

SUBJECT

MKULTRA, Subproject No. 83

editorial and technical survey activities of

and is covered as an employee of the During the past B

six months, his activities have been to make technical surveys of social

and behavioral science matters of interest to TSS/CD/Branch III. During this period he has been carried on the budget of the However, it was originally proposed that as soon as he demonstrated his ability, he would be established as an independent project and his activities widened.

analysis. He has prepared a review of current attitudes towards hand-writing analyses as reflected by scientific researchers in the technique; fringe or pseudo-scientific developments in the field; general attitudes of psychiatrists, psychologists and other behavioral scientists to the techniques; and attitudes of document analysts and law enforcement agencies to the method. He has isolated the various "schools" of handwriting analysis, both American and European, and has prepared a readable, accurate and informative document that can be made available to



potential consumers of handwriting analyses. More important, however, he has assembled data making it possible to design relevant and meaningful research into the usefulness and applicability of handwriting analyses to intelligence activities.

- it is now possible to undertake systematic research. During the next year, will be responsible for the development of a research project on handwriting analysis. The recommendations for the design of this project, as developed by the are included as Attachment No. 2.
 - 4. In addition will begin to develop similar technical surveys on other controversial and misunderstood areas.

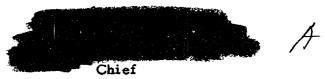
 These will include, though not necessarily in the next year:
 - a) a revision and adaptation of material already developed on deception techniques (magic, sleight of hand, signals, etc.)
 - b) psychic phenomena and extrasensory perception
 - c) subliminal perception
 - d) hypnosis
 - e) "truth serums"
 - f) expressive movements (body type, facial characteristics etc.)



He will also assist the in editing the material they develop including annual reports, project summaries, and conference notes.

will be under the supervision of the Executive Secretary of the and will continue to work out of the offices. Additional space for his activity is necessary and is included in the summary budget attached. Accounting for money spent will be included in the regulat

- 6. The total cost of this subproject will be \$25,000.00 for a period of one year beginning 1 May 195%. Charges should be made against Allotment 8-2502-10-001.
- has been cleared for access to Top Secret material by the Agency.



TSS/Chemical Division

Approved for Obligation of Funds:

Research Director

+36 24-1915

Attached:

1. Proposed Budget

Recommendations

Distribution: Original only





PROPOSED BUDGET

Salary for Salary for one year	\$12,000.00
Salary for clerk-typist (to be employed)	4,000.00
Space, utilities, phone, etc	4,000.00
Consultant fees, travel and expenses in setting up case history project	4,000.00
Supplies, incidentals, etc	1,000.00
TOTAL	\$25,000,00



Recommendations for a Test of Handwriting Analysis

General Comment. Handwriting analysis in the present state of its development is more art than science. The modern graphologist attempts to assess total personality in terms of the total handwriting sample, and insists that no single handwriting element has meaning in and of itself, but must be considered in the context in which it is found. There are certain "principles" to which most graphologists adhere that lead to general agreement on many points of handwriting interpretation, but the final product is an intitidual performance reflecting the training and convictions of a particular graphologist. Asked to explain how he drrives at a particular judgment, the graphologist will assign tentative values to various handwriting elements, such as slant, pressure, speed, sire, insisting that his interpretation of each element is analitioned by the total pattern of graphology that can be tested per set the only practical recourse is to test the performance of several handwriting analysts who appear to be most qualified.

Types of Handwriting Analysis Experiments. An experiment intended to test the effectiveness of handwriting analysis as a method of assessing personality can be designed in a number of ways. For purposes of validation, a knowledge of the salient personality features (traits and attitudes) of each person whose handwriting is to be analyzed remains a basic requirement, regardless of experimental design.

In the matching test, the graphologist's performance can be compared with the performance of a psychologist using accepted psychological projective methods. The graphologist prepares personality sketches from blind analyses of neadorfflings, and these are compared with sketches by the psychologist based on a battery of prychologisal tests. In a variation of this method, beychologist are graphologist make

scaled judgments of specific criteria of personality in lieu of narrative or descriptive personality sketches. Ferformance in either case is evaluated by an "expert" judge or panel of judges whose knowledge of the Subjects may include face-to-face interviews, appraisal by acquaintances, biographies, and indeed all information available for delineating each personality.

A simple sorting test can be employed. In the past, scripts have been shuffled and the graphologist asked to sort them according to sex, indications of honesty or dishonesty, and according to whether the writer would score high or low on certain psychological tests. (In passing, it should be noted that the modern graphologist refuses to judge the sex of a writer.)

A favorite approach of American psychologists who have concerned themselves with handwriting analysis, is the measurement of certain physical or geometric aspects of handwriting in the attempt to establish correlations between these and well-defined personality traits. These studies have produced claims of significant correlations and claims of no correlation whatspever. As an investigation of handwriting, this method comes the nearest to satisfying the demands of objective methodology. The need for a professional graphologist is eliminated, for this is a test of handwriting as a projective device, and not a test of handwriting analysis as practiced by the graphologist. It does not consider the total sample, nor has it thus for been able to explore the interplay of various handwriting elements.

A fourth method would provide a test of graphology in its industrial or business applications, particularly in personnel selection. This would require the cooperation of three or possibly four business firms, either retailers or manufacturers, and would employ skewed samples of the handwritings of individuals who alearly have succeeded

in designated positions and those who clearly have failed in or are otherwise not fitted for the positions. There are no known instances of this precise approach to the test of handwriting analysis, possibly because there has been no need of it or quite possibly because it is a "loaded" situation smacking of unethical practice.

In the matching or the sorting tests, the graphologist would know that he was participating in an experiment, though he need not be aware that other graphologists were making judgments on the same handwriting samples. In the test of graphology in industry, the handwriting analyst would, of course, remain unaware of the test situation.

Personnel Selection. If only one experimental approach is to be used, the test of industrial graphology is recommended as the least encumbering and the easiest to evaluate. Although it will not permit a comparison of handwriting analysis with other projective techniques, it offers an excellent apportunity to test the accuracy of the graphologist's judgments concerning a subject's performance and behavior. The selection of suitable handwriting samples for this test will be more difficult than it would be for sorting or matching experiments.

Graphologists place no restrictions on the types of jobs for which they are willing to interpret handwriting. They have declared themselves competent to advise on jobs as diverse as contan grading, advertising, proof reading, accountancy, and various supervisory and administrative positions. They assist in hiring new amployees, promoting old ones, and in discovering underlying causes of low production and unsatisfactory interpersonal relationships on the job.

Unless the graphologist has previously been retained by a firm, he expects the client to tell him the qualifications desired in the applicant. As an example, a retailer of children's toys decides to hire a chief buyer. Beyond the applicant's

experience as a buyer, the client wants a man who is honest, intelligent, reliable, and energetic; a man who has personal warmth, social poise, a good sense of humour, an understanding of parents' mentality and a good intuitive sense of the psychology of children. As a matter of practice, the graphologist is willing to interpret the meaning of "reliable," what constitutes "a good sense of humour," how much intelligence the position demands, etc. Given the handwritings of 10 applicants, he will narrow them to two or three, and ask the client to make the final choice. He will extend himself further, if the client wishes, and list his choices in 1-2-3 order, indicating why he feels one applicant is qualified and another is not, why one applicant is likely to sale.

The types of positions for which the graphologist seems most frequently to make recommendations are: (1) sales personnel and buyers, (2) bookkeepers and accountants, (3) public relations personnel, (4) clerical personnel: secretarial and stenographic, and (5) supervisory positions (of no fixed description). These positions should be central to the experiment, but the handwriting of any person whose dominant traits and attitudes are known and whose behavior is marked and explicit, regardless of level or type of employment, potentially constitutes a suitable sample for purposes of the experiment.

The facets of personality which the graphologist is asked to detect and evaluate will be controlled largely by the psychological makeup of the individual supplying the handwriting sample. The points on which the graphologist is asked to make judgments need not be a comprehensive as the toy merchant's requirements for a qualified chief buyer, they can be circumscribed to whatever degree suits the needs of the experiment.

Individuals who have demonstrated their competence in the positions for which they will be "applying" in the experimental situation can be selected according to

various recognized criteria of achievement; for example, long, meritorious service, authority and responsibility in the organization including salary and number of employees supervised; productivity, a willingness to put the firm's best interest first (overtime work, relinquishing vacation time, etc.) excellent attendance record, and so forth.

have failed in positions for which they would be "applying." The purpose will be served by obtaining "applications" from persons unfit by virtue of misconduct, low production, chronic absenteelsm, unsatisfactory interpersonal rolationships, and the like. In addition to those criteria, the "undesirable population should contain instances of unwanted behavior established by conviction in a court of law. This would require the apoperation of a penal institution, and the examples thus obtained should reflect affenses—projectable repeated offenses—of embazziement, forgery, lesceny, destruction of property, and sexual deviation.

To a lesser degree, instances of argenic or functional disturbances can be included among the "undestrables." These should be restricted to heart disease, speech impairment, Parkinson's disease and possibly orthritis, and should be used sparingly and solvatively. Three of the seven handwriting analysts who will be recommended for participation in the experiment have concerned thomselves with the relationship of handwriting to organic illnesses; this is not personality projection, but a preoccupation with essentially physiciagical or motoric concernitants of handwriting. It seems possible to test some of these claims with little additional cost.

One of the most common claims or grap relogists concerns their dillity to detect scribes emotional disturbances by inspection of bandwitting. Mostal use of the

handwriting of mentally III persons seems advisable, provided legible samples showing at least moderate speed and energy in the execution can be obtained.

Matching and Scriing Tests. The possibility of evaluating handwriting enalysis

by sorting and matching tests should not be discounted entirely. It seems advisable to accumulate a file of handwriting specimens drawn from the Extensive background and testing data are already available on this group, and the use of specimens written in would have

the further educations of danying the graphologist content class. Samples can be

octained by --

- 1. Drafting a routine letter to the minimum informants inquiring the their health and well-being and inviting comment on their life in
- 2. Initiating correspondence requesting their participation in the proposed follow-up study of
- 3. Directing the interviewer in the follow-up study to obtain one written statement from each informant interviewed.

The Craphologists. The Society's inquiry into handwriting analysis reveals that the applied graphologist, practicing handwriting analysis as a profession, usually has no formal training in psychology and help possesses only a popular or folk knowlinds of personality saturators. The graphologist is usually trained in simple observatorology which assigns fixed meanings to handwriting sharronts, and thuse are slightly availed to personality traits that are often value and liberalized.

The graphologist who came from where is a patter understanding of esychology and trajective methods a few claim degrees from an investigation and passed theories of personality.

It is from this group that the claims for graphology seem sufficiently impræsive to justify experimentation.

C/F Among the handwriting analysis, four are recommended for $\mathcal B$ participation in sponsored experiments:

Based on personal Interviews, review of published works, and the general regard for them by fellow-graphologists and experimental psychologists, these handwriting analysts appear to have as high qualifications as any in the reaks of applied araphology.

C Among Candwriting analysts, three are singled out for possible testing:

The Handwriting Receimen. Although the requirements for a semple suitable for analysis varies from graphologist to prachologist, there are certain minimum standards about which there is general agreement. The sample must be written in ink, on unlined 0.1/2 m in least, though the size of the paper is not a rigid requirement. There is a decided preference among prophologists for samples written with tenventional penacint, but either beligaint or conventional pen samples are accordable. The proclam must have then freely written, with no foreknewledge by the writer that his head is to be analysed. It must be the original specimen, not a photostatic copy. In every case, the graphologist will inside an knowing the sex and anyweximete ago of the writer.

Acceptable samples extend from one-ind? page to spread pages. It is astimated

that at least 50 samples will be needed, and as many of these as possible should be two or three pages in length, with accompanying signatures. Each page of the langer samples can be used as a separate specimen, thus permitting a test of the graphologist's consistency by obtaining two or three analyses of the same writing over an extended period. As a practical consideration in testing business applications of graphology, it should be borne in mind that the employer who applies to a graphologist has a vested interest in competent analyses, and is therefore likely to submit long samples if the graphologist insists.

There are certain content clues that are always available to the handwriting analyst, provided the sample is in a language he can read. The writer's selection of words and his syntax may very well provide rough indices of his intelligence.

Secause the subject of the samples need not deal with the position for which the individual is "applying," or to which he is being promoted, there is reason to believe that judicious selection can hold content clues to an acceptable minimum.

be left to chance, the informants should in all cases be encouraged to respond in should provide the same pun (no ballpoint) and the same quality of unlined white paper for each specimen.







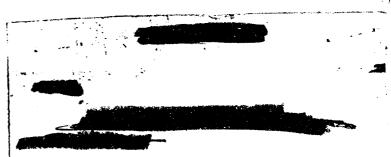
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N/A

Support editorial

& technical survey activities of



<u>_</u>

Satisfactory

NA





Purpose: To study the nature of the hypnosis process as it may relate to induction of a changed motivational state (MKULTRA 84).

Initiated: 19 August 1960

Contractor: Dr. 1 38 a

Cost: \$30,000.00. (These are supplemental funds; and, although time extensions may be granted, it is not anticipated that further funds will be made available for this research.)

Status: Continuing.

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the previous accounting period.

Enter in this section the amount of each receipt during the accounting period showing pertinent

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Advances made to third parties which

Enter on Line 2 the amount of outstanding advances made to third parties, brought forward from

Enter on line 1 the amount of cash on hand at the beginning of the period.

attach hereto. In Enter

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CERTIFICATION

MK Grantee Dr

Aug. - Dec. 1961 \$30,000.00

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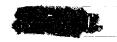
- 1. This grant was made through Me in 1961, \$10,000.00 in August 1961 and \$20,000.00 during the period Sept. Dec. 1961. The funds were provided on a "to-be-expended-as-necessary" basis for which we secured various sensitive consultation privileges and services. The grantee acknowledged the receipt of the grant and the unexpended balance of \$20,507.53 in his letter dated 28 March 1966. Since no successor has been named to Me it is unfeasible from a security or cover standpoint to require or receive further accountings from Me
- 2. It is therefore requested that the unexpended portion of the original grant (\$20,507.53) be written off based on services being received in the form of research reports.

Chief, TSD/BAB

APPROVED:

C/TSD





30 August 1967

TSD/BAB MEMO #232-67

MEMORANDUM FOR: Chief, TSD/BF

SUBJECT : Request for Write-off Memorandum

Account

C4 B

li For security and cover reasons BAB is unable to give direction or receive accountings in the name of For the same security and cover reasons no individual or organization has been named.

It is therefore unfeasible to require or receive

accountings from for the unexpended portion of the 1961 grant from in the amount of \$20,507.53.

2. It is therefore requested that a write-off memorandum be executed on this account.

APPROVED>

Chief, TSD/BAB

Sidney Gottlieb Chief, TSD

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- Enter on line 2 the amount of outstanding advances made to third parties, brought forward from the previous accounting period.
- Enter in this section the amount of each receipt during the accounting period showing pertinent i.e., method or source of acquisition and applicable rate of exchange, if indigenous currency. If more space is required to explain receipts, prepare receipt form, number and receipts. In every case, completely identify the source of attach hereto.
- the sum of amounts shown in accounted for which shall be Enter on this line the amount to be and 3. 1, 2,
- in lieu thereof a certafication explaining the lack of a receipt. Each amount listed in this section shall be supported by a voucher consisting of either the entries exceeds the available space they may be consolidated as one entry entries on a separate sheet ndividual a listing of receipt obtained from the payee or section 5 and supported by f the number of
 - the advancee any refunds of Enter on this line the amount of or money order check. by cash,
- or advances are obtained, list as expenses the end of the accounting period amount on this line supported by a Final credit will not be given for disbursements which are Advances made to third parties which remain outstanding at shall be consolidated and the total entered as a single advances to be accounted for When accountings or refunds of cash, as approprate listing on a separate sheet.
- Inter on this line the amount of cash on hand, or if the amount of the disbursements exceeds the amount advanced the balance due the advancee shall be shown in parenthesis, i.e. "Total Accounted For", line 9 treated as a minus amount in arriving at the
- which must agree with the amount shown on Reflect on this line the "Total Accounted For "Total To Account For line 4

GPO 821-580

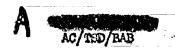


CERTIFICATION

This is to certify that I have received an accounting from MKULTRA Sub-project # 84 for the period 18 October 1963 through 17 October 1965. The accounting reflects expenses in the amount of \$5,362.47 against the outstanding grant balance of \$25,870.00. The remaining grant balance to be accounted for is \$20,507.53.

The counting statement and payment certification will be retained in TSD and will be made available for review in TSD if necessary.

I further certify that satisfactory services represented by the accounting have been received and that to the best of my knowledge and belief the funds expended were for the purposes authorized by the project approval.







B 84-7

C. Executive Director

Treasurer

March 28, 1966

Dear B	
Enclosed is the accounting to years. The expenditures were as follows:	rover the past two
B for the purchase of a sound movie	
camera with appropriate accessories (used)	\$3,050.00 managaran
Legal-Fees	341.56
Insurance for equipment	314.46 ===================================
Miscellaneous laboratory furniture and equipment	656.45
To help underwrite a meeting of scientists working on hypnosis	
	1,000,00
Total	\$ <u>5,362,47</u>

As we discussed sometime ago, it has been my understanding that there is no time limitation for the expenditure of monies from the and, for this reason, we have avoided expending these except in situations where no other support could be used or was available.

What might appear to have been a very small level of expenditure over time has, in fact, played a vital role in supporting our research activities in allowing us to make necessary guarantees to certain senior staff personnel.

March 28, 1966_

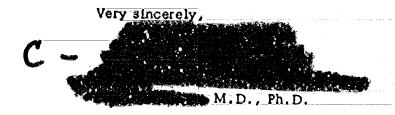
As we have discussed in the past, the primary purpose of this grant has been to provide emergency contingency funds. Thus, it is possible to assure key personnel that continuing support for them would be available even if certain other grants or contracts with government agencies were delayed. The laboratory has been fortunate in obtaining other support over this time and thus it has not been necessary to use the bulk of the grant to cover salaries. I am sure that it will be clear that contingency funds of this kind are of vital importance in allowing us to hold together the essential nucleus of a research staff. Obviously we would otherwise lose key personnel to other institutions which are in a position to make permanent guarantees.

At this time, we are pledging contingency funds pending approval of contract and continuation of contract. It looks highly probable that these contracts will be renewed. If things progress as expected, we will be enlarging our laboratory and, under those circumstances, some \$15,000 may be required to facilitate the conversion of existing space to appropriate laboratory facilities. Here again, we hope to obtain other support to undertake these modifications, but contingency funds are essential to allow us to proceed with our plans and avoid a one to two year delay.

Finally, I would like to explain the item to help underwrite the conference

The bulk of the cost will be borne by however, certain restrictions exist on the use of the funds which make it imperative that a relatively small additional amount be available. While only \$1,000 has been pledged officially, it is possible that a larger amount may be required. This meeting may help to provide access to some of the recent work being carried out by facilitating an informal exchange of communication.

I hope that this clarifies our expenditures to date. I am sure it will be clear that the importance of these funds to the laboratory has been completely out of proportion to the amount actually expended. Without contingency funds of this kind, it would not have been possible to accomplish many of the important studies that have been carried out in the past and are being carried out at this time.



STATEMENT

E

Total Grant Amount	\$30,000.00
Amount expended 1962-63 \$4,130.00	
Amount expended 1964-65	
Total expended \$9,492.47	9,492.47

Balance

\$20,507.53

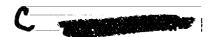
January_7, 1966

Memorandum for the File

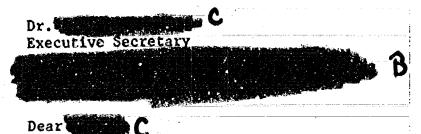
Subject:

Telephoned Dr. today requesting an

answer to my letter of October 19th. He promised to send me an accounting as fast as he could get the figures together.



October 19, 1965



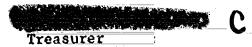
Time goes by so quickly that I am sure you do not recognize that it has been two years since your last accounting on the grant to

My records show that your last accounting was dated October 17, 1963 and showed expenditures of \$4,130. This leaves a balance of \$25,870 according to my records.

I would appreciate receiving an up-to-date accounting.

Hope all is going well with you. Best personal regards.

Sincerely,



MKU-84

14 October 1965

	We have on our records an outstanding grant for Dr.
C.	In my file I have a copy of your letter dated 28 October 1963,
	which forwarded an accounting through 17 October 1963.
	C Dr. letter to you dated 17 October 1963 states that an
	annual accounting will be made, therefore, we are one accounting in
	the arrears with one due this month.
	Please take the necessary action to secure accounting or accoun-
	tings to bring Dr
•	

MKJ-84

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INSTRUCTIONS

- made to third parties, enter the total of such advances outstanding at the beginning of the accounting period in the form of other than U.S. Dollars were on hand, received, or disbursed during the accounting If advances have been period, all pertinent data, i.e., rate, method of acquisition, etc., must be shown. on line la.
- If more space is required to explain receipts, prepare receipt form, number and attach hereto. In every case, completely identify the source of receipids. ď.
- The voucher may be When a receipt is not obtained, prepare a certificate and attach as a prepare a listing on a separate sheet the close of the accountsednence. and enter the total under item 3. If advances to third parties are outstanding at Attach a voucher for each expenditure and assign a number thereto in numerical When space on form is not sufficient to list all vouchers, ing period, attach an itemized list and enter the total on line 3a. the receipt obtained from the payee. voucher. ė
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- g agree with the total Total receipts entered on the line "Total to Account For" Accounted For the line following Š

October_28,_1963__

Dear C

Attached please find the first of many accountings

o come on

153

Total he received was \$30,000.00 Total Expended at

as of Oct. 17, 1963 \$4,130.00. Balance in account \$25,870.00.



C

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1.000 sent in August was a later in that year. Dr. you brought the matter is for a 5 year period we all out and ask for his	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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Dear Tou are absolutely right. The first \$10,000 sent in August was sent to the first \$10,000 sent in that year. Dr. 1s answerable for all \$30,000. However, since you brought the matter up, I checked into the file and even though this is for all \$ year period we did request yearly accountings so I will drop Dr. a note and ask for his latest financial report.	4
bear to a large late	
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% 12 min 1771/172	

August 1, 1963

Dear

Thank you very much for the recent accountings. However,

I am still foggy on Dr.

In looking over your Finances reports back thru
the months, I note you received 30,000 for in Sep 1960.

10,000 was disbursed to him in August 1961. 20,000 went

b to describe during the Sep-Dec 1961 period.

I've a hunch that maybe these two items make up the 30,000,

C and is accountable for it all.

Anyway it's the 30,000 we've charged to that I'm looking for. I'm a newcomer to this business, so maybe the answer is available in our records, but it's justa matter of knowing where to look! I'd appreciate any light you might shed on this.

PER 22 AUG 1963
The \$30,000 did go to
It is to be a 5-yr project, but
they had agreed to send
annual accountings. Will C
try to get them started on
the accts. Is cut-ofthe picture re: the 30,000.

October 17, 1963

Treasurer

Dear C

Please excuse the previous absence of accounting to
In reference to the grant to
Over the past two-years the expenditures made from this grant were as follows:

A fellowship to

worked on the posthypnotic phenomenon and is now in the process of completing study. Work under this fellowship was satisfactory and will represent a large part of \$3,000.00

To Dr. for statistical consultation 600.00

Fire file 330.00

It has been my understanding that there are no time limitations for the expenditure of funds under the grant from and we have chosen to conserve as much as possible of these funds, utilizing other sources of support whenever possible. In the future we shall make an annual accounting of funds expended.

I certify that services or materials have been satisfactorily received and the expenditures were incurred on official business.

Date: 1969

Total spent to date

Very sincerely yours.

M. D., Ph. D.

200,00

\$4,130.00

Executive Secretary

July 11, 1962

Accounting of May 1, 1961 - April 30, 1962 \$ 2,073.32 Balance May 1, 1961 1,250.00 Received lotal \$=3.323.32 Disbursements: \$.498.35 Equipment Supplies Postage, Freight 41.23 245.60 Travel 19.24 Subscriptions -1,151.50 Services 761.00 Subjects · (259.45) Miscellaneous = Total Disbursements 640.68 Balance pril 30, 1962

This is a true statement of expenses as reported to

Prepared by

1

I have exactned and approved the submitted expenditures.

A

Chief TSS/Chemical Division

Date:

1/1/62



Disbursements for the Period: 5/1/61 to 10/31/61

Equipment	\$-498.35
Supplies	201.17
Postage	32.23
Travel	94-40
Books	: 12.2 <u>4</u>
Services Pu	rchased 109.31
Subjects	720.00
	Total \$1667.70
	c 105.62

October 19, 1960

Memo to C B
Subject: Project -

Attached is an accounting received from

through April 30, 1960. This is a true statement of expenses as reported to us.

ection C

84-22

October 19, 1960

Accounting of Market from Company

May 1, 1959 - April 30, 1960

Balance May 1, 1959 \$8,818.80

Total \$-10,818.80

Disbursements:

Pension, retirement	
Soc. Sec.	363.41
Equipment	403.61
Supplies	-1,109.86
Telephone & Tel.	223.17
Postage & Freight	103.95
Travel	882.61
Subs. & Books	63.34
Bindirg	9.00
Publishing	55.85
Air Travel	26.90
Misc.	12,00
Services Purchased	236.63
Subjects	377.10

Total Disbursements

8,771.68

Balance-

\$ 2,047.12

This is a true statement of expenses as reported to the Society.

I have examined and approved the submitted expenditures.



TSS/Chemical Division

Date: 10/31/20

C

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Receipt is hereby acknowledged of the following check: RECEIPT Treasurers Checki

No.

Object Class

Date		Remarks and References	Obligations — Incurred	Obligations Liquidated	Unliquidated Balance
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17 August 1960

MEMORRANTINA	MY:	CONTROLLER
		CANA TAXABLE

ATTENICA : Financa Division

SUBJECT !

MCULERA, Subproject 84, Additional Authorisation No. 2

Under the authority granted in the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 84 has been approved and \$30,000.00 of the over-all MOULTRA project funds has been obligated to cover the subproject expenses. This obligation of funds should be charged to Allotment Number 1525-1009-1902.



APPROVED FOR OBLICATION OF FUNDS:



1125.1029. 1112

Research Director

AUTHORIDED CHICER

19 AUG 1960

Distribution:

Orig & 2 - Addressee

1 - TSD/CC

l - TSD/FASS

TSD/RB (17 Aug. 60)







23 August 1960

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

1 TSO/Budget Officer

SUBJECT

MOUTRA, Subproject St, Invoice No. 2
Allotment 1525-1009-1902

1. Invoice No. 2 for the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$30,000.00, drawn on the same and made payable to

B

- 2. Please forward the check to Chief, TSD/Research Branch through TSD/Budget Officer by Tuesday, 5 September 1960.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief
TSD/Research Branch

Attached:

Invoice & Certifications

Distributio.

Orig & 2 - Addressee









23 August 1960

MANORAWIM FOR: CHIEF, PINANCE DIVISIO	MYDRIGORIA	202 ·	CHIEF.	FINANCE	DIVISION
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AIA

1 TSD/Budget Officer

SUBJECT

MINITA, Subproject 84, Invoice No. 2 Allotment 1525-1009-1902

1. Invoice No. 2 for the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$30,000.00, drawn on the check in the amount of \$30,000.00, drawn

B

2. Please forward the check to Chief, TED/Research Branch through TED/Budget Officer by Tuesday, 5 September 1960.

3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

A Chief
TSD/Research Branch

Attached: Invoice & Certifications

CHECK#____ RECEWED.

MOUNT OF SAME

Distribution

Orig & 2 - Addressee

1 _TSD/FASS ___

I CERTIFY THAT FUNDS ARE AVAILABLES
ONLINGATION REFERENCE NO. 345
CHARGE TO ALL'OTMENT NO. 1135-1205-1702-668

ALTHORIZING OFFICER



3 40





INVOICE

For services

\$30,000.00

B

CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. 2 applying to Subproject No. 34 of MOULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that
a detailed agenda of the payments and receipts is on file in TSD/NB, that
this bill is just and correct and that payment thereof has not yet been
made.

Chief, TSD/Research Branch

Date:

(2) It is hereby certified that this invoice applies to Subproject No. 84 of MCULTRA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:





27 July 1960

MEMORANDUM FOR	:_THE RECORD
SUBJECT	Renewal of MKULTRA 84, Partial Support for Project at
ATTENDANCE	: Drs. A
SUMMARY	: It was decided that the \$30,000 should be provided as partial support for this project through tunning mechanism. The major position of research funds will come from the Agency will have access to all the results from this laboratory.
8,C+-	is presently unwittin of Sponsor, but it is contemplated that he will be made witting in September. No special direction will be given to
	research since virtually every problem he has set for himself has a bearing upon Agency interests. TSD/Research Branch

DRAFT August 1960 A

MEMOR	ANDUM	FOR:	THE	RECORD

SUBJECT

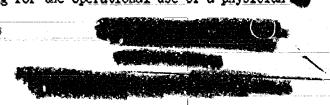
:- Continuation of MKULTRA, Subproject 84

program of Dry of to study the induction of high motivation in individuals by means of the development of specific interpersonal relationships. Expansion of this project along lines of major Agency interest requires a grant of \$30,000.00 to supplement funds which are available from that no future funds will be provided for this research although, considering the scope of this study, time extensions may be granted.

- 2. Three major areas of interest encompass the scope of this research program:
 - a. Basic research on the nature of special states
 of consciousness which to date has focused upon
 particular aspects of the trance state.
 - b. Methodological studies which have dealt with the solution of problems which are a prerequisite to progress in basic research.
 - c. Methodological studies dealing with instrumentation problems which have major importance for some current research interests.

Considerable progress has been made to date in each of these areas. A statement of progress is appended.

3. An additional reason for supporting this project is to provide a sound scientific setting for the operational use of a physician



4. 1	The partial support of this project beginning 1 June 1960	<u>- 2-12-12-12-12-12-12-12-12-12-12-12-12-12</u>
vill not e	exceed \$30,000. Charges should be made against Allotment	· · · · · · · · · · · · · · · · · · ·
1525-1009-	}-1902 ,	
5. 1	This Subproject will be handled as a grant-in-aid from	
	and the handling	
of funds d	disbursed will follow the standard practice set up for that	
organizati	ion, <u>la la la calacte</u> de la calacte de la	•
6. 1	This project has been handled to date in a Government Sterile	
fashion an	and none of the personnel at have been witting of true	
sponsorshi	ip. It is contemplated that Dr. will be made witting of	
sponsorshi	ip and purpose on or about 1 September 1960 in order to guide	- Company on the Company of the Comp
his projec	est along lines that will further Agency operational needs.	
-		
	A	,
	Chief TSD/Research Branch	
ADDDAMED T		-
OF FUNDS:	FOR OBLIGATION	
	A CONTROL OF THE CONT	

Research Director

Date: 8 19 60

Attached:
Statement of Progress

Distribution:
Original only





May 9, 1960

Memorandum to

R

Subject - Project at:

Attached please find a progress report from Dr.

Continuation of support for the project is requested. Justification for the support follows:

- 1. Dr. work in hypnotism is an area of direct use to the Sponsor.

 Hypnotism is a subject that is continually be suggested as the panaceato all the Sponsor's problems and needs to be examined exhaustively.
- 2. Dr. has publized the on a countrywide basis as well as to many other organizations where he has presented publications.
- 3. In keeping with the basic objectives of initial grants from to encourage and stimulate work in areas of interest to the Sponsor, this project during the past two years has attracted both support and additional funds from It is felt that support provides the basis for enriching the investigations, insures that we get the first and best reporting on all work there in the laboratory and maintains a facility for special crash projects on a continual basis.

has approved continuation of this grant.

In addition, the panelshave expressed great interest in the work in these two fields being done under this project and have suggested its continuation.

It is recommended that an additional grant of \$30,000.00 be made to insure continued work in this vital area.

Where is might ?

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34-1

In this report I would like to first express my appreciation to the Directors and Officers of for the assistance which has given to our work. Not only have we had considerable financial support but of equal importance have been the very fruitful suggestions by several of the scientists associated with the several as well as the continuing active supporting role which the group has played. Without both the financial and psychological support much of the research would never have been successfully undertaken.

This report will describe briefly the activities supported by funds in whole or in part since May 1, 1958. Some of the papers which have evolved from the research supported by are appended to this report.

The research which has been undertaken may be thought of as covering three separate but interdependent areas. 1. Basic research on the nature of special states of consciousness which to date has focused upon particular aspects of the trance state. 2. Methodological studies which have dealt with the solution of problems which are a prerequisite to progress in basic research. 3. Methodological studies dealing with instrumentation problems which have major importance for some current research interests.

1. Studies dealing with the Nature of the Hypnotic State.

The theoretical framework in which our studies of hypnosis have been conducted has been to view the hypnotic state as having two well demonstrated components; 1.) an increased motivation to comply with the suggestions of the hypnotist, and 2.) the tendency on the part of the subject to play the role of a hypnotized subject. A third more basic but less understood aspect is, what we have termed, "the essence of hypnosis". While the source of the increased motivation and an understanding of the desire to role-play are basic issues, we have concentrated on the "essence of hypnosis" in the belief that it is this, rether than the other factors, which is uniquely related to a variety of psychological experiences, such as mystical experiences, sensory deprivation effects, placebo effects, and, of course, hypnosis. A paper conceptualizing one particular aspect of this problem is appended, the same This project has been fortunate to have had Dr and currently as a with it from the onset. First as a follow. In a previous study the concept of trance logic was discussed. A study of hallucinations in hypeosis compared the performance given by faking subjects with that of deeply hypnotised individuals. A paper discussing this and will soon appear research was read A preliminary draft in ditto form is appended.

The differences between deeply hypnotized subjects and simulators seemed to present a way of asking questions as to what the hypnotic state adds above and beyond high motivation and role-playing. This line of investigation is currently being followed and pilot work is being done using films of both simulators and real subjects, thus making possible judgement at various uniform points by observers who all see the same thing. It is hoped that this will help to reveal that which distinguishes real and simulating subjects and thus shed light on the nature of the process itself.

A major investigation was undertaken on the suppression of pain by hypnosis.

This study is currently being re-written into a major publication. Three major findings emerged from this study: 1.) for just about all practical purposes there were no differences in physiological reactivity to pain among any of our experimental conditions, 2.) in general, only tiny physiological responses to pain occurred even in the waking control condition, and 3.) our subjects showed far less signs of stress in this experimental situation than in other experiments at using roughly comparable amounts of electric shock. The study strongly suggests that hypnotic analgesis reduces the overreaction to pain under conditions of apprehension and stress but has no effect on the physiological response to painful stimulus under conditions of minimal anxiety. Having established this point, the need for another experimental study becomes apparent to investigate the effect of hypnotic analgesia in conditions where anxiety is maximized. We would anticipate that under these conditions marked differences would emerge. A very interesting point, however, will be to determine whether or not similar differences may emerge even in the simulating subjects. In other words, whether hypnosis as a process or state protects the individual experiencing intense ansiety or whether the hypnotic situation, regardless of the subjective experience, serves this function.

A pilot study was undertaken

has
been affiliated with this project for some time. The response of hypnotized and
simulating subjects to requests to express fear, depression, happiness, and
anger was studied. Pilot studies have suggested that simulators are able to control their emotions to a far greater degree than assumed heretofor and that this
control is no less than an individual in hypnosis. This study does not deal
with an artificially induced situation but merely with the effect of direct suggestions and a rigorous study of this phenomenon is now being conducted.

For the past one and one-half years a study has been conducted of the trance phenomena occurring in the Pentacostal churches with the view toward understanding their relationship to other states of consciousness. A considerable amount of observational data is now available and is in the process of being analyzed. As a part of this study, the personal experiences which one might expect of good hypnotic subjects and Pentacostal church members who are trance

reactors and non-trance reactors are being investigated. This study has been facilitated by the availability of Mr.

Mr. is ideally suited to act as research assistance in this project. This study will not be completed until sometime this summer.

2. Methodology.

In the area of methodology, a paper has been contributed to the symposium.

This deals primarily with

This paper will appear in a book edited by.

In the near future. A pilot study has been conducted with

Students dealing with demand characteristics in sensory deprivation type situations which demonstrated the utility of a process called the pre-experimental interview. A preliminary draft is appended.

3. Instrumentation.

A new electrode has been developed for the more adequate measurement of potential GSR. This promises to be more useful for psycho-physiological work than the classical resistance GSR. A description of the electrode is being readied for publication and a careful evaluation of the electrode in comparison with three other electrodes currently used has been performed. A copy of the study, which is being submitted for publication, is appended.

One further study which has been of considerable interest to us has been the investigation of the subjective pain experience associated with electric shock. A preliminary attempt has been made to scale this along the lines of Wolff, Hardy, and Goodell's efforts. In conjunction with this, a new kind of shock electrode is being developed which may control spacing of contact points better than previously possible.

Largely through the initial help which was given by.

It has been possible to obtain substantial support from and, in the form of a contract, from

of the investigation of real and fake differences in part in collaboration with other investigators in other laboratories. Another major effort being undertaken is the study of hypnotizability and its relationship to responsivity in sensory deprivation under mescaline, etc. Also, we are studying the occurrence of trance-like behavior in the normal experience of subjects. Part of this major research undertaking will be the replication of previous report which claimed to predict hypnotizability using parts of the TAT, Rosenzweig's Picture Frustration Test, and the Zeigarnik effect, the sway test, the heat illusion test, and personality instruments. Questionnaires developed by our group are also used and we hope that these will aid not only in the prediction of hypnotizability but permit specific predictions to be made about the type of response obtained from each subject. A preliminary report on one questionnaire is in press.

Another investigation which is currently being undertaken along these lines is the evaluation of the newly reported audio-analgesia and the relationship which this technique has to hypnotic pain suppression. Informal working relationships have been established with and Dr.

It is hoped to evaluate good and bed reactions to this technique of analgesia in regard to subjects trance-like experiences and hypnotizability.

Finally, the controversial question of anti-social behavior in hypnosis will be re-evaluated experimentally. It is hoped to be able to shed considerable light on the limitations of hypnosis as a technique of controlling behavior in this manner. A paper has been written, in part under the suspices of dealing with the potential uses of hypnosis in interrogation and is to be published.

Publications of studies supported in whole or in part by

K

Published or Presented

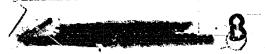
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In Press

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In preparation

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MAY 1, 1958 - APRIL 30, 1959

\$ 18,750.00

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expenditures.

Chief TSS/Chemical Division

I have examined and approved the subm

TOTAL DISTURSEARNTS:

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November 6, 1958

C Treasurer

Dear Mr. Alle C

representing the third payment on the grant that is making to rour organization to support the work of Dr. on

Sincerely,

Executive Secretary

MERCHAN C

Enc.

84 P

84-32

September 11, 1958

C Treasurer

Dear Mr.

Enclosed is check in the amount of \$9,500.00 representing the second payment on the grant that is waking to your or anization to support the work of Dr. Son

The third payment in the amount of \$6,250.00 will be forwarded to you on or about December 1, 1958.

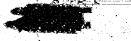
Sincerely.

Executive Secretary

in the amount of \$20,000.00 drawn on I hereby acknowledge receipt of the following: 84-33

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18 April 1958

MEMORAREUM POR: THE COUPTROLLER

APPRETION | Pinesce Division

subject 1 Mailth, Subproject 84

the authority granted in the MSACRARUM dated

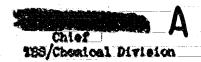
13 April 1953 from the DCI to the DD/A, and the extension

of this authority in subsequent memorands, Subproject 84 has

been approved, and \$25,000.00 of the over-all Project MULTAL

funds have been obligated to cover the subproject's expenses

and should be charged to Alletsent 8-2502-10-001.



APPROVED FOR CELLCATION OF PUREE!

AUTHORIZING OFFICER

Dates

Distributions

Orig 6 2 - Addressee

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are destroy

16 July 1958

84-36

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

1 TSS/Budget Officer

SUBJECT

MKULTRA Subproject 84, Invoice No. 1
Allotment 8-2502-10-001

1. Invoice No. 1 for the above subproject is attached.

Payment should be made as follows:

Cashier's check in the amount of \$20,000.00, drawn on and made payable to

B

- 2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Wednesday, 30 July 1958.
- 3. This is a final invoice. A total of \$25,000.00 was obligated under this subproject during FY 58. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

A - Chief

TSS/Chemical Division

Attachments:
Invoice & Certifications CHECKO N THE AMOUNT DE 32002

Distribution:

Wrig & & - Addressee

A

R1. 600-1-888->102-10-001-173-8>16-00-00 C1. 600.1-88m->102-10-001-17.3-6 5000.00

CM. - C ept. \$ 20,000.00

CERTIFIED FOR PRIMITING OR GLIEFITHE

Fron 84 \$ 39



84-36

INVOICE

For services

\$20,000.00

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CERTIFICATIONS

(i) It is hereby certified that this is Invoice No. I applying to Subproject No. 84 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject No. 84 of MKULTRA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1952 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:

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CERTIFICATION

(3) It is hereby certified that the program under subproject 39 has been satisfactorily completed. It is requested, therefore, that \$5,000.00 on Invoice #1 of subproject 84 be credited to subproject 39. This credit represents the return of unused funds of subproject 39 originally charged to Allotment 6-2502-10-001, MOR_______

Chief, TSS/Chemical Division

Date:

Research Director

Date:

From Precious Fixal Subject The following funds have been returned to funding indicated projects in previous years B-(a) 5,000.00 C-(b) Comay have additional claims to make against the class above assisted before the termination of the project; Therefore I would recommend witholding delaying making the fiscal adjustment until further notification 3. Recommend ctlook adjustment (a) above be meade the proposed of the #25000.00 on the editorial project. #83) project.

18 April 1958

REMORARDIN PORT THE COOPEROLLER

attention .

: Pineace Division

SURJECT

: MANATRA, Subproject 64

Under the authority granted in the MESKARLUM dated

13 April 1953 from the RCI to the DD/A, and the extension

of this authority is subsequent memorands, Subproject 84 has
been approved, and \$25,000.00 of the over-all Project MULTIA

funds have been oblighted to cover the subproject's expenses
and should be charged to Allotsent 8-2502-10-001.

Chief Tes/Chealcal Division

APPROVED FOR COLLICATION OF FURES!

Research Director

Date:

Distribution

Orig & 2 - Addressee

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1 - TSS/FASB

1 - 188/8RB

2 - TSS/CD

TSS/CD: (18 Apr 1958)

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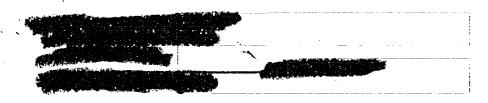
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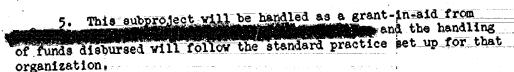
MEMORANDUM FOR THE RECORD

SUBJECT: Project MKULTRA, Subproject 84

1. The purpose of this Subproject is the partial support of the activities of Dr. Of the induction of high motivation in individuals by means of the development of specific interpersonal relationships. The attached proposal indicates the general areas of coverage and the techniques that will be exploited. Dr. Opposed will require two years to complete and will cost a total of \$34,000.00 for that period. He has requested that the grant of \$25,000.00 to supplement funds which are available to him from other sources.

- 2. The Board of Directors of has considered this proposal and recommends that it be accepted on its merits and upon the demonstrated capability of its chief investigator.
- Agency interest in work along the lines which will be pursued 3. Agency interest in work along values. First of all, even centers around three salient points. First of all, even though the study is oriented in a very extensive and little understood field, i.e. individual motivation, the work itself will be divided into segments of a practical and realistic size, both from the standpoint of the research itself and that of later practical application of the results in Agency-type situations. Secondly, the development of techniques for altering or generating high motivation in individuals is the logical extension of the program of development of techniques for individual assessment now being carried out by the Agency. The ability to assess an agent adequately will only become a powerful operational tool when it is accompanied by the ability to use such knowledge in conjunction with techniques for the production of high motivation toward Agency goals. Finally, in carrying out this work, it appears that Dr. will probably establish in fair measure the limits of usefulness of hypnosis, since it is one of the motivating techniques which will be investigated. It would serve a useful purpose to the Agency to have this information developed on a sound scientific basis.
 - 4. The cost of this project for a period of two years beginning
 1 May 1958 will not exceet \$25,000.00. Charges should be made against
 Allotment 8-2502-10-001.





6. This project will be handled in a Government Sterile fashion and none of the personnel at will be witting of true sponsorship or purpose of the investigation.

Chief
TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

Research Director

April 28-19581

Distribution: Crig. only



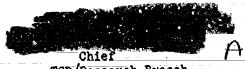
7 November 1960

MEMORANDUM FOR: THE RECORD

SUBJECT : MKULTRA Subproject 85

1. The purpose of this memorandum is to correct an error made in the original memorandum for the record of this Subproject by amending it to delete the requirement expressed therein for an accounting for the funds granted to Dr. eyond his receipt for those funds.

2. The transaction with Dr involved his agreement to produce a technical monograph on a specific subject for the sum of \$1,000.00 and as such represents an agreed upon price for a specified product rather than an accumulation of expenses for which an accounting could be made.



TSD/Research Brench

CONCI	JRRED:	<u> </u>			
Rese	Arch Director	. /	A	* ****	
(.	Procedy !	<u> </u>			
(Date				
		•			

Orig only



1 July 1958



Gentlemen:

We are pleased to be able to transmit to you the following funds:

Check 159085 drawn on the for \$1,000.00

Check 159088 drawn on the for \$40.00.

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosures: (2)_

18 June 1958

Support the research

14, 19:00

human blood groups.

Satisfactory

18 June 1959

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10 June 1958

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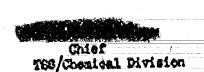
| Finance Division

SUBJECT

: MOJITA, Subproject 85

Under the authority granted in the memorandum dated

13 April 1953 from the DUI to the DD/A, and the extension of
this authority in subsequent memorands, Subproject 85 has been
approved and \$1,000.00 of the over-all HSULTRA project funds
has been obligated to cover the subproject's expenses. This
obligation of funds should be charged to Allotment 9-2502-10-001.



approved for celloation of fund	Si
Original signed by	Legal of was the AVALANTE
Research Director	100 of 10 billion to go and the policy of
Date: 13 JUN 1958	AUTRORIEM & OFFICER
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19 June 1958

				•	
	MENORANDUM	YOR: CHIEF, YINANCE DIVI	SION	•	
	YEA	1 TES/Budget Officer		•	
	SUBJECT	Allotment 9-2502-10	85, Invoice No. 1,		
	1. attached.	Invoice No. 1 covering t	he above subproject	1.0	
		Cashier a sheek in the	amount of \$1,000.00		
:	4	Cashier's check in the	amount of \$40.00,	ElB	
•	Division, 27 June 19	Please forward the check through TSS/Budget Office: 58.	to Chief, TSS/Che r, no later than Fri	mical day,	
	authorised	This involce represents under Subproject 85. Ros additional funds vill be	vaver. Since lt le c	MIRIGIA -	
	the stime	should not be closed.		P	
GHEE	K#122001N IVED271258	THE AMOUNT OF \$222	Chief		
Millianne Millian al Marciganya	Attachmen		TSS/Chemical Divi	ision	· ss 1/2 2
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Ar	888 0	02680 (400.1 2502	-10-001 17.2	7,04	1040.00
Cr	Carl		# 5	<i>)</i>	10,000



INVOICE

For services

\$1,040.00



CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. 1 applying to Subproject 85 of MULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TES/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Dates

(2) It is hereby certified that this invoice applies to Subproject #85 of MULITRA which was duly approved, and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:



DRAFT 10 June 1958

MEMORANDUM FOR: THE RECORD

SUBJECT

:_ MKULTRA Subproject 85

of Dr. Some of Subproject 85 is to support the research of Dr. Some of the leading investigators C on blood groups in man from both the immunological and genetic standpoints.

- 2. The scope of Dr study will include a literature survey on blood groupings from the forensic standpoint. He will also include in his survey the latest information available on the minor groupings. The attached proposal gives in detail the nature of the work to be done.
- 3. The total cost of the project for one year is estimated to be \$1,000.00. To this sum must be added \$40.00 representing a four percent service charge to the making the \$\begin{align*} \text{making the } \begin{align*} \text{making the } \begin{align*} \text{making the } \begin{align*} \text{total amount \$1,040.00.} The cover title of the project is \$\begin{align*} \text{cover for this grant.} The cover title of the project is \$\begin{align*} \text{cover total and is presumably being supported by a research grant from the } \text{Foundation.} Charges should be made against Allotment 9-2502-10-001. The project commences 1 July 1958.
- 4. The Foundation has requested Dr. to submit a (summary) C accounting of monies received and to return any unexpended grant funds

at the	end of the project year.	٠,
	5. It was mutually agreed that documentation and accounting	+ · ·.
for tra	avel expenses which are reimbursable by the University shall	
confor	m with the accepted practices of that institution.	
	6. The requirement for a six months' informal accounting	
on the	part of the principal investigator is waived.	
-	7. Dr. de cleared through TOP SECRET and is aware	
of the	true purpose of the program.	
		•
	1855/Chemical 1974	
	APPROVED:	
	Chief	
	TSS/Chemical Division	

		ATION OF E		A	
Researc	h Director				
Date:	Jane 1	5-1613	*		
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BLOOD GROUPINGS

PURPOSE:

Establishing and substantiating "true identity" of individuals, either agent or staff, through the medium of blood groupings.

The fact of belonging to a definite blood group is a fixed character of every human being and can be altered neither by the lapse of time, blood transfusions, nor intercurrent disease. By determining the presence of factors in the blood, the degree of accuracy in identification is greatly increased. Furthermore, by increasing the number of factors to be determined also increases by logarithmic progression the chances of definite exclusion. Mendelian Law of inheritance and derivation of offspring also holds true for all the specific blood groupings.

Today, because of rapid changes and reassignments of our overseas case officers, coupled with the long continuing operations of agent nets within denied areas for varying periods of time beyond our control and sight, the paramount question upon the exfiltration of the agent (3) is: Is this agent the same one we sent in?

It is hoped that this type of identification can be accomplished through the medium of blood groupings previously filed for such reference. If nothing more, positive exclusion can be made, if not positive identification. What could be a better method for detecting a penetration? Since Mendelian Law of inheritance and derivation of offspring holds true, the screening and identification of displaced persons, immigrants, line crossers, or any questioned individual claiming familial relationships and direct linage can be greatly enhanced and expedited.

IMPLEMENTATION:

In order to implement this highly specialized technique, a definite program of research is indicated that will encompass the following:

- A. A feasibility study to determine the worthiness and effectiveness of such a technique. This can be easily effected by a cover study on "the determination of paternity vs non-paternity through blood examinations".
 - 1. Introduction
 - 2. Historical aspects
 - 3. Identification of blood

THE	HUMAN	BLOOD	GROUPS
-----	-------	-------	--------

System Antigens	Possible	Antigens which Possible have caused		Frequency	Prequency of transfusions incompatible				
	genotypes n(n+1)	Hemolytic transfusion reactions	Erythro- blastosis fetalis	Frequency erythroblastosis per 1000 births	for these antigens if matched for A, B, D	the format of the second of th		and the second s	
ABO(H) Rh-He	A1; A2; B; Q C; C*; C'; 0	10 78* or more	A; B C; C*; e	A; B C; C"; c	0.3-1.2 G.1				
миз	D; D'; d; E; e (F); !	10†	D E; e f	D E M	0.0 0.1 2 cases	0.37			
	S; s		S	S; s (cf. 139)	1 case each	0.35			
Eell- Cullano	K k	3	K; k	K	0.1 1 case	0.09			
Duffy Kidd	Fyb	3	Fy*	None Fyh Jk*	1 case Very few	0.38	·		
Lewis	Jk ^b Le ^a ; Le ^b ; (Le ^c)	3 or more	Let	None		0.37			
Leiberan PQ	Lu ^a (Lu ^b) P; Q; Q; (p); (q)	3 ===	None None	None None					·

HIGH OR LOW INCIDENCE BLOOD GROUP FACTORS

•					Incidence of — factor in population tested	Source of antigenic stimulus
Jay (144, 143a, 144a, b)	Tja (Tjb)	3	None	3 indiv- uals. Re-	5000/5000	Pregnancy?
			·	peat- ed mis		
:				ages. 8 cases of ac-		
Miltenberger (143)	Mis (Mis)	3		Tiat I case I case	0/320 0/448	Pregnancy Transfusions
Berrens (147)	Be ^a				· ·	of hus- band's blood;
Lavsy (128a)		3	-	None to		pregnancy Transfusion
Graydon (140) Jobbins (141) Beoker (148)	Gr	3	None None None	None 1 case 1 case	0/191 0/120 0/272	Unknown Pregnancy Pregnancy

THE HUMAN BLOOD GROUP FACTORS

TABLE 3-Continued

					Incidence of factor in population tested	Source of antigenic stipulus
Wright (150)	Wr.	3	None 2 cases	1 cass	1/1277 99.96%	Pregnancy i
Vel (149, 149a)		3	None	1 case	9/170	Pregnancy Pregnancy
Diego (151) U (152, 153, 158)		3	1 case	- 442	1100/1100 cauca- soids; 977/989	Unknown
Verweyst (154) Batty (158a) Chr* (158b) Cavaliere (158c) V (158d)	V _w (Same as Mi*) § By Chr* Ca	3	None None None	Pone Pone Pone	negroida 0/740 0/500 2/500 0/48 D= 105/371 Negross 2/851 Whites	Pregnancy Tregnancy Unknown Pregnancy? Related to Rh-Ht system Pregnancy
Romunde (154)	Ros	3	Liore	Noce	10/100	
Based on C, C bla genotypes become Excluding He Some of antise Anti-Walloun	not actually identiff, c; D, d; and E, e gives 300. E*, E*, and not and hurahew (He) and hurahemolyse as well d widely distributed reonal Communications	ving twelv C" bave : nter (Hu) sa agglutin very freq		. ,	·	number of possi-

Branch II

ISOIMMUNIZATION AND THE DISCOVERY OF BLOOD GROUP SYSTEMS 17

TABLE 3 THE HUMAN BLOOD GROUPS

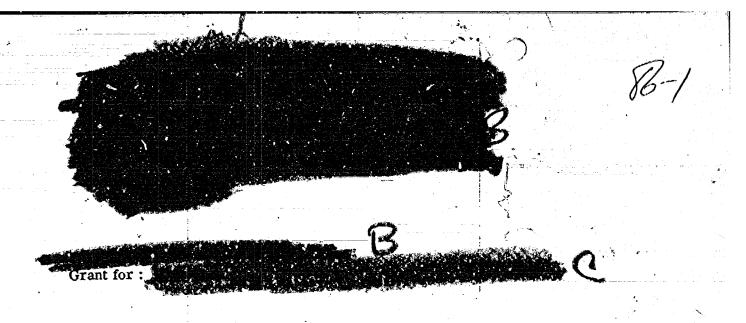
		Possible	Antigen: bave co	which_ used	Frequency	Frequency of transfusions incompatible	
System Antigens	Antigens	genotypes s(s+1) 2	Hemolytic transfusion reactions	Erythro- blastosis fetalis	Frequency erythroblastosis per 1000 births	ntigens if antigens if matched for A, B, D	
ABO(H) Rh-He	At; As; B; O C; C*; C*; e	10	A; B C; C*; e	A; B C; C"; o	0.3-1.8		
mns	D; D"; d; E; e (F); f M; N	10†	D E; e f	D E	6.0 0.1 2 cases	0.37	
	S; a ———————————————————————————————————		S	S; s (cf. 139)	1 case each	0.35	
Kell- Cellano Dufy	k Fy*	3	K; k	K k None Fyb	0.1 1 case	0.09	en e
Kidd	Fyb. Jk ^b Jk ^b Le ^a ; Le ^b ; (Le ^a)	3	Jk*	Jk" None	Very few	0.38 0.37	·
Letherin PQ	Lu ^a (Lu ^b) P; Q; Q; (p); (q)	more 3	None None	None None			

HIGH OR LOW INCIDENCE BLOOD GROUP FACTORS

:		•			Incidence of factor in population tested	Source of antigenic stimulus		
Jay (144, 143a, 148a, b)	T)* (T) ^b)		None	3 indiv- uals. Re- peat- ed	5000/5000	Pregnancy?	•	
Milton jerger (143) Berreis (147)	Bog (Wip)	17. 3		carri- ages. s cases of an- ti- Tjat 1 case 1 case	0/320 0/418	Pregnancy Transfusions of hus-	- <u> </u>	
Levay (128a)	Gr	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	None None None	None to date None I case I case	0/350 0/191 0/190 0/272			

THE HUMAN BLOOD GROUP FACTORS

, .				· · · · · · · · · · · · · · · · · · ·	Incidence of factor in population tested	Source of antigenic stimulus
Vright (150) Vol (149, 149a) Von (146)	WA	3 2	None 2 cases None	1 case 1 case	1/1277 99.96% 0/170 0/200	Pregnancy Transfusion Pregnancy Pregnancy
Diego (151) J (152, 153, 158)		3	l case	. used	1100/1100 cauca- solds; 977/989 negroids	Unknown
Verweyst (154) Batty (15%) Chr ^a (158b) Cavallere (158c) V (158d)	V _n (Same as Mi ⁿ) \$ By Chr ⁿ Ca	3 =	None None None	? 0,740 ? 0,500 None 2,500 ? 0,48 D- 105,371 Negro		Pregnancy Prognancy Unknown Pregnancy? Related to Rh-Hr system
Romunde (154)	R	- 8	None	None	2/851 Whites 0/200	Pregnancy



Financial Statement
June 30, 1958 to July 1, 1959

Funds received

43,052.00

Expenditures:

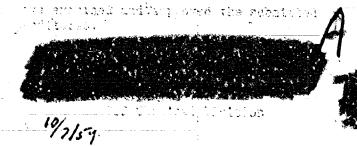
Wages & salaries	18,804.00
Equipment -	194,14
Supplies	422.52
Subjects, testing	800.00
Overhead	2,839.38
*	
Apparatus (#3 units)	19,990.00

Total expenditures:

43,110.72

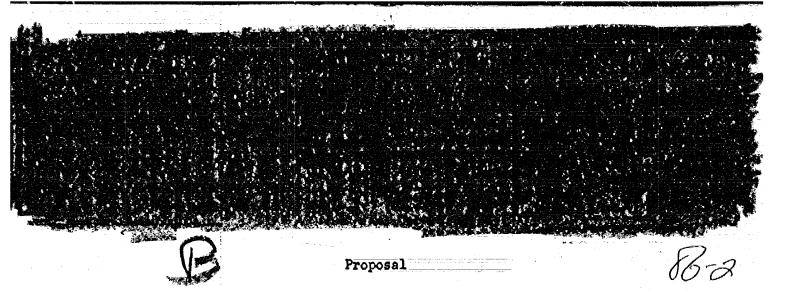
Balance July 1, 1959 (Deficit)

\$ 58.72)



Accountant

July 2, 1959



Caro

PHYSIOLOGICAL RESPONSE RECORDER

Prepared for:

August 15, 1958

Prepared by:



Scope: This proposal covers the design, development and fabrication of three direct writing three channel recorders displaying respectively:

- 1. pressure changes induced in a pneumatic cuff wrapped around the upper arm of a primate.
- 2. chest expansion movements detected by a rugged transducer strapped around the chest with a slip-proof buckle.
- 3. skin resistance changes detected by an electrode device furnished by the purchasor.

Specifications, General: The unit will be portable, weighing approximately 30 lbs., and will be housed in a handsome fibreglass unbreakable carrying case providing storage for accessories. Ball point pens will be used. Cverall dimensions of case will be approximately 9 x 14 x 15 inches. Power required will be 115 volts 60 cycles. Quality of materials and workmanship will be in accordance with best practices.

Specifications, Detail:

Chart Paper: 3 separate grids will be used on a single roll of paper.

Identifying nomenclature will appear upon each grid.

Each grid will be a minimum of 2 inches wide. 100 rolls will be supplied.

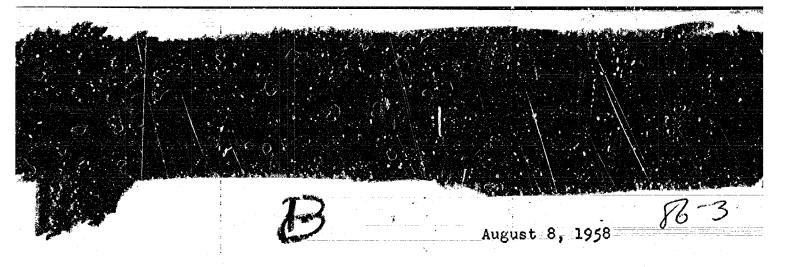
Chart Speed: Fixed, 6 inches per minute.

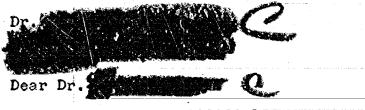
Controls: Adequate controls and calibration means will be provided in accordance with good engineering design.

Operating Instructions; Maintenance and operating instructions will be provided.

Construction: Chassis will be readily removable and accessible. Front panel will have louvered air vents and will be held in place by magnetic fasteners.

Delivery: One single channel unit, complete with case and transducers, operating in accordance with the above specifications will be delivered within 33 days from the contract award. This first model will be returned to upon delivery of the first of three recorders within 45 days from the contract award. Delivery of the remaining two recorders will be effected within 90 days.





PROPOSAL

Three (3) Biological Response Recorders with 3 pen single chart drive and a speed of 6" per minute complete with pen motors, pen and chart paper rolls.

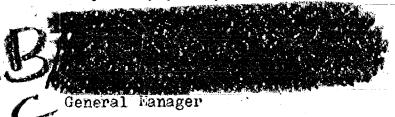
Total price....\$19,940.00

Terms:

\$7,000.00 cash with order. Balance on acceptance of delivery of the 3 complete units. Terms less 1% with payment on delivery.

Delivery: One workable single channel instrument which will demonstrate and prove the principle of these units within 45 days after receipt of order. Complete order within 45 to 90 days after receipt of order.

Very truly yours,



Enc. CC to

10 (Dr.				C			DATE	OF INQ	UI RY	Verbal 9-16-58 9-16-58	8-4
	Attn., Dr.			<u>C</u>		rou	Via			VANCETY	UNIT PRICE	EXTENSION
T TEM	CATALOG NO.	PLASTI(MOLDED	HAND 1	ELECTROD	DE ASSE	MBLX, For			3 ea.	Lot	\$ 50.00
``		only,	ith lead	is and	connect	ors						
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PRICES SUBJECT TO CHANGE 30 days after date of this bid DATE September 22, 1958

SHIPMENTS WILL BE MADE FOR Destination

SHIPPING CHARGES WILL BE COLLECT OR PREPAID. (PLEASE YOUR PREFERENCE ON YOUR ORDER.)

ORDER WILL BE SHIPPED TO

SHIPMENT WILL BE MADE At time of delivery of Recorders

AFTER RECEIPT OF YOUR ORDER.

PLEASE STATE WHETHER TAXABLE OR NONTAXABLE

THANK YOU

1 July 1958



Gentlemen:

We are pleased to be able to transmit to you the following funds:

Check drawn on for \$42,052.00

Check drawn on for \$1,682.08.

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goels of your organization.

Yours truly,

20 June 1958

Phase II Polygraph equipment

and procedure

by Dr.



Satisfactory

20 June_1959

Dr.

A

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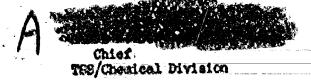
17 June 1958

PROPANIZA FOR CONTROLLS

Pinence Division

1 MOTITRA, Subproject 86 SUBJECT

Under the authority granted in the menorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 86 has been approved and \$43,734.08 of the over-all Milliam project funds bes been colligated to cover the subproject's expenses. This obligation of funds should be charged to Allotment 8-2502-10-001.



APPROVED FOR OBLIGATION OF FUNDS:



I CERTIFY THAT FUNDS ARE AVAILABLES

Research Mirector

Cater

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Distribution:

Orig & 2 - Addressee

1 - TSS/CC

V1 - TSS/FASB

1 - TSS/

MEMORARDUM FOR: CHIEF, FIRANCE DIVISION

8-9

20 June 1958

	AIV	: TBS/Budget Officer		
·	SUBJECT !	MULTRA, Subproject 86, Allotment 8-2502-10-001		
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	attached;	Payment should be made as fol	Tone:	
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		Cashier's check in the am drawn on a heart bank,	payable to	
	Division; 30 June 1	Please forward the checks to through TSS/Budget Officer, no 958.	o Chief, TSS/Chemical o later than Monday,	
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INVOICE

For services



CERTIFICATIONS

(1) It is hereby certified that this is invoice No. 1 applying to Subproject 86 of MAULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/UD, that this bill is just and correct and that payment thereof has not yet been made.

Chief. TSS/Chemical Division

Dates

(2) It is hereby certified that this invoice applies to Subpreject 86 of MEDITRA which was fully approved, and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Dates

DRAFT 17 June 1958

MEMORANDUM FOR: THE RECORD

SUBJECT

MKULTRA Subproject 86

1. The purpose of Subproject 86 is to provide funds

to the Department of Medicine, Neurology Division,

8

School of Medicin

support Phase II of the research program on polygraph equipment and procedures undertaken by TSS/CD for the Office of Security.

2. The first phase of this program involved the design of a miniature recording unit applicable to the sensing units now in use by Office of Security and which produces a record identical with that now produced by the machine.

The present phase will entail building two of the machines and subjecting them to the necessary biological and physical evaluation required to bring them to the prototype stage. At the same time, personnel of the project will continue as during Phase I to perform feasibility and background work aimed at Phase III of the program. Phase III is the final part of the program and envisions the production of an which will also incorprate more reliable estimates of the stress reaction in human beings if any such parameters can be found.



3. Dr. Associate Clinical Professor

of Medicine (Neurology) will monitor and direct and actively

participate in this project as principal investigator within

the School of Medicine,

4. The cost of this program for a period of one year is estimated at \$42,052.00. To this sum must be added \$1,682.08 representing a four percent service charge to the making the total amount \$43,734.08. The

Foundation will function as cutout and cover for this grant. The cover title of the project is

research grant from the

- 5. The total cost of the project for a period of one year will not exceed \$43,734.08. Charges should be made against Allotment 8-2502-10-001.
- 6. The has requested the University to submit a summary accounting of monies received and to return any unexpended grant funds at the end of the project year.
- 7. Title to any permanent equipment purchased by funds granted to the University shall be retained by them in lieu of higher overhead rates.
- 8. It was mutually agreed that documentation and accounting for travel expenses which are reimbursable by the University shall conform with the accepted practices of that institution.

9. The requirement for a six months' informal accounting on the part of the principal investigator is vaived.

10. Dr. is cleared through TOP SECRET and is aware of the true purposes of the program. Also, he has agreed to comply with the requirements of the Memorandum of Agreement.

Chief TSS/Chemical Division

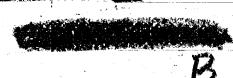
APPROVED FOR OBLIGATION OF FUNDS:

Attachment:

Distribution:
Original only

Research Proposal







25 April 1958

Gentlemen:

We are desirous of receiving support in broading certain aspects of our present activities in the screening and evaluating of new tranquilizers within the Neurophysiological Laboratories. Department of Neurology University School of Medicine,

The scope of the research program is outlined in the attached research proposal. Our laboratories have been equipped, staffed and actively engaged in neurophysiological research for a considerable period of time. As a nucleus for the present proposal, the laboratory is already equipped with an 8 channel Grass Model polygraph, 3 EEGs, and a Meditron EMG.

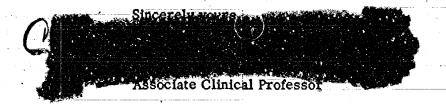
It is our proposal to conduct investigations along the following lines in order to produce a simple, rapid, and objective test for screening and evaluating new "tranquilizers".

- 1. Design, engineer and construct two (2) prototype polygraphs with their inherent advantages.
- 2. Evaluate and standardize the prototypes on random and select populations.
- 3. Compare the effacacy of the prototypes vs existing polygraphs in measuring physiological responses in man quantitatively.
- 4. Determine the degree of variation and the extent of accuracy between the _____ prototypes and our present screening techniques.

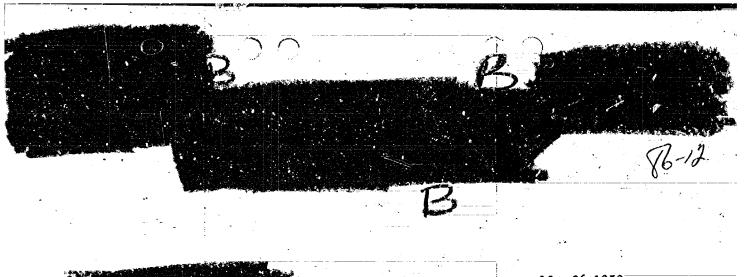
The following is the proposed yearly budget:

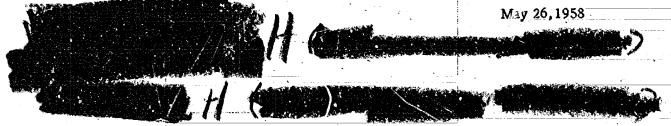
Neurophysiologist (MD) 1/2 time	<u> </u>	8,000.00
Fellow in neurophysiology (PhD) fu	ıll time	7,500.00
Technician, laboratory (1/2 time)		2,000.00
Technician, electronic (1/3 time)		1,700.00
Subjects, clinical testing		600.00
· · · · · · · · · · · · · · · · · · ·	**	
Total salaries and wages		19,800.00
University overhead 14%		2,352.00
<u>.</u>	Sub total	22,152.00
Equipment and apparatus (incl 2 pr	rototypes)	19, 200.00
Supplies and expendables	1	700.00
:		**
:	Total	42,052.00

In view of the fact that departmental requirements and budgetary allowances must be submitted by June 30, 1958 for the next academic year, an early reply by you will be greatly appreciated.









This is a request for a supplement of one thousand dollars (\$1,000) to be added to the grant assigned to

An additional supplement of the above amount would obtain three prototype polygraphs instead of two. In view of the fact that the construction of the three units total \$ 19,990.00, whereas the cost of two units is relatively the same; it is definitely to our advantage to have an additional unit made.

Your immediate attention to the above request will be extremely helpful in finalizing our terms with the manufacturer.







8 May 1957

MEMORANDUM FOR: THE RECORD

SUBJECT:

Discussion with Mr. ... of the Office of the General Counse

1. On 7 May 1957, I had a discussion with Mr.

of the General Counsel's Office about whether or not invacting as a consultant for the Agency after my resignation and receiving compensation for professional services rendered in that capacity would in any way be a violation of any of the so-called conflict-of-interests statutes. Mr. stated that he could not see how such activity on my part would be a violation of the conflict-of-interest statutes in any way.

Tss/chemical Division/Br. II

Distribution:
Orig & 2 - TSS/CD

TSS/CD (8 May 1957)



MEMORANDUM FOR: THE RECORD

SUBJECT

: Authorization To

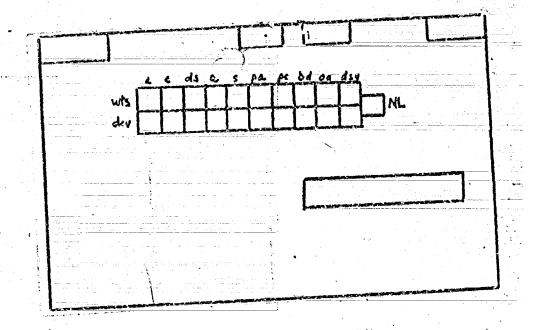


1. Reference request from 22 May 1958.

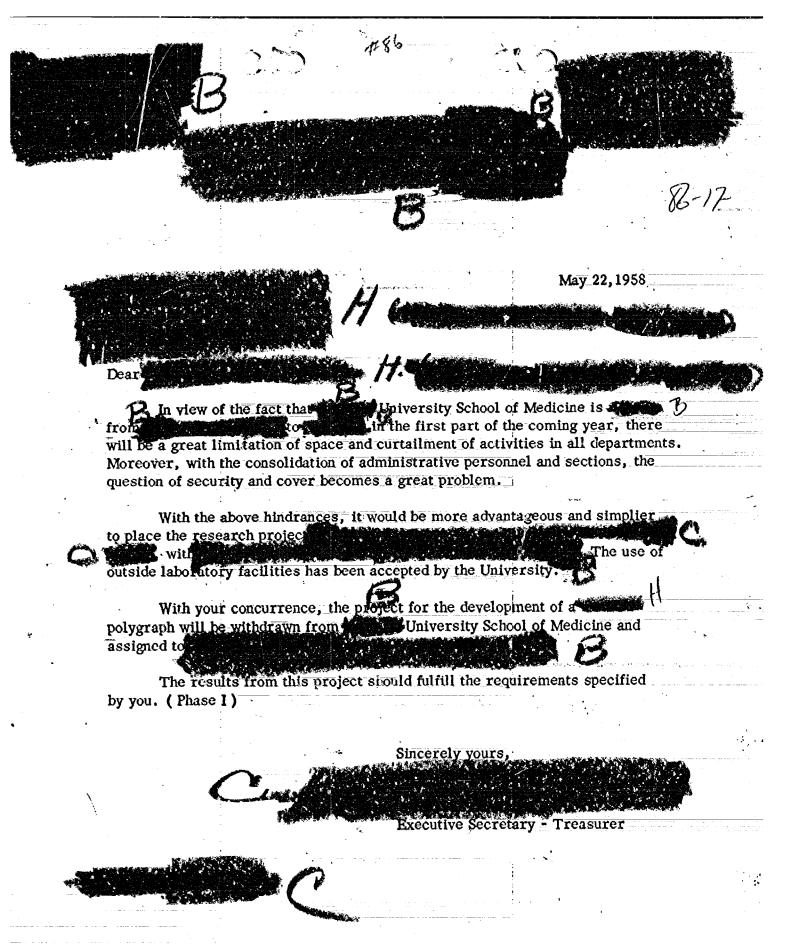


2. Authorization requested above referenced letter granted by telephone, 30 May 1958.





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86

86-18

PROPOSAL

A considerable amount of planning and designing has been expended by the undersigned on specific problems in Branch II, TSS/CD.

In order to maintain a continuity of direction and effort, it is therefore proposed that the services of the undersigned be utilized on a continuing basis in the following areas:

- A. Plan, monitor, and direct research and development of a polygraph.
- B. Design new and more refined physiological measurements for the detection of deception (e.g. infra-red irradiations, voice harmonics analysis).
- C. Consolidate all pertinent and available information for the preparation of an
- D. Monitor, direct and/or actively participate, from the standpoint of TSS/CD, in the research conducted within Subprojects No. 56 and No. 72.
- E. At the specific request of TSS/CD, Draw will evaluate the reliability and validity of proposed and completed research projects.
- F. Compile literature surveys on specific problems at the request of TSS/CD.
- G. Report on general scientific and medical meetings attended.
- H. Act as medical consultant, and whenever feasible and mutually agreeable, actively participate in TSS/CD operations and support functions.

Arrangements have been made for the appointment of the undersigned as an Assistant Clinical Professor of Medicine, Neurology Division, University School of Medicine,

E

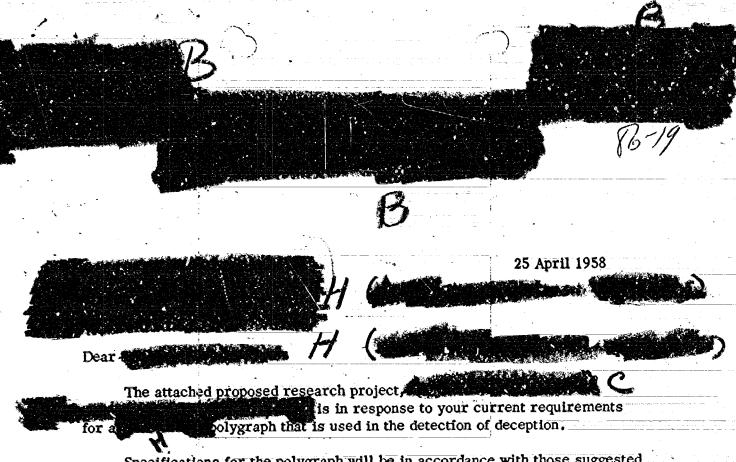


The following is an estimate of funds needed to cover the program outlined above for a period of one year:

Professional services	6,000.00
Secretarial services	2,500.00
Consultant fees	500.00
Supplies, expendable	600.00
1	

\$9,600.00





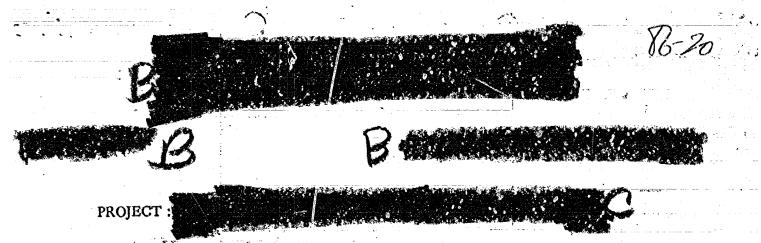
Specifications for the polygraph will be in accordance with those suggested in the attached memorandum entitled Polygraph.

Due to the necessity and standpoint of cover, the true purpose of the research proposal was submerged in academic and medical terminology and form.

I hope that this proposal will fulfill one of your many pressing requirements.

Sincerely yours,

executive Secretary - Treasurer



INTRODUCTION:

Today, anxiety and stress are recognized as a concommitant part of every day living. Simply for the sake of discussion, and well recognizing the existing dispute over the meaning of anxiety, we can consider anxiety as essentially a human function because it is associated with the capacity of delayed action, choice of action, self reflection of motivation, and the capacity for projection of the self into the future. The concept of stress revolves around the arousal of anxiety. In general, anxiety can be aroused by any condition which threatens the integrity of the organism. Therefore, any stimulus may in principle arouse an anxiety response because of the particular meaning of threat it may have acquired for the particular individual involved. However, we can distinguish a class of stimuli which is more likely to produce a disturbance in most individuals; the term "stress" can be applied to this class of conditions.

Recently, there has appeared a group of drugs known as "tranquilizers" that have established their effacacy in the treatment of anxiety and stress problems. The term "tranquilizers" is an attempt to describe the peculiar type of sedative and hypnotic effects evoked by the administration of these drugs, which differ from those produced by known substances such as barbiturates with their heavy central inhibitory activity. Characteristically, these "tranquilizers" produce hypotension with bradycardia, hypothermia, respiratory inhibition, and a reduction of activity of the sympathetic regulating centers.

Chemical syntheses have produced such an alarming abundance of these new medications that accurate clinical appraisals become a physical impossibility from the sheer force of numbers. A simple, rapid, objective test that will demonstrate in man a pharmacological effect confirmatory of animal experiments and that will evaluate the comparative effectiveness and safety of the new drug when used in place of accepted medications is certainly indicated.

PROPOSAL:

Therefore, it is our proposal to conduct investigations along the following lines in order to produce a simple, rapid, and objective test for screening and evaluating new "tranquilizers":

- 1. Design, engineer and construct two (2) prototype polygraphs with their inherent advantages.
- 2. Evaluate and standardize the prototypes on random and select populations.
- 3. Compare the efficacy of the prototypes vs existing polygraphs in measuring physiological responses in man quantitatively.
- 4. Determine the degree of variation and the extent of accuracy between the prototypes and our present screening techniques.

The above proposal is only an attempt to answer a pressing need. It must be kept in mind that there is still an existing necessity to furnish better sensitivity and reliability in quantitating physiological responses in man. Definitive steps can be taken to modify and refine the present methods of physiological measurements, e.g.

86-70

MINATURE POLYGRAPH

There exists within the Agency a continuing requirement from the Division of Security for improvements and refinements of the current instrumentation used in the detection of deception. In addition, new and better methods for measuring changes in emotional stress are sought.

Currently, the Polygraph is utilized by Security
The instrument is of such a nature that the sucessful use of it is almost negated by its inherent weaknesses and faults. Revisions and refinements of the present instrument are critically and urgently needed. The following proposal is an attempt to meet this urgent need and is based on the various criticisms and suggestions of the polygraph operators in the field. Therefore, this project is designed to answer some of the current operational problems.

PROPOSAL: It is therefore proposed to

a Polygraph by transistorizing all components and utilizing printed circuits for all wiring.

- b. Incorporate an new recording system of in place of the existing ink writers.
- c. Repackage the components into one or two units, effectively disguised as items of normal use, e.g. radios, traveling bags, etc.

The advantages to be gained by the new model are:

- a. for light weight and easy portability.
- b. Capable of withstanding use and abuse due to ruggedness and compactness.
- c. Ease of disguise and concealment
- d. No loss of evaluative procedure due to identical tracings.
- e. Minimize wearing parts
- f. Simplification of function to minimize operator errors, carelessness, and instrument failure.

- g. Minimize the failure of expendable components to offset "chain reaction" failures.
- h. Ease of field repairs through cative screws, plug-in assemblies and components, removeable panels and accessible check points.
- i. Easy assembly, adjustment, disassembly, maintenance and repair.
- i. Built in calibration with automatic standardization.
- k. Permanent operating instructions attached to the instrument.

The above proposal is only an attempt to answer a pressing need. It must be kept in mind that there is still an existing necessity to furnish better sensitivity and reliability in quantitating physiological responses in man.

Definitive steps can be taken to modify and refine the present methods of physiological measurements, e.g. utilizing a n lieu of the cumbersome pneumatic chest tube; and utilizing a n place of the sphygmograph.

Furthermore, many provacative suggestions have been raised that warrant investigation, e.g.

MEMORANDUM FOR: THE RECORD

SUBJECT:

Establishing and substantiating the "bona fides" of agent and/or staff personnel through techniques and methods other than interrogation.

1. BACKGROUND:

The life blood of intelligence is information. Collection of information is
the most characteristic activity of the entire intelligence business. Accordingly,
an intelligence organization a cannot exist until it does a broad and systematic
job of collecting. But in this very task lie methodological problems which are so
tough as to be almost insolvable and in their unsolved state are a perpetual source
of inefficency.

A certain important fraction of the knowledge which intelligence must produce is collected through highly developed secret techniques. Herein begins perhaps the major methodological problem of the collection stage of the intelligence process.

It begins with the compartmentation of the clandestine services. This compartmentation is dictated by the established necessity of secrecy. An absolute minimum of people must know "anything" about the operation, and the greatest amount of caution and dissimulation must attend its every move. But unless the clandestine services watch sharply it can become its own worst enemy. For if it allows the mechanisms of security to cut off from some of the most significant lines of guidance, it destroys its own reason for existence.

With a high wall of impenetrable secrecy, it is constantly in danger of collecting the wrong information and not collecting the right. This danger is intensified by the very way the clandestine services operate. It involves highly complicated "tradecraft" techniques, clandestine agent recruitment and handling, nets and subnets, security and reliability of communications, and so on. Isolated by the security barrier, the perfecting of these techniques sometimes threatens to become an end in itself.

To concern ourselves with a specific problem, then, how can the "bona fides" of an agent or staff individual be established? Today, because of rapid changes and reassignments of our overseas case officers and the continuing operations of agents or long periods of time, the paramount question arises upon the exfiltration of the agent(s). Is the agent "bona fide" is he the same person we started with?

Worst yet, as we know has the existing net, especially those been penetrated and a penetration agent substituted for our original agent?

Any means by which we can increase to the maximum degree the element of identification will in turn enhance the acceptibility and reliability of the information obtained.

2. IMPLEMENTATION

In order to increase the maximum degree of identification, the following techniques and methods are suggested:

A. Polygraph

On a current basis, the polygraph is used extensively in attempts to establish "bona fides." The problems of utilizing the polygraph, especially in overseas areas, are numerous. In an effort to refine and improve the present polygraphic techniques, a three phase research program is proposed.

- 1. Minaturize and repackage the existing polygraphic equipment to gain the advantages of compactness, lightness, better concealment, simplicity of operation and maintenance, and ruggedness. (see attached proposal)
- 2. Modify and refine the present methods of physiological measurements. e.g. utilizing a small strain gage in lieu of the cumbersome pneumatic tube; utilizing a optical or impedence type plethysmograph in place of the sphygmograph.
- 3. Detecting and developing new and better measurements of emotional stress, e.g. infrared, voice harmonics, myelograph

B. Ideal biographic file

A systematic and methodical compleat of data that will render maximum support in cases of questioned identity.

- 1. Dactylography or finger printing has been universally accepted and proven. However, in clandestine operations, it is at times impossible to obtain finger print specimens for future reference.
- 2. Anthropometry or Bertillon's system of identification is based on the descriptive data and exact physical measurements of the human body. However, the chief disadvantage lies in the inaccuracies of measurements produced by human error.

Ancillary to the above is the "protrait parle" a method for the scientific indexing and filing of the descriptions of certain facial characteristics of individuals.

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7 October 1959

MEMORANDUM FOR: THE RECORD

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SUBJECT : Schedule of Grant Payments MKULTRA 87

September 1959 to August 1960

 Paid
 1st two qtrs (Sept 16, 1959)
 1,850.00

 Due
 Mar 1, 1960
 925.00

 Due
 Jun 1, 1960
 925.00

TOTAL GRANT

3,700.00

Project MULLIA, Subproject 87

Date Initiated: 1 November 1958

Date Expires: 1 August 1962

Funds-current year: \$4,000.00

greater effect in programs involving studies on the General Adaptation Purpose: To purify and characterize allergen materials of extremely high potency which show promise of greater potentiality and have a Syndrome. Perform consultative services on request. Status: Chemical structure of sensitizing portion has been determined. last phase involving determination of protein portion of activating substance one half complete.



(When Filled In)

74048 on any attachments were incurred for official purposes of a confidencial nature, that payment or credit therefor has not been received, and that this accounting is true and correct. (1:13) 758.68 758.68 758.68 AMOUNT CREDIT 748245 FEB 20 67 c/rep/bb 71-80 AMOUNT MONEY ORDER 75603 certify that the expenditures 156.03 7. OUTSTANDING ADVANCES END OF PERIOD (Attach listing) 8. CASH ON HAND END OF PERIOD OR BALANCE DUE ADVANCEE . VOUCKER NO. - see attached DEBIT certiffice than SIGNATURE OF PAYEE DESCRIPTION CHECK TOTAL ACCOUNTED FOR TOTAL EXPENSES 68.70 DUE DATE FOTALS 67.70 OBJECT CLASS 2140 CABA Expense 61-66 CK: NO: REF. NO. OFFICE OF FINANCI COST - FAN ACCOUNT SYMBOL 5. EXPENSES THIS PERIOD CERTIFIED FOR PAYMENT OR CREDIT SIGNATURE OF APPROVING OFFICER 6. REFUNDED HEREWITH 53-66 DATE SIDIEX COLLIES PERIOD OF ACCOUNTING VOUCHER NUMBER OF 760.0 038 760.0 160.0 APPROVED SPACE BELOW FOR EXCLUSIVE USE 51-54 Sub-project 87 REVIEWED BY 758.68 758.68 48. 30 49 CA PAY OR PER. C LIQ. 9 L10. PER. PAY REF. NO. soos si usaan 18000 EMP. NO. 42.47 8 MULTRA SUBMITTED BY DATE COOM MXEMZO 756.03 2.65 Adj Bal 758.65 FROM E ... 2 Stroits 25/110/85 STATION 35770185 32.33 PROJECT DESCRIPTION 34.39 SIGNATURE OF AUTHORIZING OFFICER 2. OUTSTANDING ADVANCES BEGINNING OF PERIOD SHIP.DOC. NO. TOTAL TO ACCOUNT FOR CERTIFY FUNDS ARE AVAILABLE DESCRIPTION-ALL OTHER ACCOUNTS 19-33 ACCOUNTING BY INDIVIDUAL 4125-1390-3902 760.0 Bal CHARGE FAN ACCOUNT NO. Follow Instructions on Roverse . CASH ON HAND BEGINNING OF PERIOD 101 XON 10 101 TAN 8 MOR 1:07 FOR ADVANCE INV 4 MOR 99 DESCRIPTION -PREPARED BY 3. RECEIPTS THIS PERIOD DATE OBLIG.REF. NO. NOTE: 0. DATE

INSTRUCTIONS

Line or Section

- Enter on line 1 the amount of cash on hand at the beginning of the period.
- Enter on line 2 the amount of outstanding advances made to third parties, brought forward from the previous accounting period. ò
- Enter in this section the amount of each receipt during the accounting period showing pertinent data, i.e., method or source of acquisition and applicable rate of exchange, if indigenous If more space is required to explain receipts, prepare receipt form, number and attach hereto. In every case, completely identify the source of receipts.
- Enter on this line the amount to be accounted for which shall be the sum of amounts shown in 1, 2, and 3.
- the lack of a receipt. Each amount listed in this section shall be supported by a voucher consisting of either the If the number of entries exceeds the available space they may be consolidated as one entry in section 5 and supported by a listing of the individual entries on a separate sheet. receipt obtained from the payee or in lieu thereof a certification explaining
- Enter on this line the amount of any refunds of advances by the advancee indicating whether by cash, check, or money order. 9
- advances to be accounted for. When accountings for advances are obtained, list as expenses Advances made to third parties which remain outstanding at the end of the accounting period shall be consolidated and the total entered as a single amount on this line supported by a Final credit will not be given for disbursements which are or refunds of cash, as appropriate. listing on a separate sheet.
- Enter on this line the amount of cash on hand, or if the amount of the disbursements exceeds the amount advanced the balance due the advancee shall be shown in parenthesis, i.e. treated as a minus amount in arriving at the "Total Accounted For", line 9
- Reflect on this line the "Total Accounted For" which must agree with the amount shown on line 4, "Total To Account For" 6

CERTIFICATION

This is to certify that I have received an accounting from MKWLTRA Sub-project 87, for the period 31 August 1964 to 30 June 1966. This accounting reflects expenditures in the amount of \$758.68. The accounting is being retained in the TED/BEF office.

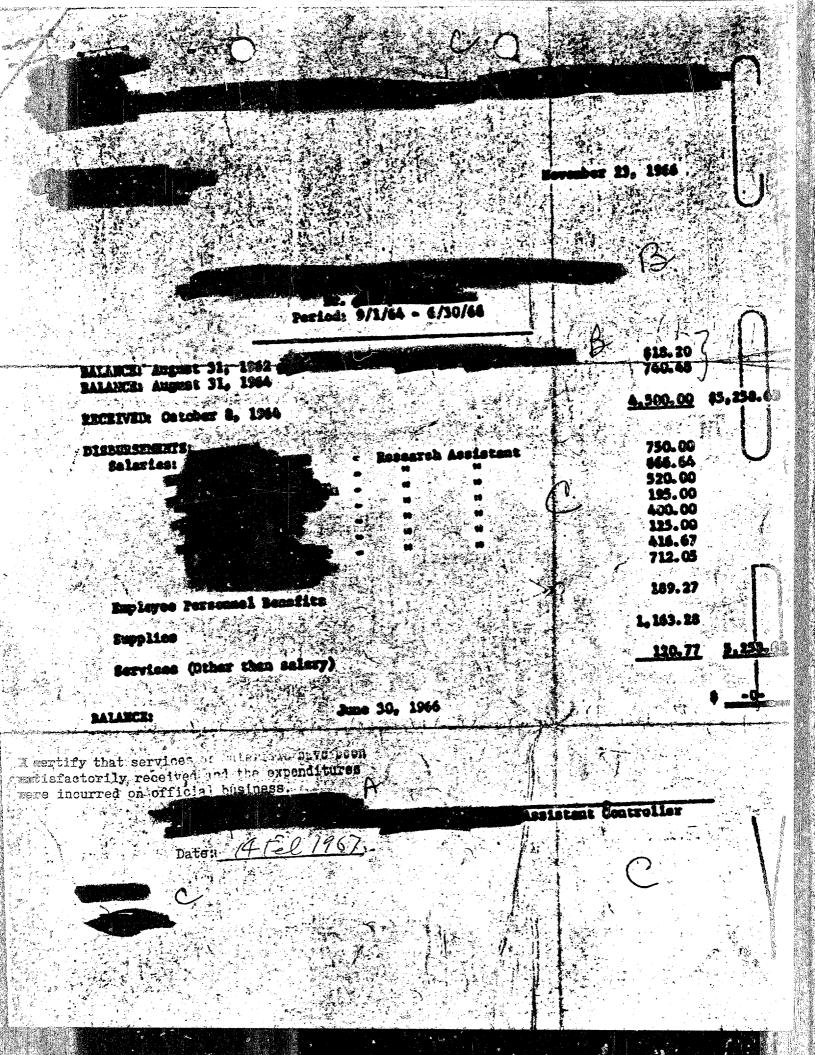
I further certify that satisfactory services represented by the accounting have been received and that to the best of my knowledge the funds advanced were expended for the purpose for which advanced.

C/TSD/BB

SIDNEY GOTTLIKE C/TSD



January 13, 1967 Dear Miss We have your letter of Jenuary 11th referring to Dr. We are enclosing a copy of our report of November 23, 1966, howed, all funds expended. which showed all funds expended. We had prepared a tentative report dated October 5. 1966 for Dr. We had prepared a tentative report dated October 5. 1966 for Dr. We had prepared which showed a balance of \$21.59. This required Dr. Correction, and the corrected report was prepared November 23; 1966. apparently a copy of the tentative report, of which we still have the original, was sent to you with our letter of December 21, 1966. Sincerely yours, ssistant Controller Enclosure



7 87-7

March 1, 1966





This is to notify you that your request for an extension of time until June 30, 1966, has been granted. This extension will be carried on kille unexpended balance of \$123.69, as stated in your letter of January 10, 1966.

The Assistant Comptroller's office has been notified of this extension.

Thank you very much.

Yours very truly,

Director

M.D.

/⁰/

0 5 87-8

B

November 25, 1964

Ble

Dr. Period: 9/1/63 - 8/31/64 FY1964

BALANCE:

August 31, 1963 December 31, 1983 March 24, 1964

\$ 542.06 1,125.00 3,375.00 \$ 5,042.06

DISBURSEMENTS:

Salaries Supplies Equipment Services 3,345.00 817.94 110.64 28.00

15

4,301.58

BALANCE:

August 31, 1964

\$ <u>740.48</u>







I certify that services of property live been satisfactorily received and the expenditures were incurred on official hasiness.

Date: 20 apr 1965

A. V

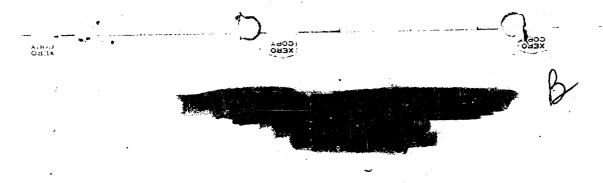
#87 fiscal

April 22, 1966

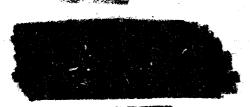


Sincerely yours:

Enclosure



March 10, 1966

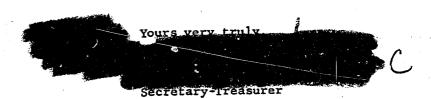


Dear Mr.

In answer to your letter of recent date, this will authorize you to add the \$18.20 unexpended balance on Dr. grant to the unexpended balance of Dr. s present grant (\$123.69), making a total of \$141.89.

Please advise Dr. of this action. When the funds have been expended, we shall appreciate very much receiving the final accounting.

Thank you very much.





87-11

5

6 January 1966

MEMORANDUM FOR : Chief, TSD/BB

SUBJECT : Delinquent Accounting MKULTRA-87

1. The records of TSD/B&F indicate that a final accounting is now past due from MKULTRA-87. The last accounting received from MKULTRA-87 was for the period 9/1/63-8/31/64. It is requested that your office obtain the past due accounting and forward same to TSD/B&F for processing.

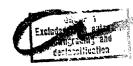
2. In reviewing the MKULTRA-87 file of past accountings we find a difference of \$18.20. Subject reports a balance of \$740.48 as of 8/31/64 whereas the correct balance should be \$758.68. The accounting for the period ending 8/31/62 reflects a balance of \$18.20 which was not carried forward to the next grant year. This oversight should be brought to the attention of the grantse.

Chief, TSD/SS

Distribution:

Original & 1 - Addressee





87-12



13 Jensery 1965

MENURAMIUM FOR : Chief, Covert Claims Branch

SUBJECT : MILLIPA Subproject 87

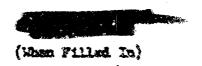
Attached is a certification from Chief, Riological Branch, for NECETIA Subproject 87 Invoice 5 and should be recorded in account 760.

Chief, TSD/SS

Distribution: Original & 1 - Addresses







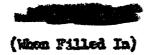
CERCIFICATION

I have received an accounting from Sub-Project 87.

For Invoice 5, in the account of \$3,957.94 accounting is being retained in the office of TSD share it may be reviewed by the Certifying Officer upon request.

I further cartify that satisfactory service represented by the accounting have been received and that to the best of my knowledge the funds advanced for such services were expended for the purpose for which advanced.

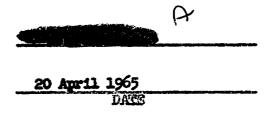
13 January 1965



CERTIFICATION

	I bave	received	i an acc	cunting:	fræ Svi	-Projec Ske.06	t <u>87</u>	
for	Invoice	5	, in th	e emount	œ <u> </u>	759.52		T2:8
acc	punting:	is being	retaine	d in the	office	of TSD	where it	usy
be 2	raviered	by the (: Certifyi	ez Offic	er wor	request	0	

I further certify that satisfactory service represented by the accounting have been received and that to the best of my knowledge the funds advanced for such services were expended for the purpose for which advanced.





October 12, 1964 November 30, 1962 \$ 4,500.00 RECEIVED: DISBURSEMENTS: 3,400.05 Selery General Expenses 206 € 64 Equipment RALASCE: August 31, 1963 Assistant Comptroller P 13.2175

I certify that services or received an attended have been satisfactorily received on the expenditures were incurred on official instructions.

Dates

18 Jan 1965

INV 5

. 874

(When Filled In)

No. 143

Cost Account .

4125-1390-3902

Object Class

Date	Remarks and References		Obligations Incurred	Obligations Liquidated	Unliquidated Balance
4 SEP 1982	Sub 87	•	4,680.00		4,680.00
101963	/NY. #6			4,680.00	
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(When Filled In)

When Filled In)

SHS

(38-48) on 4 Sept. 1963. I acknowledge receipt of funds in the amount stated here-under to be used for the purpose stated and accounted for CREDIT to the reporting point stated and by the due date checked below. In the event ofmy failure to so account and refund any unexpended balance, I authorize deduction from my salary to effect settlement. I agree that I will fully account for this advance by submission of vouchers and refund of any unexpended balance in accordance with attachment A of EKULTRA Fiscal Annex. 71.80 AMOUNT RECEIPT FOR FUNDS ADVANCED MUCHER NO. (Finance use only) Pls forward checks (2) to TSD/BB thru TSD/Budget Office no later than 16 December 1963. U.S. GOVERNMENT PRINTING OFFICE: 1962 0-649743 AMOUNT DEBIT DUE DATE ON ARRIVAL AT DESTINATION ON OR ABOUT OSI/S MONTHLY - ON THE LAST WORKDAY OF EACH MONTH SIGNATURE OF ADVANCEE OBJECT 68-70 DUE DATE CLASS TOTALS VOUCHER NO. 7-12 Advance to MKULTRA Subproject # 87, invoice # 6 for activity approved by as shown above. X REF. 20. COST DC/TSDATE \$4,500.00 TELEPHONE EXT. ACC T. NO SPACE BELOW FOR EXCLUSIVE USE OF FINANCE DIVISION 58-67 ALLOT. OR 2802 SIGNATURE OF APPROVING OFFICER AUTHORIZED CERTIFYING OFFICER CERTIFIED FOR PAYMENT OR CREDIT 43 SIDNET COTTLIEB, 5 December 1963 GENERAL ACCT. NO LEDGER 54-87 REPORTING POINT FINANCE DIVISION . HEADQUARTERS Λ ¥ 93 See attached payment inst. B-10 APVANCE ABVANCE EMP. NO. PER. CODE 45.48 ρΑΥ REVIEWED BY Accounting for this advance will be et ruzo e FY 40-42 EXPEND DATE DATE CODE MKULTRA # 87 34-39 STATION UNACCOUNT ED BALANCE PROP. NO. PROJECT NO. 4125-1390-3902 CODE CHARGE ALLOTMENT NO. NAME OF ADVANCEE STATUS OF OUTSTANDING ADVANCES CERTIFY FUNDS ARE AVAILABLE - - -PAYABLE TO DESCRIPTION-ALL OTHER ACCOUNTS 13-33 REQUESTING OFFICER USE PREVIOUS EDITIONS. AMOUNT SIGNATURE SIGNATURE REQUEST FOR ADVANCE DESCRIPTION-ADVANCE ACCOUNTS 13-27 OBLIGATION REFERENCE NO. 12/5/63 PREPARED BY DATE FORM 281 PURPOSE DATE

(When Filled In)

on 4 Sept. 1963. I acknowledge receipt of funds in the amount stated hereunder to be used for the purpose stated and accounted for CREDIT I agree that I will fully account for this advance by submission of youchers and refund of any unexpended balance to the reporting point stated and by the due date checked bolow. In the eventofmy failure to so account and refund any unexpended balance, I authorize deduction from my salary to effect settlement. Advance to MEULTRA Subproject # 87, involce # 6 for activity approved by C/TSD on 4 Sept. 19 Accounting for this advance vill be in accordance with attachment A_6 of MEULTRA Fiscal Annex. RECEIPT FOR FUNDS ADVANCED AMOUNT Pls forward checks (2) to TSD/BB thru 18D/Budget Office no later than 16 December 1963. AMOUNT SC. . OG FERUCHER NO. (Finance use only) 6835 O. S. GOVERNMENT PRINTING OFFICE: 1962 0-649743 AMOUNT 11630 DUE DATE رئ ON ARRIVAL AT DESTINATION ON OR ABOUT ナ MONTHLY - ON THE LAST WORKDAY OF EACH MONTH SIGNATURE OF ADVANCEE DATE 62-67 ck: No. | OBJECT CLASS VOUCHER NO. 7-12 as shown above. X REF. NO. 58.67 ALLOT. OR COST SIDNEY COTTLIEB. DC/TEDATE \$4,500.00 TELEPHONE EXT. ACCT. NO. SPACE BELOW FOR EXCLUSIVE USE OF FINANCE DIVISION SIGNATURE OF APPROVING OFFICER AUTHORIZED CERTIFYING OFFICER CERT IF IED FOR PAYMENT OR CREDIT 5 December 1963 GENERAL LEDGER 54- 87 REPORTING POINT FINANCE DIVISION . HEADQUARTERS APPROVED 5 % ACCT. NO. See attached payment inst. B-10 EMP. NO. PAY PER. C00 E. REVIEWED BY DATE DATE 40.42 EXPEND CODE KKULTRA # 87 34-39 STATION UNACCOUNT ED BALANCE PROJECT NO. PROP. NO. CODE £125-1390-3902 OBLIGATION REFERENCE NO. CHARGE ALLOTMENT NO. NAME OF ADVANCEE STATUS OF OUTSTANDING ADVANCES 32.33 CERT IFY FUNDS ARE AVAILABLE PAYABLE TO DESCRIPTION-ALL OTHER ACCOUNTS 13-33 20-33 T/A NO REQUEST ING OFFICER AMOUNT SIGNATURE SIGNATURE REQUEST FOR ADVANCE ADVANCE ACCOUNTS 13-27 DESCRIPTION-12/5/63 ARED BY DATE PURPOSE DATE DATE

(T)revised

Date 5 September 1963

	(formerly	IIa)
Investigation of Hype Project Title Allergic Substances		N.A.
Project CryptoMKULTRA	Crypto Classification	N.A.
Branch Project No	Project Engineer	
contractor Dr.		<u>e</u>
Contract No. MKULTRA 87	Task No	N.A.
ype of Contract D&E	Date Initiated	August 1962
ost\$4,680.00	Completion Date	Continuing
Purpose: To support the work of to provide TSD/BB with	Dr. on a	allergenci materials a es of these materials

Status: Current and satisfactory

Requirement: Internally generated in support of the requirement to maintain an offensive chemical toxicants capability.





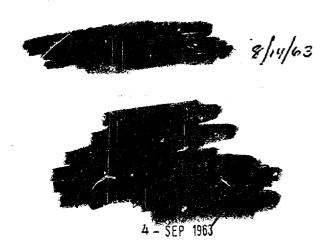
14 August 1963

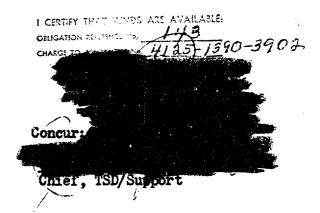
\$4,680.00

4125-1390-3902



Ch. Sci. TSD/D&E



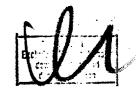


13 August 1963

	(bed)	
Branch BB Category New Ma	aterials, New Concepts Surveillance XE,	ř
Investigation of Hyper- Project Title Allergic Substances	Item Classification N.A.	•
Project Crypto MKULTRA	Crypto Classification N.A.	ing of the
Branch Project No. N.A.	Project Engineer	
Contractor Dr	C	
Contract No. MKULTRA 87	Task No. N.A.	
Type of Contract D&E	Date Initiated August 1962	
Cost \$4,680.00	Completion Date Continuing	
	C	
Purpose: To support the work of Dr 4 TSD/BB with small quantities	on allergenic materials and to provies of these materials.	.de
	1 CENTRY THE ANALYSIS OF SERVICE 143 CHARGE 10 / 11 4125-1390-3902	
Comment and anti-all-at-	ACIDEMAN CONS	

Status: Current and satisfactory

REQUIREMENT SOURCE: Internally generated in support of the requirement to maintain an offensive chemical toxicants capability.





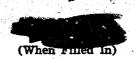
	Date_	15 February 196	3
Branch BB Category	Harassment		(IIa)
Investigation of Hyper- Project Title Allergic Substances	Item Classification	N.A.	
Project Title	•	*	
Project Crypto MKULTRA	Crypto Classification	N.A.	A
Branch Project No.	Project Engineer	C	
Contractor Dr.			
Contract No. MKULTRA 87	Task No.	N.A.	
Type of ContractR&D	Date Initiated	August 1962	
Cost\$4,680.00	Completion Date	Continuing	
	C	:	٠.
Purpose: To support the work of Dr. TSD/BB with small quantities	on allerger s of these materia	nic materials and	to provid

Status: Current and satisfactory

SOURCE: Internally generated in support of the requirement to maintain an offensive chemical toxicants capability.







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No.		· .~	 	

Cost Account 3125-1390-3902

Object Class _____

Remarks and References MKIII TRA - Sub-Project 87	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
MKIII TRA - Sub-Project 87			- Leante
	\$h,680.00		4,680.00
MKULTRA - Sub-Project 87		4,680.00	
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(When Filled In)

Date: 7 August 1962

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\$4,680.00

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LESSON TOXISTERS AND A CHARLE TO ALLOWER NO.

ALAHORIUMG OFFICER

10 AUG

BB Category BB IIa

(When Filled In)

I acknowledge receipt of funds in the amount stated here-under to be used for the purpose stated and accounted for CREDIT I seres that I will fully account for this advance by submission of youchers and refund of any unexpended balance to the reporting point stated and by the due date checked below. In the event of my failure to so account and refund any unexpended balance. I suthorize deduction from my salary to effect settlement. for funding MKULTRA Subproject 87 Invoice #5 which activity was approved by C/TSD on RECEIPT FOR FUNDS ADVANCED AMOUNT VOUCHER NO. (Finance use only) AMOUNT DEBIT DUE DATE ON ARRIVAL AT DESTINATION ON OR ABOUT 90 MONTHLY - ON THE LAST WORKDAY OF EACH MONTH SIGNATURE OF ADVANCEE OBJECT 68-70 DUE DATE CL ASS Accounting to be in accordance with the Fiscal Annex Attachment C. TOTALS VOUCHER NO. 7-12 es shown above. 62-67 ck. NO. F 66 X REF. NO. TO LUCK AMOUNT OF 58-67 ALLOT. OR COST DATE AMOUNTS 4, 500. TELEPHONE EXT. ACCT. NO. SPACE BELOW FOR EXCLUSIVE USE OF FINANCE DIVISION 2841 Sidney Cottileb, DC/rSD SIGNATURE OF APPROVING OFFICER AUTHORIZED CERTIFYING OFFICER CERTIFIED FOR PAYMENT OR CREDIT 75 9 Nov. 1962 ACCT. NO. GENERAL LEDGER 54 - 87 1000 BUILDING REPORTING POINT FINALTE DIVISION . HEADQUARTERS KECENCO 53 CA YR CITION A ADVANCE ACCT NO. EMP. NO. 47-52 0BL 16. 121 DATE L19. 45.46 PAY REVIEWED BY n D z FY 40-42 EXPEND DATE DATE CODE UNACCOUNT ED BALANCE 34-39 STATION CODE PROJECT NO. PROF. NO. 3125-1390-3902. See Artached CHARGE ALLOTMENT NO. NAME OF ADVANCE OUTSTANDING ADVANCES CERT IFY FUNDS ME AVAILABLE PAYABLE TO ---DESCRIPTION-ALL OTHER ACCOUNTS 13-33 REQUESTING OFFICER 10 August 1952. AMOUNT SIGNATURE SIGNATURE REQUEST FOR ADVANCE DESCRIPTION-ADVANCE ACCOUNTS 13-27 OBLIGATION REFERENCE NO. OF FUNDS STATUS OF Tol PARED BY DATE DATE DATE

		NAME OF AD	VANCEE	-	<u>a</u>	DATE			NAMOUND 4, 500		VOUCHER NO. (Finance use only)	(Finance	use only		
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DATE	SIGNATURE	E	T	DATE		<u>s</u>	SIGNATURE OF		APPROVING OFFICER	I acknowin 'ge under to be use as shown above.	I acknowle 'ge receipt of funds in the amount stated here- under to be used for the purpose stated and accounted for as shown above.	t of funds the purpos	in the amor re stated an	int stated d accounte	here ed for
I CERT IF	CERT IFY FUNDS	ARE AVAILABLE	3LE	1		ž	dney	Cottlie	Sidney Cottlieb, DC/TSD	DATE			AMOUNT		
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PREPARED BY		111	k.,	REVIEWED BY	ED BY					VOUCHER NO.	NO. 7-12				
DESCRIPTION	OTHER ACCOUNT	COUNTS 13-33	34.39	40.42	43 45.46	46 47-52	52 53	8	58.	58.67	98-70		71-80	80	
		28-33 T/A NO.	CODE	EXPEND	D PAY				¥ 00 €	NO.			AMOUNT	UNT	
DESCRIPTION- ADVANCE ACCOUNTS	ON-	2 2	PROP. NO.	CODE.	CODE	ACCT.	NCE 	A LEDGER		CK. NO.			DEBIT	CRE	CREDIT
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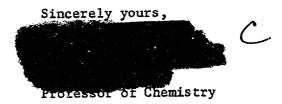


August 8, 1962



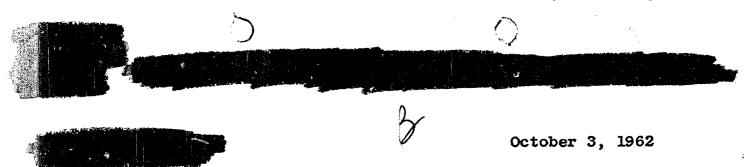
I am enclosing two copies of the final statement for the period September 1, 1960 to August 31, 1961. I understand that our Treasurer's office has already sent the others that you requested. I am sorry that these have taken so long. The difficulty was that the responsible person was away on vacation. I hope that the delay has not seriously inconvenienced you.

The Treasurer's office tells me that the 1958 and 1959 statements were mailed to but through some slip the 1960 and 1961 were not. I do not understand how such an oversight came about and I am trying to run down the difficulty now.



enclosure cc: Mr.

File 24K alter comprh



Dear Mr.

I am enclosing the financial statement for the period of September 1, 1961 to August 31, 1962 under the direction of Dr.

Sincerely yours:

Assistant comptroller

Encl.

October 1, 1962

GRANT-IN-AID

UNDER THE DIRECTION OF DR. Period: 9/1/61 - 8/31/62

\$ 10.46 RECEIPTS: Balance August 31, 1961 (1,000.00 October 19, 1961 1,000.00 January 12, 1962 1,000.00 March 13, 1962 1,000.00 June 14, 1962

\$4,010.46

EXPENDITURES:

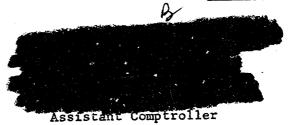
\$3,559.09 Salaries Employee Welfare 177.95 Benefits

255.22 General Expenses

3,992.26

BALANCE: August 31, 1962

18.20



P 13.2163

I have examined and approved the submitted expenditures.

TSD/Biological Branch

87-22

MKULTRA #87





August 8, 1962

GRANT-IN-AID

UNDER THE DIRECTION OF DR Period: 9/1/60 - 8/31/61



RECEIPTS:

Transferred from prior year

\$2.65

- August 5, 1960

\$1,000.00

- January 16, 1961

1,000.00

March 16, 1961

1,000.00

June 5, 1961

1,000.00

\$4,002.65

EXPENDITURES:

Salary

\$3,889.73

Social Security

102.46

3,992.19

BALANCE: August 31, 1961

\$10.46





P 13.2151

I have examined and approved the submitted expenditures ..

> Chief TSD/Biological Branch



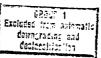
Date 23 July 1962

Branch_	88	_ Category	Harasament	· IIa)
Project		stions on Hype Substances	Item Classification	N.A.	
Project	Crypto_MKU	LTRA	Crypto Classification	Unclassified A	
Branch	Project No	N. A	Project Engineer		
Contrac	tor Dr.				
Contrac	t No_ Subproj	ect 37_	Task No	N.A.	
Type of	Contract	MKULTRA	Date Initiated	Oct. 1958	
Cost	\$4,000		Completion Date Co	ntinuing(renewal July 15	(2
Purpose	Research	and purificat	al field of allergins, in the most poten	with emphasis on the t sensitizers and	

Final report for 61-62 received & judged satisfactory.

Status:





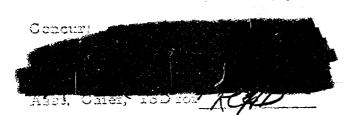
Date: 7 August 1962

MEMORANDUM FOR: C/TSD/FASS

SUBJECT

: MKULTRA, Subproject No. 87

Under the authority granted in the momowandum dated 13 April 1953, from the DCI to the ID/A, and the outension of this authority in subsequent memorands, Subproject 87 has been approved, and \$4,680.00 of the over-all Project MINULTYA funds and been oblighted to cover the subproject's expanses and should be changed to oct center 3125-1390-3902



Concur:

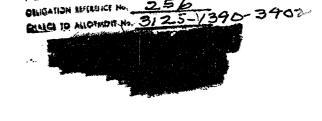


APPROVED FOR OBLIGATION OF FUNDS:



Dogs 10 1962

Distribution:
Orig & I - Addresses
2 - TSD **BB**



1 CERTIFY THAT FURIOS ARE AN ARLASILE

GROUP 1 Emolicided from automatic downgrading and declassification

Date	4	August	1962	

Branch_	BB	Category	ieressment (II	()
Project	Invest	igation of Hyper- ic Substances	Item Classification	
Project	Crypto	LITRA	Crypto Classification	
Branch	Project No		Project Engineer	
Contrac	tor_Dr			
Contrac	t No	A #87	Task No	
Type of	f Contract	RAD	Date Initiated August 1962	
Cost	A,500.00	-	Completion Date Angust 1963	
Purpos	e: To suppoprovide TSD/1	ort the work of D	r. Common on allergenic materials and to ntitles of these materials.	

Status: The University is a little behind in its accounting, but has notified us of its intention to bring the matter up to date during August. A final report, given verbally, was judged quite satisfactory by the project engineer.



24 May 1961

NEMORANDUM FOR: Comptroller

مآس

: Finance Division ATTEMPTION

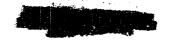
: MOULTRA, Subproject 87 SUBJECT

Additional Authorization #4

Under the authority granted in the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 87 has been approved and \$4,160.00 of the over-all MKULTRA project funds has been obligated to cover the subproject's expenses. This obligation of funds should be charged to Allotment No. 2125-1390-3902.

> chier TSD/Research Branch

APPROVED FOR OBLIGATION OF FUNDS:



Research Director

Date: 1910L

Distribution;

Original & 2 - Addressee

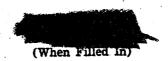
/I - TSD/FASS

2 - TSD/RB

* CERTIFY THAT FUNDS ARE AVAILABLES SHAPOR TO ALLTINENE IN. 3135-1340-3462 GRUGATION SCIENT OF No.

AUTHORIZING OFFICER





	•
No.	99

Object Class

		Incurred	Obligations Liquidated	Unliquidated Balance
17 JUL 1961	musto buth # bet 57	4 160.10		4160.62
17 JUL 1961	musto buth " Sub 57		4/60.00	
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(When Filled In)

					CONF	CONFIDENT IAL	FUNDS	POSTING VOUCHER	VOUCHER				
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	DESCRIPTION.ALL OTHER	ALL OTHER A	ACCOUNTS 13-33	34-39 STATION	24	3. 45.46	47.52 08LIG.	53 54-57	58-67 ALLOT. OR COST	COST	68 - 70 DUE	71-80 AMOUNT	80 UNT
<u> </u>	DESCR! ADVANCE ACC	DESCRIPTION- ADVANCE ACCOUNTS 13-27	Z8-33 T/A NO. 7 O NO.	CODE FROF. NO.	E EN	N PER.	ADVANCE ACT. NO.	GENERAL CA LEDGER YR ACCT. NO.		62.67 CK. NO. X REF. NO.	UAIE OBJECT CLASS	0 5 6 1 7	CREDIT
·	C., H. Ro., S.		77,			,	66	0.100	C035-0351-55 (2902	732	4.160.00	
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<u> </u>)											
<u></u>	DATE	PREPARED	a.	DATE		REVIEWED	Y8 0:			CERTIFIE	D FOR P	CERTIFIED FOR PAYMENT OR CREDIT	017
4	12014								DATE	SIGNATURE		OF CERTIFYING OFFICER	
	FORM GOK use pervious to 1	. 8001/1000	10170			*		1					(10-48)
	10.59 CCC))))))		t						:			



MEMORANDUM FOR: Chief, Finance Division

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 87, Invoice #4 Allotment 2125-1390-3902

1. Invoice No. 4 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$4,000,00 drawn on the

Cashier's check in the amount of \$160.00 drawn on

Both checks should be made payable to

2. The checks should be forwarded to Chief, TSD/Research Branch, through TSD/Budget Officer, no later than 24 July 1961.

3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

RECEIVED.

Chief TSD/Research Branch

Attachment:

Invoice & Certifications

Distribution: Orig & 2 - Addressee

_____TSD/FASS

2 - TSD/RB

TSD/RB:

WHEEK # 2064 35 THE AMOUNT OF \$ 260 REDEIVED.

I CERTIFY THAT SUNDS ARE AVAILABLE CAUGATION CHRESCH So 99 CHARGE TO ALL THE THE SISS 1540 - 3982

AUTHORIZING OFFICER

CHECK# 367 FOX THE AMOUNT OF BYONG

24 July 1961



Gentlemen:

We are pleased to be able to transmit to you the following funds:

Treasurer's check No. 267804, drawn on the dated July 21, 1961, in the amount of \$4,000.00, payable to

E

Cashier's check No. 2-064225, drawn on the distribution of \$160,00, payable to the order of the latest state of \$160,00, payable to the order of the latest state of \$160,00, payable to the order of the latest states of

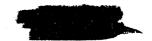
-В

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosures: (2)

Meet marked



12 July 1961

MEMORANDUM FOR: Chief. Finance Division

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 87, Invoice #4
Allotment 2125-1390-3902

1. Invoice No. 4 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$4,000.00 drawn on

Cashier's check in the amount of \$160.00 drawn on

Both checks should be made payable to

B

- 2. The checks should be forwarded to Chief, TSD/Research Branch, through TSD/Budget Officer, no later than 24 July 1961.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief TSD/Research Branch

Attachment: Invoice & Certifications

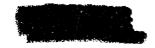
Distribution:

Orig & 2 - Addressee

1 - TSD/FASS

2 - TSD/RB

TSD/RB:





INVOICE

For Services			\$4, 160. 00	_
• •,				1 B
* * * * * * * * * * * * * * * * * * * *				
			•	-
•	CERT	IFICATIONS		
(1) It is hereby cer No. 87 of MKULTRA, accomplished in accor the payments and rece correct and that paym	that performance rdance with mutua cipts is on file	is satisfa l agreement in TSD/RB,	ctory, that services s, that a detailed a that this bill is ju	are being genda of
		Chie	f, TSD/Research Bran	ch
Date:				
(2) It is nereby cer of MKULTRA which was in accordance with thand the extension of	duly approved, a memorandum of	nd that the 13 April 19	project is being car	
			•	
			Research Director	
	•			
	•			
Data.				
Date:				

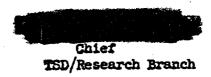
MEMORANDUM FOR: Comptroller

ATTENTION : Finance Division

SUBJECT : MKULTRA, Subproject 87

Additional Authorization #4

Under the authority granted in the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 87 has been approved and \$4,160.00 of the over-all MKULTRA project funds has been obligated to cover the subproject's expenses. This obligation of funds should be charged to Allotment No. \$\frac{1}{25}-1390-3902.



APPROVED FOR OBLICATION OF FUNDS:

******	Research	Director	_
Date	e:		
Dis	tribution	,	

Original & 2 - Addressee

1 - TSD/FASS

2 - TSD/RB



No. 107

Object Class _____

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
20 1960 1960	Mkultia het 87 such "3	4/60.00	4/60.10	4/60.00
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			12	
				-
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18 May 1960

MEMORANDUM FOR: COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject 87
Additional Authorization #3

Under the authority granted in the memorandum dated

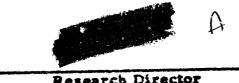
13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda, Subproject 87 has
been approved and \$4,160.00 of the over-all MKULTRA project
funds has been obligated to cover the subproject's expenses.

This obligation of funds should be charged to Allotment

SSEXMEDICATION 1525-1009-1902.

Chief
TSD/Chemical Branch

APPROVED FOR OBLIGATION OF FUNDS:



Research Director 20 MAY 1960

Date:

Distribution:

Orig & 2 - Addressee

1 - TSD/OC 1 - TSD/FASS 2 - TSD/CB





I CERTIFY THAT FUNDS ARE AVAILABLES
OBLIGATION REFERENCE No. 107
CHARGE TO ALLOTMENT No. 1375-1577-1902

AUTHORIZING OFFICER

10:

FROM

SUBJECT:

I hereby acknowledge receipt of the following:

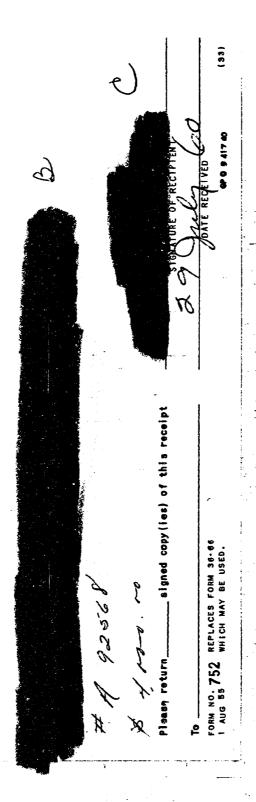
		(88)	
4	2 range recorded	DATE RECEIVED	
# 25 3303	Please return signed copy(ies) of this receipt	FORM NO. 752 REPLACES FORM 36-66 1 AUG 55 YHICH MAY BE USED.	The second difference and the company of the compan

6

FROM:

SUBJECT:

I hereby acknowledge receipt of the following:





21 July 1960

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 87, Invoice #3 Allotment 1525-1009-1902

1. Invoice #3 covering the above subproject is attached. Payment should be made as follows: A92568

Cashier's check in the amount of \$4,000.00, drawn

Cashier's check in the amount of \$160.00, drawn on a local bank.

Both checks should be made payable to

- 2. The checks should be forwarded to Chief, TSD/Research Branch, through TSD/Budget Officer, no later than 26 July 1960.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

PAID

JUL 26 1960

Chief

TSD/Research Branch

Attachments: Invoice & Certifications

ECERTIFY THAT FUNDS ARE AVAILABLES DILIGATION REFERENCE No.

AUTHORIZING OFFICER

Distribution:

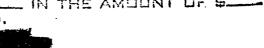
Orig & Z - Addressee

TSD/FASS 2 - TSD/RB

IN THE AMOUNT OF 54160.

TSD/RB/

IN THE AMOUNT OF \$___ CHECK#_ RECEIVED.

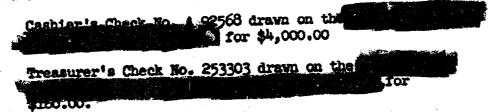


1 August 1960



Gentlemen:

We are pleased to be able to transmit to you the following funds:



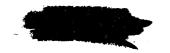
These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosurers: (2)

INVOICE

\$4,160.00 For Services CERTIFICATIONS (1) It is hereby certified that this is Invoice No. 3 applying to MKULTRA Subproject 87, that performance is satisfactory; that the services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSD/RB, that the bill is just and correct and that payment thereof has not yet been made. Chief, TSD/Research Branch Date: (2) It is hereby certified that this invoice applies to MKULTRA Subproject 87, which was duly approved, and that the project is being carried out in accordance with the memorandum dated 13 April 1953, from the DCI to the DD/A, and the extension of this authority in subsequent memoranda. Research Director Date:



2 - 87-34



21 July 1960

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 87, Invoice #3
Allotment 1525-1009-1902

1. Invoice #3 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$4,000.00, drawn on account to

Cashier's check in the amount of \$160.00, drawn on

Both checks should be made payable to

- 2. The checks should be forwarded to Chief, TSD/Research Branch, through TSD/Budget Officer, no later than 26 July 1960.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

A

Chief
TSD/Research Branch

Attachments:

Invoice & Certifications

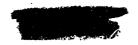
Distribution:

Orig & Z - Addressee

1 - TSD/FASS

2 - TSD/RB

TSD/RB/



18 May 1960

MEMORANDUM FOR: COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject 87 Additional Authorization #3



APPROVED FOR OBLIGATION OF FUNDS:

	Research Director
ate:	
)istri	bution:

- 1 TSD/OC
- 1 TSD/FASS
- 2 TSD/CB

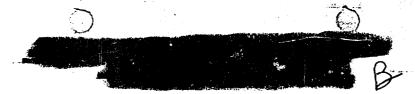
TSD/CB/





1. Does this require the stamp.

s personal billing for Removed Dr.





September 30, 1959

RESEARCH GRANT FOR A FELLOWSHIP UNDER THE DIRECTION OF DR

PERIOD: 1/1/59 - 8/31/59

RECEIPTS:

January 7, 1959 May 7, 1959

\$ 925.00 925.00

August 12, 1959

1,850.00

\$3,700.00 /

DISBURSEMENTS:

Fellowships:

Scholership

2,074.99

General Expenses

1,015.00

607.36

3,697.35

BALANCE:

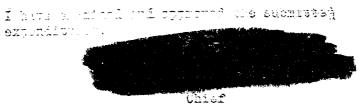
August 31, 1959

2.65*

*Transferred to continuation grant.

P 96.2244

Assistant Comptroller



TSS/Chemical Division

Dates 15 December 1959

September 25, 1959



Dear Sir:

handed me your letter of September 16th re the renewal of the fellowship grant under the direction of Doctor On behalf of the University I want to thank you and your associates for this important award.

The reason you have not yet received the annual accounting summary for the 1958-59 grant is that the term of the award does not end until December 31, 1959. However, has advised me that the full amount has been expended and Mr. so office will send you promptly the requested financial report. For reasons which I am sure you will understand our files are arranged to bring the need for such reports to our attention on the terminal dates of the grants.

has asked me to convey his appreciation for this renewal. He plans to submit a final report in mid-October on the research aspects of the 1958-59 grant.

Sincerely,



87-39

ä665

9-2502-15-902

24, JUN Set 87
6 1959 Survey *1

3848.00

3,848. N

3,845.10



4 August 1959

MEMORANIAM FOR: CHIEF, FIRANCE DIVISION

AIA

: TSS/Budget Officer

SUBJECT

: MKULTRA, Subproject 87, Invoice #2

Allotment 9-2502-75-902

1. Invoice #2 covering the above subproject is attached. Payment should be made as follows;

Cashier's check in the amount of \$3,700, drawn

Cashier's check in the amount of \$148, drawn on

Both checks should be made payable to

2. The checks should be forwarded to Chief, TSS/Chemical Division, through TSS/Budget Officer, no later than Friday, August 14, 1959.

3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project the files should not be closed.

Chief TSS/Chemical Division

Attach:

Invoice & Certifications

Distribution:

Orig & 2 - Addressee

1 - TSS/FASB

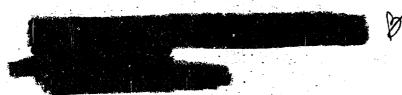
CHETTI 6 34150

I CERTIFY THAT FULL TO AND AVAILABLES. OBLIGATION THE HOLY IN BEGS

4. 2503-75-802

A

25 August 1959



Gentlemen:

We are pleased to be able to transmit to you the following funds:

Check No. G34250 drawn on for \$3,700.00.

Check No. FE 16936 drawn on for \$148.00.

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosures: (2)



4 August 1959

MEMORAHDUM FOR: CHIEF, PIRANCE DIVISION

YIA

TSS/Budget Officer

SUBJECT

: MEULIRA, Subproject 87, Invoice #2

Allotment 9-2502-75-902

1. Invoice #2 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$3,700, drawn on

Cashier's check in the amount of \$148, drawn on

Both checks should be made payable to

2. The checks should be forwarded to Chief, TSS/Chemical Division, through TSS/Budget Officer, no later than Friday, August 14, 1959.

3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project the files should not be closed.

Chief TSS/Chemical Division 0

Attachs

Invoice & Certifications

Distribution:

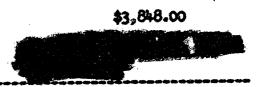
Orig & 2 - Addressee

1 - TSS/FASB 2 - TSS/CD

TSS/CD/ (4 Aug. 59)



For services



CERTIFICATIONS

It is hereby certified that this is Invoice No. 1 applying to M Si ti Ti bi

MKULTRA Subproject 87, that perform services are being accomplished in that a detailed agenda of the paymeters/CD, that the bill is just and that not yet been made.	accordance with mutual agreements, ents and receipts is on file in
	•
	Chief, TSS/Chemical Division
Date:	
(2) It is hereby certified that to Subproject 87, which was duly appropriated out in accordance with the from the DCI to the DD/A, and the subsequent memoranda.	oved, and that the project is being memorandum dated 13 April 1953,
,	
,	Research Director
Date:	

20 Nay 1979

MENCHARIUM FORE CONTROLLER

ATTENTION : Please Bivision

HOLDER & HOLDERS, Bobyector 87

Addition Land #2

Under the enthurity granted in the membrandom dated

[3] April 1953 from the DOI to the DO/A, and the extension of

Shis authority is subsequent mentrands, Dubgrojout 87 has

been approved and \$3,888.00 of the ever-all MEMERA project

funds has been obligated to cover the subgrojout's expenses.

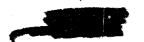
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Approved for orligation of purious

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	di		Sec. 15. 15.	20 1 1 1 1 1 1	CALL THE SECOND	79.19.19	677

87-44



30 October 1958

H

MEMORANDUM FOR: COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject 87

Under the authority granted in the memorandum dated

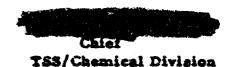
13 April 1953 from the DCI to the DD/A, and the extension of

this authority in subsequent memoranda, Subproject 87 has

been approved and \$3,848.00 of the over-all MKULTRA project

funds has been obligated to cover the subproject's expenses.

This obligation of funds should be charged to Allotment 9.-2502-75-904.



APPROVED FOR OBLIGATION OF FUNDS:

Research Director

Date:

S 1607 1958

Distribution:

Orig & 2 - Addressee

1 - TSS/OC

Y- TSS/FASB

1 - TSS/SRB

2 - TSS/CD



CELTRY TO THE PROPERTY TO THE

19 1958 DATE

10:

FROM:

SUBJECT:

I hereby acknowledge receipt of the following:

CO.0028 T TO T TO THE STORY OF

REL

HEBINGS 27 STUT IN REDENCE Please return signed copy (ies) of this receipt

752 REPLACES FORM 36-66

SIGNATURE OF RECIPIENT

(88)

(33)

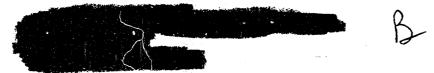
TO. 105&

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9-2502-15-902

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<u> </u>				

19 November 1958



Gentlemen:

- 7

We are pleased to be able to transmit to you the following funds:

Check No. 74554 drawn on the for \$3,700.00.

Check No. ICP 65827 drawn on for \$148.00.

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosures: (2)

87-46



4 Movember 1958

MEMORANUM FOR: CHIEF, FIRANCE DIVISION

VIA

: TBS/Budget Officer

SUBJECT

: MANUTRA Subproject 87, Invoice No. 1 Allotment 9-2502-75-902

1. Invoice \$1 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the securit of \$3,700, drawn on &

É

Cashier's check in the amount of \$146, drawn on a

B

Both checks should be made payable to

- 2. The checks should be forwarded to Chief, TBS/Chemical Division, through TBS/Budget Officer, no later than 17 Nov. 1958.
- 3. This is a final invoice. However, since it is enticipated that additional funds will be obligated for this project the files should not be closed.

Chief

TSS/Chemical Division

Attch:

Invoice & Certifications

Distribution:

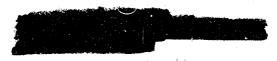
Orig & 2 - Addressee

1 - Comptroller

1 - TSS/FASB

For services

\$3,848.00



~

CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. 1 applying to MECHIFFA Subproject 87, that performance is satisfactory; that the services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TES/CD, that the bill is just and correct and that payment thereof has not yet been made.

Date:

Chief, TSS/Chemical Division

(2) It is hereby certified that this invoice applies to MKULTRA Subproject 87, which was duly approved, and that the project is being carried out in accordance with the memorandum dated 13 April 1953, from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Dates

Research Director



MEMORANDUM FOR: COMPTROLLER

ATTENTION

: Finance Division

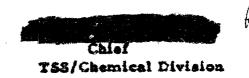
SUBJECT

MKULTRA, Subproject 87

Under the authority granted in the memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda, Subproject 87 has
been approved and \$3,848.00 of the over-all MKULTRA project
funds has been obligated to cover the subproject's expenses.

This obligation of funds should be charged to Allotment 8-2502-10-001.



APPROVED FOR OBLIGATION OF FUNDS:

Research Director

Date:

Distribution:

Orig & 2 - Addresses

- 1 TSS/OC
- 1 TSS/FASB
- 1 TSS/SRB
- 2 TSS/CD

TSS/CD/ (30 June 1958)

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	9-2502-15-902
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88-2

9 July 1958

MEMORANDUM FOR: COMPTROLLER

ATTENTION

: Figance Division

SUBJECT

: MKULTRA, Subproject No. 88

Under the authority granted in the Memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda, Subproject 88 has been
approved and \$5,000.00 of the over-all Project MKULTRA funds
have been obligated to cover the subproject's expenses and
should be charged to Allotment 9-2502-10-001.
9-2502-16-952-

Chief
TSS/Chemical Division

APPROVED FOR OBLIGATION

OF FUNDS:

I CERTIFY THAT FUNDS ARE AVAILABLE.

ORIGINAL SIGNAL BY

CHARGE TO PROTECTION

AUTHORIZING DEPOSITOR

Date:

Distribution:

Orig & 2 - Addressee

1 - TSS/OC 1 - TSS/FASB 1 - TSS/SRB





10 July 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

: TSS/Budget Officer

SUBJECT

: MKULTRA, Subproject 88, Invoice No. 1 Allotment 9-2502-10-001

1. Invoice No. 1 for the above subproject is attached. Payment should be made as follows:

> Cashier's check in the amount of \$5,000.00, drawn on a bank and made payable to the

2. Please forward the check to Chief/TSS/Chemical Division through TSS/Budget Officer by Thursday, 24 July 1958.

3. This is a final invoice. A total of \$5,000.00 was obligated under this subproject during FY 59. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

TSS/Chemical Division

Attachments:

Invoice & Certifications RECEIVED.

DHECK# 378 N THE AMOUNT OF 6 100

Distribution: Grig & 2- Addressee

Dr 889 ccolly 6001 2502-15-902 Cr Clash Miller Control

5000.00



CENTIFICATION

(3) It is hereby certified that the program under subprojects 39, 61 and 65 have been satisfactorily completed and returned unused funds.

Ensurer, subproject (30) which is still continuing also refunded somey.

Therefore, it is requested that the security as shown below on Invoice Busher 1 of subproject 124 by credited to the subprojects as shown below.

Project	- Awat	8 ATKITANA
439	\$1,356,26 1k3 1,977.52 63	5-2502-10-001 9-2502-55-902 8-2502-10-001
655	50.00 200 1,690.00 115	A 2012 A 2013

Chief, Tay/sessares breach

De to I



January 15, 1959

Memorandum to

Subject:

We received the sum of \$5,000.00 for the special four months study to produce a series of cultural studies. The consultant fee of \$3,000.00 was paid directly to and the sum of \$310.00 was paid to him for typing expenses. This leaves a balance of \$1,690.00 in the account.

88 1.

October 24, 1958



Enclosed is the check. I am still reading the last material. I find that -I'm way behind on all of my reading, including your last section, for which I apologize. I shall be away much of next week but will be in touch by telephone to try and arrange an appointment. Regards to the family.

Sincerely yours,

Executive Secretary

Enc: 1

88-6

RECEIPT

Receipt is hereby acknowledged for Check No. 220 dated July 18, 1958, drawn on the in the amount of \$5,000.00, payable to the



10 July 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

MKULTRA, Subproject \$8, Invoice No. 1
Allotment 9-2502-10-001

1. Invoice No. 1 for the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$5,000.00, drawn on a bank and made payable to the

- 2. Please forward the check to Chief/TSS/Chemical Division through TSS/Budget Officer by Thursday, 24 July 1958.
- 3. This is a final invoice. A total of \$5,000.00 was obligated under this subproject during FY 59. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Cales

TSS/Chemical Division

Attachments:

Invoice & Certifications

Distribution:

Orig & 2- Addressee =

۱ - TSS/FASB _____ TSS/CD

TSS/CD (10 July 1958)





INVOICE

For services

\$5,000.00



Chief, TSS/Chemical Division

Research Director

CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. 1 applying to Subproject No. 88 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

(2) It is hereby certified that this invoice applies to Subproject No. 68 of MKULTRA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Date:

4



9 July 1958

MEMORANDUM FOR: COMPTROLLER

ATTENTION

OF FUNDS:

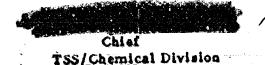
: Finance Division

SUBJECT

: MKULTRA, Subproject No. 68

Under the authority granted in the Memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda, Subproject 88 has been
approved and \$5,000.00 of the over-all Project MKULTRA funds
have been obligated to cover the subproject's expenses and
should be charged to Allotment 9=2502=10=001.
9-2502=15=90



APPROVED FOR OBLIGATION

		A
Res	earch Director	
Date:	10 18 18	
Distribution	oa:	
Orig & 2	- Addressee	
. 1	- TSS/OC	
1	- TSS/FASB	
	mee leb b	



DRAFT 9 July 1958

MEMORANDUM FOR: THE RECORD

SUBJECT

Project MKULTRA, Subproject 88

1. The purpose of this subproject is to provide funds for the compilation of information and background material for a short course in Culture Appraisal. This work is undertaken in response to a requirement established with TSS by the will essentially follow the attached proposal.

witting consultant of the

has agreed to act as principal investigator and to

produce the required material within the time limitation specified

by The cover used to explain this requirement to

is outlined in the last paragraph of the proposal.

will be handled by the in the regular manner. Accounting for the funds expended will be according to the procedures previously established for the relative to grants to unwitting agents. Any unused funds remaining at the conclusion of the project will be returned to the Agency. It is not anticipated that any permanent equipment will be acquired during the project. Travel funds will be accounted for in a manner consistent with the established practice of the

4. The total cost of this project for a period of four months beginning 1 July 1958 will not exceed \$5,000.00 including those administrative costs borne by the

Charges should be made against Allotment

9-2502-10-001.



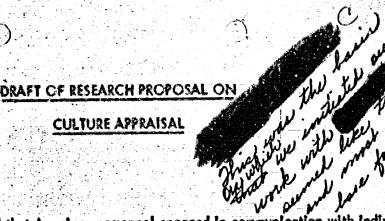
Approved for Obligation of Funds:



Date: July 10-1955.

Attachment:
Research Proposal

Distribution:
Original Only



The Problem:-

or groups of a foreign country have a clear understanding of the "social character" of that country. In order to achieve such an understanding, the American, whether he be in business, in government or a tourist, must understand his own society and how it influences his perceptions and behavior. The task of developing this understanding has never been fully appreciated in the American culture, despite the fact that the social sciences have emphasized for many years the necessity for developing frames of reference, training programs, and specific guidance for behavior under given situations. How can the knowledge and skills of/social scientist be best applied to this critical, national problem?

Discussion

It is felt that the writings in the fields of cultural anthropology, sociology, social psychology, political science and economics contain adequate information at the present time to erect a theoretical framework for communicating to the neophyte in international affairs:

- a. an understanding of current literature about his own or any foreign area
- b. an understanding of the power and social structure of most areas of the world
- c. a system for rapid assessment of the Interplay between the various social and cultural forces in a given area

d. an Improved appreciation of ways of exploiting these indigenous forces for his own purposes.

to develop training programs in the past based upon the above assumptions. The results have not been particularly noteworthy. Instructors working with the training programs have usually concluded that it was better to have no knowledge than to have incomplete know—ledge. It was felt that short-term training in such a complicated area could at best produce only pseudo-sophistication which, in most cases, is more damaging than ignorance. The training efforts have been relegated to attempts to convey specific substance pertaining to events of a given area rather than attempts to provide a broad understanding. Further, officials of the theory that "experts" could be selected and employed to fill the needs of any given time. This has been true despite the fact that selection methods have tagged further behind in scientific development than have culture appraisal methods or training methods.

Approaches to Solution:

It is felt that the efficacy of short term training programs has never been fully tested. No concentrated attempt has been made to extract those portions of social science lore which can be readily assimilated by the neophyte and applied for his own use "on the lob." As an experiment, it is proposed that the following be compiled for use in teaching a course in "culture assessment":

- a. an integrated report coversing the major literature on social character
- b. an annotated bibliography appropriately categorizing major considerations in culture assessment

- c. g reading guide for the student of international affairs to be broken down according to area
- d. a brief report identifying major components of American national character
 to provide the base line for observations of other cultures
- e. a similar report containing pertinent observations on the character.

The assumption underlying the above documentation is that upon exposure to a system—
Itized method of observation providing base lines for comparison can in a comparitively short
time equip an individual to engage in intercultural affairs with greater efficiency and con—
sequently improved chances of success.

Recommendations:-

experimental training program of SEVEN days for the seventh second being assigned of the proficiency of the profice
18 June 195

MEMORANDUM FORI

AUBJECT

Project for the

L. Your request for service from the the service from the the service from the terminal service from the ser

resentative in implementing this project. It is hoped that you will feel completely free to offer whatever advice, guidance and placeing is necessary to insure that this activity will meet your needs.

3. It is suggested that describe contact the project plan for my final approval.

Chief, DD/P/TSS

Distribution:
Orig & 1 - Addresses

TSS/CD/4000 19 June 1958)

Chief, 788

Project for the

1. I am in the process of surveying the needs of the same in order to provide you with the general types of assistance I should like to have from the same in the

- 2. In the meantime, however, there is one project I should like to request, to be undertaken at the earliest practical moment, and completed by mid-September, 1958. This project concerns the development of a package which can be used in the training of the training to entire the training that the training training the training training the training training training the training - a. American social character and how it influences the way the American looks at himself, at foreigners, and at many different phases of his living.
 - h. The social character of the country to which the first the being assigned, and how it will influence the attitudes and values of the natives of that country.
- 3. Kere specifically, it is requested that two packages be produced, one for inerican culture, and one for culture, from a survey of available knowledge which will contain the following things for each culture:
 - a. In integrated report covering the major literature on social character.
 - b. A bibliography of the major literature categorised in some appropriate fashion with a summary of the major points covered in each area,
 - c. A listing and brief description of major readings which would be most useful to the beginning student.

Majach Project for the

A is rough guide lines, it is suggested that the integrated report include a description of the different approaches which have been used to study incrican social character, or any parts thereof, and examples of representative findings which have resulted from each approach. For example, the integrated report might include a discussion of the more general attitudes and values related to incrican social character, attitudes and values associated with social class, and attitudes and values associated with personality organisation. Illustrations of the three different levels might include attitudes towards foreign and ethnic groups, patterns of up-medility strivings associated with a particular social class, and notivation studies at the need level, such as the belongingness needs associated with certain aspects of conformity behavior.

5. Decause of the time limitations involved, it is clear that the initial packages need not be based on exhaustive survey of the literature, but more on a representative survey.

is willing to undertake this project, the Chief,

Vill discuss with your representative the

people who might be persuaded to undertake it. Among those to
be occasidered would be a lat the

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		l	MOTOR CHECK ITE		
	At Date of Original Authorisation	Ferios Covared	Time Extended	Allotmant Eunber	Amount of
	16 Sept 58	1 year		Commence of the last of the la	10,620.00
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REWARDS:

1



INVOICE

For services



CERTIFICATIONS

(1) It is hereby certified that this is invoice No. 7 applying to MKULTRA, Subproject 60, that performance is satisfactory; that the services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSD/RB, that the bill is just and correct and that payment thereof has not yet been made.

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Dates

(2) It is hereby certified that this invoice applies to MKULTRA, Subproject 60, which was duly approved, and that the project is being carried out in accordance with the memorandum dated 13 April 1953, from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Dein





CERTIFICATION

(3) It is hereby certified that the program under Subproject 89 has been satisfactorily completed and returned unused funds. In addition, Subproject 60, which is still continuing has also returned unexpended funds from its 1959-60 annual budget. Therefore, it is requested that the amounts as shown below on Invoice No. 7 of Subproject 60 be credited to the subprojects as shown below.

Subprojec	•	Amount	MOR	Allotment	
) 89 1 60		\$3721.78 \$1860.34	637	9-2502-15-902 0525-1009-4902	
			Chief, TSD/	Research Branch	
Dates					
			Research D	rector	
Date:					



September 15, 1960

Memorandum

Subject:

Hungarian Returnee Project

The status on this project is that we are awaiting approval final report. We are holding the balance of this account until we are certain that no further expenses will arise. The following is the status on this project:

Received:

\$ 10,620.00

Expenditures:

\$6,390.00 xpenses Translator fees

and expenses

271.50

Balance remaining in Project Account

The above is a true accounting on this project.

I have examined and approved the submitted

expenditures.

Chief

TSS/Chemical Division

Dates - 21 Systember 1960

SUMMARY STATEMENT OF MRS ON FEES AND EXPENSES PAID

	Fees Exp	enses Translator	<u>Total</u>	
Sept. 1958	390.00		390.00	
October	750.00	21.00	771.00	
Nov.	600.00	<u></u>	651.00	
Dec.	750.00 27.	52 36.60	814.12	
Jan. 1959	600.00		600.00	
Feb.	600:00 62.	79.45	741.95	andre see and see a br>Let also a see
Mar.	600.00	00 29.00	632.00	
April	750.00		750.00	
May	450.00		450.0C	· · · · · · · · · · · · · · · · · · ·
Aug.	900.00 37.	71.40	1,008.40	· · · · · · · · · · · · · · · · · · ·
	6390.00 130	101 288.45	6,808.47	
Total Receive	d for 10,	620.00		
Paid	·C 6.	808.47		William.

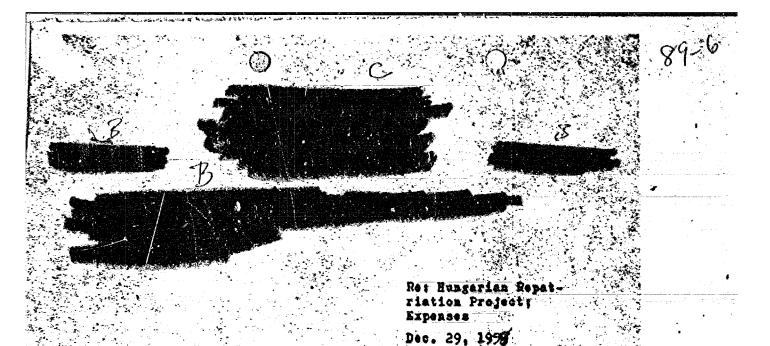
I have explained and approved the submitted expanditures.

8-31-59 3,811.53

Balance

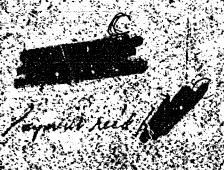


TSS/Chemical Division
Date: 2 Nov 159



EXPENSES 10.00 payment to respondent 8.72 telephone and telegrem .80 postage 8.00 transportation 127.52

7,00 payment to respondent
2,00 telephone
2,50 transportation
1,10 postage



have examined the worderd the resultted exceptions

Tasighesical Division

Dator & Oct 50

7

Feb. 6, 1959

Re: Expenses Jan.1959
Hungarian Repatriation Research

Mr. Interpreter

Interpreteing: 18% hrs @ \$3.00/hr
Transportaion:
Telephone:

\$ 55.50 \(\sigma \)
3.70
3.30
\$ 62.50

٠ ٥

Mrs. della

Telephone and telegram: Transportation: Pestage& stationery: Respondent; 6.13 5.27 1.00 67.05

• \$48.60 of this amount spent in relation to

This amount excludes \$30 reinburged to for expenses related to

120.00 from

120.00 from

120.00 From Barrender.

120.00 From Barrender.

120.00 From Barrender.

OR 525 a 524

I have examined and approved the submit expenditures.

TSS/Chemical Division

Date: 8 (9 ex CE

Expenses for Bre

b., 1966

\$2.15 telephone 27.00 9 hours interpreting 28.00 total

Expenses for manual 17eb., 1959

\$8.00 telephone, postage, etc.
(im very willing, since this amount is so small,
that payment of this expense be held and added
to next bill.)

RV 1032/ 0W 1032/

I have examined and approved the submitted expenditures.

TopyChedical Division

Dates

13

Aug. 16, 1050

Reiverenses Hungarian Research

Nra

Interpreter

Interpreting: 21% hours 6 33/hr

Transportation - Tolephone

4 64.50 77 4.30 2.60 4 71.40

Mrs

Interviers of Ps 16,17,18,10,20,21

Rynerses

\$900.00 LOL7 37.00 87

* Finel expenses on phase of research covening interviewing of repatriation applicants.

AFTE OVED BY

M have examined and approved the submitted expenditures.

issignment division

Dates 80 2159

NO.			31		^{to} €
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ALLOTESNT

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16 September 1958

MEMORANDUM FOR: COMPTROLLER

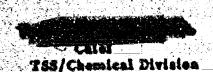
ATTENTION

1 Finance Division

BUBJECT

. MKULTRA, Sabproject No. 89

Under the authority granted in the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memorands, Subproject 89 has been approved and \$10,620.00 of the over-all MKULTRA project funds has been obligated to cover the subproject's expenses. This obligation of funds should be charged to Alletment 9-2502-15-902.



APPROVED FOR OBLIGATION OF FUNDS:

I CERTIFY THAT FUNDS ARE AVAILABLES 4

Research Director

Distribution:

Orig & 2 - Addressee

1 - TSS/OCSA 1 38 64 .28 TSS/FASB COMPTROLLER





MEMORANDUM FOR: CHIEF, FINANCE DIVISION

1 TSS/Budges Officer

RUBJECT

MKULTRA, Subproject \$9, Invoice \$1 Allotment 9-2502-15-902

1. Invoice No. 1 for the above subproject is attached. Payment should be made as follows:

> Cashier's check in the amount of \$10, 620.00, drawn hank and made payable to

2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Monday, 6 October 1958.

3. This is a final invoice. A total of \$10,620,00 was obligated under this subproject during FY 59. However, since it is anticipated that additional funds will be obligated for this project, the flies should not be closed.

TSS/Chemical Division

Invoice & Certifications

CHECK IE 13/194

E AMOUNT DE BALLO

Distributions

Orig & 2 - Address

REDEIVEL 2,8%

000637 6001 250778 962. 17,1 10, 620.00

FINANCE COURSION

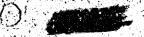
10, 620,00

RECEIPT

I hereby acknowledge receipt of the following:

Treasurer's Check No. FE 13146, in the amount of \$10,620.00 drawn on the lated September 30...

D. 4-C



22 September 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

YLA

: TSS/Budget Officer

SUBJECT

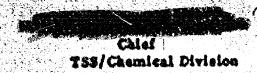
MKULTRA, Subproject 84, Invoice #1
Alletment 9-2502-15-902

I. Involce No. I for the above subproject is attached.

Payment should be made as follows:

Cookiesia check in the amount of \$10, 620, 00, drawn

- 2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Menday, 6 October 1958.
- 3. This is a final invoice. A total of \$10,620.00 was obligated under this subproject during FY 59. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.



Attachmants: Involce & Certifications

Distribution:

Orig & 2 - Addressee

1 - TSS/FASB

2 - TSS/CD

SS/CD/2007 22 Sept. 1958)

are solding



IMAOICE

For services

\$10,620.00

IS

CERTIFICATIONS

(1) It is hereby certified that this is invoice \$1 applying to Subproject 89 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject No. 89 of MKULTRA which was dely approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memorands.

Bessarch Director

Datas

16 September 1958

MEMORANDUM FOR: COMPTROLLER

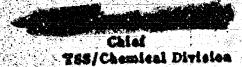
ATTENTION

. Piesece Divisios

BUBJECT

MKULTRA, Subproject No. 89

Under the authority granted in the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority is subsequent memorands, Subproject 87 has been approved and \$10,620.00 of the ever-all MKULTRA project funds has been obligated to cover the subproject's expenses. This obligation of funds should be charged to Alletment 9-2502-15-902.



Distribution:

Orig & 2 - Addressee

1 - TSS/OC

1 - TSS/FASB

TSS/CD (16 Sept 58) TSS/CE

MEMORANDUM FOR: THE RECORD

SUBJECT

: Project MKULTRA, Subproject No. 89

- 1. The purpose of this project is to investigate the sources of disaffection of Hungarian refugees and to determine the cause for voluntary redefection (return) to Hungary. This investigation is undertaken in response to a continuing requirement (a) to elucidate the sources of disaffection of the defectors and (b) to authenticate recommendations on the handling of defectors. The attached proposal summarizes the procedure which will be followed.
- investigator. The cover has been the general interest of the Society in coordinating research in all aspects of the Hungarian revolt and refugee problems.
 - handled by the handled by the funds expended will be according to the procedures previously established for the Society relative to grants to unwitting agents. Any unused funds remaining at the conclusion of the project will be returned to the Agency. It is not anticipated that

SUMMARY OF PROSPECTUS - STUDY OF RETURNING HUNGARIAN REFUGEES

Purpose

To determine the factors leading to the critical decision of certain Hungarian refugees in the U.S. to return to Hungary.

Interviews with returness: Employing data supplied by

Procedure

The interviews will ionow the contacts, oriented primarily to a large schedule of potential causal factors and secondarily to possible remedical action.

- 2. Control group interviews: A control group matched to the returnee sample but which has not applied for return will also be interviewed.
- 3. Examination of relevant data on other refugee groups from which there has been a significant sample of returnees.
- 4. Comparison of returnee sample characteristics with characteristics of refugees studied in the study.

Personnel

The principal investigator will be Mr a live an experienced psychiatric case worker who has already participated in the pilot interviews in the follow-up of the Cornell-Rutgers case study.

The principal investigator will be assisted by a suitable part-time interpreter-translator. Clerical assistance will be supplied by but statistical and other data processing assistance as required will be performed by part-time help.

Duration

The project is planned for a duration of one year. It is estimated that the interviews will be completed within a period of nine months.

The subsequent 3 months will be devoted to final data processing and preparation of reports.

Estimated Cost for one year:

Principal investigator	8,000.00
Interpreter-translator (part-time)	2,000.00
Travel	350.00
Telephone and other contact costs	270.00

rotal \$10,620.00

DRAFT

89-19

.1. Background:

A major focus in the investigation of human ecology is the study of personality and situational determinants of extremely critical decisions made by individuals and groups. The emigroes from the 1956 Hungarian revolt have proved to be a unique source of case material for such a study because:

- e. they represent a relatively homogeneous group (national culture, departed at some time under somewhat similar circumstances, etc.)
- b. they made two extremely critical decisions—
 to leave Hungary

to come to the United States—affort in obtaining a visa

Considerable research has been conducted with the groups of emigrees who

cano to America, for examples

Medical, psychological, sociological factors in motivations follow-up of solscied cases

Brief Summary)

(Brief Summary)

(Brief Summary)

A small percentage of this group have made on even more critical decision—to return to Hungary. This group, therefore, would appear to represent a particularly valuable object of study in terms of the personality and situational determinants of each of the three decisions, with special complians on the third and most final, but with attention to consistencies and regularities in the process of all three.

It has been reported "that approximately 500 of the 38,000 refugees admitted to United States have already returned. Of these 500, current information indicates that about half are returning as a result of their own decisions that is, were not forceably repatriated or were not dependents of a family of returness. It was also reported that not one of the returness came from the group of 1300 professionals assisted by the NAS in vocational placement. A breakdown of 111 "unable to adjust" and "unwilling" to adjust to the United States was reported. No Indication was given of who made this categorization, nor on what data.

2. Research Problems-

It is proposed to study a sample of Hungarian returnees in order to learn answers to the following questions:

- a. What are the determinants of the decision to return?
- b. How well do those determinents discriminate returnees from those who stay?
- c. How is the decision to return related to earlier decisions to:
 - (I) leave Hungary
 - (2) go to United States?
- d. What actions prevent (or would have prevented) the decision to return?
- 3. Optominants to be investigated and Exemples of Hypotheses to be Tested:
 - a. Demographic Is it a specific age, sex, occupational, educational, or family status which is returning?

[•] By Mr. 20 to a conference on the Hungarian problem sponsored by

- b. Social -
 - (1) is the kind and amount of assistance in integrating into the American community an important determinant?
 - (2) is family separation important?
 - (3)
- c. Economic Has lack of job apportunity contributed to desire to return?
- d. Political Is political ideology and/or distillusionment with Democracy
 responsible for a desire to return? Have propogunda or more direct means
 of influence affected their decision?
- e. <u>Psychological</u> Have specific personality traits or psychopathology influenced the actions of the returness to an important degree?
- f. Cultural Is Identification with the Hungarian culture or Institutions of major importance in preventing integration in the American community?

4, Procedure:-

- a. Three sets of data to be collected:
 - Available information on all the Hungerian returness who have already departed. Information in terms of whatever identifying data is available in the records of the research groups who have and a cross-check of name files of the research groups who have interviewed or questioned refugees. —This data would have to be compared with whetever is available on the refugee group as a whole.
 - (2) Interviews with as many as possible of those who have currently

requested exit pormits, or who so request in the course of the next nine months. Where interviews cannot be erronged, use of a written questionnaire to be administered by whatever cooperating authority that can be arranged. (This will probably require assistance of which is still to be obtained.)

(3) Interviews with a matched control group, preferably of those who initiate a request and then withdraw it (size of such a sample and availability of data is still unknown), but possibly substituting individuals of similar age, education, family status, religion, occupational background, etc.

In addition, there will be studies of relevant data and literature on past-World War II returness of other paralee groups. (e.g. Chinese, Russians.)

b. Analysis of data

- (1) The data will be coded into categories relevant to hypotheses and compared, using contingency table analysis—comparing returnous with total refuges group where data is available and with control group where data is unavailable on larger sample.
- (2) A clinical analysis of intensity and implications of significant differences.
- (3) Cross validation through "blind" prediction

c. Reporting

- (1) A brief technical report will be propered
- (2) A non-technical summary criented toward welfers groups and government

agencies concorned with refugee problems in general

-		ALC:		-		•
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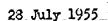
a. Principal Investigator

A social worker, Me Prings to this studys

- (1) experience in field interviewing on sensitive topics
- (2) cross-disciplinary orientation
- (3) familiarity with social rehabilitation specifically refugee groups
- (4) familiarity with Hungarian Refugee group
- b. Clerical and Non-Professional
 - (1) qualified interpreter when and as required
 - (2) clock-typist on port time

6. Ludget:

٠.	Salaries			\$10,000	.00	
	Augusta I			430	.00	
	Travel			330		
	Telephone	and Me	erone	 270	.00	
				\$10,620	.00	



MEMORALDUM FOR: THE RECORD

: Addendum to Subprojects 9, 26 and 28 SUBJECT . . .

1. The purpose of this addendum is to set forth the mutual administrative responsibilities of the contractor and sponsor.

Cy 2. The above subprojects represent the research program of financed under MKULTRA, covering the period of 9 June 1953 through 30 June 1955.

has requested the Universities to submit to them a summary accounting of monies received from the Fund. Also, they requested the return of any unexpended funds received under-a-grant from the Fund.

- 4. Title to any permanent equipment purchased by funds granted the University shall be retained by the Universities in lieu of higher overhead rates.
- 5. It was mutually agreed that documentation and accounting for travel expenses which are reimbursable by the University shall conform with the accepted practices of that Institution.
- 6. It was agreed that technical reports reflecting the progress of the research program shall be submitted at mutually acceptable intervals.

SIDNEY COTTLIFB

Chief

APPROVED:

TSS/Chemical Division

Orig & 3 - TSS/CD

Distribution:

A>

27 July 1954



Donr Dr.

On 13 August 1954, the research grant to the from the for research at the , will expire. It is anticipated that on 18 August, a small part of the funds granted for the past year will remain unspent.

In conversation, it was suggested to Dr and to me that should unspent morey remain, an extension of the time limit on the grant might be made, and that the money mught then be spent during the period of extension. Dr. and I, however, have not received written confirmation of the possibility of such an extension of the time limit on the grant.

We wish very much that such an extension be granted, and ask that written confirmation of the extension be sent to the nd to us, in order that we may begin to budget the money for the coming year.

. A summary of the budget of the past year and a tentative budget for the coming year follows:

Total grant Supplementary grant Total sum granted	•	\$20,889.00 4598.00 (See con 2.6 25,487.00)
Overhead (10% of total sum granted) Total money available	\$2,548.70	2,548.70 22,939.30	
Expenditures to 30 May 1954		- -	•
Expendable supplies	85.59		
Equipment	4,072.66		
Personal services	11,453.39		
Travel	902.59		1
Total	16,514.23	16,514.23	
Funds remaining On 31 May 1954		6,425.07	<u></u> *
Anticipated expenses 31 May 1954 to 18 A	ugust 1954		•
Personal services	3,550.00		
Travel	92.00		

3.642.00

3,642.00

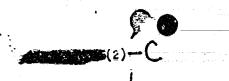
2,783.07

Proposed budget after 18 August 1954

Funds remaining on 18 August 1954

Total to 18 August 1954

Travel



2,783.07

Funds recaining on 18 August 1954

Proposed tudget after 18 August 1954

Personal services (Seneral) 900.00

Personal services (Students) 800.00

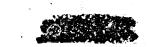
1,000.00

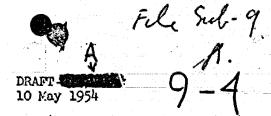
Total

2,700.00

Total unbudgeted after 18 August 1954

2,700.00





MEMORANDUM FOR THE RECORD

SUBJECT:

Extension of Time for Subproject 9, Project MKULTRA

1. Due to a shift in the location of certain key personnel in the the Project, the work will henceforth proceed at a slower pace than anticipated. For this reason it has been decided that the original time limit is now too short.

2. As originally set up, the project will end on 18 August 1954, however, this memorandum will have the effect of extending this date until 18 February 1955 with no change in funds or scope.

Chemical Division/TSS

Ought of Dritteron

APPROVED:

Chief, Chemical Division/TS

Original only.

sile su 9

9-5

CERTIFICATE

8 January 1954

No's. M136910 in the amount of \$13,926.00.



* (

MEMORANDUM RECEIPT

January 19

TO:

Sidney Cottlieb

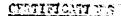
FROM: Budget Office, TSS

SUBJECT: Check Nos. M136910 & M136909

I hereby acknowledge receipt of the following:

Check No. M136909 in the amount of \$13,926.00 and Check No. M136910 in the amount of \$278.52 made payable. For payment of Invoice No. 2, Subproject 9, Project MKULTRA.

signed copy(iss) of this



(1) "It is hereby certified that this is Invoice No. 2 applying to subproject 9 of Project WEUTES, that technical performance by is satisfactory, that the work is being accomplished in accordance with the mutual agreement reached with that this bill in just and correct and that payment thereof has not yet been made.

ater	*		 	
	34.		ILALY (STILL:5
			Chief, (ID/Toon

(2) "It is hereby certified that this invoice applies to subproject 9 under Project MANIGHA which was duly approved and that the project has been carried out in accordance with the UNY memorandum to DOI dated 3 April 1953 and the UNI memorandum to DONA dated 13 April 1953.

Date:

Research Lirector!

(3) "It is hereby certified that the score of the program of subproject 9 of Project WEULTHA has been approved.

ato:

INVOICE

December 11; 1953



31 August 1953

This is to cortify that I have today received Cashier's check No. M133697 of the in the amount of \$139.26.

ζE





MEMORANDUM RECEIPT

25 August 1953

FROM: Budget Office, TSS

SUBJECT: Two Checks.

I hereby acknowledge receipt of the following:

Check #M133697 in the amount of \$139.26 and check #M133698 in the amount of \$6,963.00 as payment for invoice No. 1 Subproject 9 Project MKULTRA.



14 August 1953

MENORANDUM FOR: CHIEF, PENANCE DIVIDIOS

VIA:

TSS/EMEst Officer

SUBJECT:

Invoice No. 1, Subproject 9, Project MENULTRA

Invoice No. 1 for Subproject 9 of Project MKULTAN is attached.

It is requested that payment be made by two cashior's checks in the amounts of \$139.26 and \$6,563.00 made out to the the checks should be sent to Chief, CD/TSS through TSS/Subject Officer.

Chief Chemical Division, TSS

Attachment: Invoice Cortifications

Distributions

Addressee - Orig. & 1 .

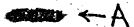
Comptroller - 1

Exec. Sec'y., -1 4

T83/3udget + 1 V

T53/00 - 1

T3S/Registry - 1





CERTIFICATION3

(1) "It is hereby certified that this is Invoice No. 1 applying to subproject 9 of Project NKULTRA, that technical performance, by its satisfactory, that the work is being accomplished in accordance with the mutual agreement reached with that this bill is just and correct and that payment thereof has not yet been made.

Date:

SIDER COTTLES Chief, CD T53"

(2) "It is bereby certified that this invoice applies to subproject 9 under Project MKULTAA which was duly approved and that the project has been carried out in accordance with the DD/P nemorardum to DUI dated 3 April 1953 and the DCI memorardum to DD/A dated 13 April 1953.

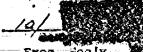
Date: 10



Research Director"

(3) "It is hereby certified that the scope of the program of subproject 9 of Project MAULTRA has been approved.

Dote:



__]A → G





9 Juna 1953

MEMORARDEM FOR: COMPTROLLER

:HOITHSTTA

Finance Division

SUBJECT:

Project MEMERA, Subproject 9

C-113

Under the authority granted in the encorandum dated 13 April 1953

from the DUI to the DD/A and the further authority granted in the
memorandum dated 17 April-1993 from the DD/A to the Comptroller on
the subject, "DD/P-TSS Project MANITAA", subproject 9 has been approved,
and \$21,306.78 of the over-all Project MANITAA funds have been obligated
to cover the subproject's apparess.

SIDNEY COTTLIES
Chief
Chemical Division, Tes

PROGRAM APPROVED

APPROVED FOR CHLICATION OF FURTHER

Original signed by

Iriginal signed by

Research Chairman

Research Director

JUN 1 0 658

JUN 10 1958

Distributions

Addressee = Orig. & 2
Frace. Secty., - 1 -- (

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JUN 19 ENTO



9-14

INVOICE

August 8, 1953

r. - 1a-ricas \$7,102.26



śtandard form no. 54

Office Memorandum • United States Government

70 : The Record

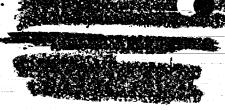
DATE: 31 July 1953

FROM :



Subject: Payment Schedule for Ultra #9

	To Froject:	Service:	7 D
Utal Auth:	\$20,889.00	\$417.78-	\$21,306.78
First Pay:	5,222.25	139.26	6,963.00
lacond:	5,222.25	278.52	13,926.00
Third:	5,222.25	417.78	20,889.00
Functh:	5,222,25		•
•	20,859.00		



DRAFT 9 June 1953

MEMORANDUM FOR THE RECORD

SUBJECT: Project MKULTRA, Subproject 9

1. Subproject 9 of Project MKULTRA is designed to continue the support of work at until 18 - B August 1954 under the guidance of Dr.

- 2. Dr. work is concerned with the evaluation of various C sternutatory agents on normal and schizophrenic human beings. In addition, his program includes the study of narcotic and other depressant drugs and those which might be of possible benefit in the treatment of alcoholic or schizophrenic patients. This investigator's facility at the provides an almost indispensable B opportunity for human testing of drugs of operational interest.
- 3. The research and financial proposals are attached. The sum requested is \$20,889.00. To this should be added \$417.78 which represents a 25 service charge to be paid to will serve as a cut-out and cover for this grant.
- 4. The total cost of the project will not exceed \$21,306.78 until the expiration on the above date.
- 5. Dr. Mas been cleared through TOP SECRET and all C possible security precautions with regard to this project are being taken.

Chemical Division, TSS

APPROVED:

Chief, Chemical Division, TSS

PROGRAM

		0	
•			

PROGRAM APPROVED
AND RECOMMENDED:

APPROVED FOR OBLIGATION OF FUNDS:

Daggarah American			· · · · · · · · · · · · · · · · · · ·	Researc
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and the state of t		•		4.62.63.65

Research Director

Date:

Date: 10, 1913

Attachments:
Proposal
Statement of Cost

Original Only.

AMERICAN STREET, COLUMN -

Research Proposals - 1953 - 1954

- 1. Continue and complete the comparison in normals and schizophrenics of the threshold of various sternutatory agents.
- 2. Continue and expand the study of depressant drugs which may more adequately control the maniacal psychotic patient.
- 3. Test new drugs which may be beneficial in alcoholics or schizophrenics.

oject: Continue and complete the comparison in normatic threshold of various sternutatory agents.	mals and so	hizophrenics of the
Continue and expand the study of depressant control the maniacal psychotic patient.	drugs whic	h may more adequately
Test new drugs which may be beneficial in al	lcoholics o	r schizophrenics.
riod: August 1, 1953 through July 31, 1954.	compagning Authorities	
Salaries:	•	• 4
A. Technical	•	•
Senior medical student	\$3,600.	
Medical technician	3,000	<u> </u>
Secretarial assistance	300.	
B. Professional		•
principal investigator	2,400.	
M.D., psychiatrist	3,600.	
Ph.D.		•
electroencephalographer C. Experimental subjects	2,000.	
C. Experimental subjects Stipends for human experimentation		
TOTAL, SALARIES	400.	\$15,300.
Taken Samuel Sam	· · · · · · · · · · · · · · · · · · ·	ψ±/9500 •
Expendable Supplies:		
A. EEG paper, etc.	500	
B. Electronic supplies	400.	
TOTAL, EXPENDABLE SUPPLIES		900.
Permanent Equipment:		
Recording Polygraph	- 1 - _{COO}	·
TOTAL, PERMANENT EQUIP.	1,500.	3 500
TATION TENENTIAL DAGITO		1,500.
Travel:	,	
A. COLORO		
4 quarterly research conferences	600.	
B. Supervisory trips		,
50 trips, 130 miles = \$7.80 ea.	390.	-
C. Other scientific personnel Research conference trips (2)	200	•
TOTAL, TRAVEL	300.	3 000
TOTAL TICATED		1,290.
(SUBTOTAL		\$18,990.)
1		W=0377001

TOTAL

\$20,889.00



Department of Pharmacology

May 22, 1953

Dr. Jan B

Dear Dr. And Company Company

Enclosed, you will find a proposed budget for a possible grant to continue our research studies in 1953-54. The research proposals, as itemized, are three in number and these can be elaborated upon if the Foundation so desires.

It is apparent from our present rate of expenditure that we will have an accumulation of three to four thousand dollars in unexpended balance from the grant allowed us last year. If possible, we should like to keep this in our account and apply it against the possible grant for next year.

In other words, the request for the coming year is approximately \$21,000, and the application of \$4,000, against this would reduce the actual amount requested this year to \$17,000. I discussed this with one of your scientific representatives recently in New York and he thought that this might be agreeable.

We wish to thank you for your past support of our basic research and hope that the Board will see fit to continue their financial aid for research.

Yours sincerely,

Professor and Head of the Department

To:

Research Proposals - 1953 - 1954

- 1. Continue and complete the comparison in normals and schizophrenics of the threshold of various sternutatory agents.
- 2. Continue and expand the study of depressant drugs which may more adequately control the maniscal psychotic patient.
- 3. Test new drugs which may be bemficial in alcoholics or schizophrenics.

5-22-53

STATCHEM OF COST

Project: Continue and complete the comparison in normals and schizophrenics of the threshold of various sternutatory agents.

Continue and expand the study of depressant drugs which may more adequately control the maniacal psychotic patient.

Test new drugs which may be beneficial in alcoholics or schizophrenics.

Period: August 1, 1953 through July 31, 1954.

Salaries: A. Technical		
Senior medical student	\$3,600.	
Medical technician	3,000.	
Secretarial assistance	300	
3. Professional	300	
of Carries principal investigator	2,400.	
() M.D., psychiatrist	3,600	
Ph.D.	25000	
electroencephalographer	2,000.	
C. Experimental subjects	- 230001	
Stipends for human experimentation	400.	
TOTAL, SALARDIS		\$15,300.
		V-23,500 .
Expendable Supplies		
A. EEG paper, etc.	500.	
B. Mectronic supplies	400	
TOTAL, EXPENDABLE-SUPPLIES		900.
Permanent Equipment:		
Recording Polygraph TOTAL PERMANENT ROUTE	1.500.	
TOTAL, PERMANENT EQUIP.		1,500.
Travel:		
A		
u quarterly research conferences	600.	
B. Supervisory trips	* 7-1-1	
. 50 trips, 130 miles = 37.80 ea.	390.	
C. Other scientific personnel		
Research conference trips (2)	300.	
TOTAL, TRAVEL	الشاريسة أأيه أأرياء	1,290.
farma anary		AA
(SUBTOTAL		\$18,990.)
Institutional Overhead		
10% - Varnead	7 000	
YOU - JOHNSON STREET,	1,899.	
		• •

\$20,889.00



\$0 3-273 9 February 1954

MEMORANDUM FOR: Cheif, Chemical Division

ATTENTION:

- A

1. Chief, Security Control Staff/SO does not interpose any objection from the standpoint of security to the publication by Dr. of the attached article entitled,

2. It is understood from the reference that the research upon which this paper is based was completed before Dr. entered on duty with this Agency.

3. Driven should not disclose his CIA connection, — A assignment, or duties in connection with this publication.



Attachment: Report

Addressee - Orig & 1 w/a as noted TSS/I&SO - 2



19 January 1954

HEMORALDUM FOR: 1250/DDP/TSS

SUBJECT:

Transmittal of Manuscript

1. The attached is a copy of a scientific paper to be submitted for publication to be submitte

2. The work covered in this paper was completed before
Dr. Decade associated with this Agency and was previously
procented with Agency permission at

⊢A

3. This copy of the manuscript is submitted for your perusal and files.

Chemical Division, TSS ← A

APPROVED:

Chief, Chemical Division, TSS

Attachment: Facer

Distribution:
Addressee - Orig. & 1
CD - 2





50 3-63 13 January 1954

MEMORANDUM FOR: Director of Security

ATTENTION.

Chief

₩ - G

TEROUGH

DD/P - (-

SUBJECT

Clearance Request - Dr.

1. It is requested that a covert security clearance be granted TSS on the following individual:

DR. C. C.

3. The Security Officer, Logistics Office was mented a covert security clearance by Clar, by TSS in his capacity — 6 on 2? April 1953 for the use of Dr. by TSS in his capacity — Case on a covert contract of TS interest. At the time of — E that request a Personal History Statement and an Appendix I was forwarded; therefore noither Personal History Statement nor appendix I is forwarded.

A. It will be appreciated if this request is handled as expeditiously as possible.

Fillian & Security Officer
PD/P/TO3

TOS/1986: A

Distribution:

addressee - orig. & 1, 00, -1, 1850 - 2



29 December 1953

MEMORANDUM FOR: DD/P/TSS/LASO

Continuation of the Security Clearance of

1. It is requested that the Top Secret covert clearance of the above subject be continued in order that TSS/CD personnel may use his services in connection with MKULTRA.

is recigning his present position to become where he will continue to work with TOS/CD if his security status can be maintained.

Chemical Division, 138

January 4, 1954



Enclosed find two forms. These should be filled out by

- end sent back to us (through you) as soon as possible. Please give no indication to compor what is
 - really behind this, nor that his deferment or assignment to special duty is in any way involved.

Looking forward to seeing you sometime soon, and with best holiday wishes to you and yours, I remain

Sincerely yours,

STOWNY COUNTINES

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and the same days and a section of the contract of the same of the	COMPANIES CARROLL AND	(TATOMOTORIUM CO		

November 18, 1960

Accounting of



Total amount received:

\$9,500.00

Disbursements:

Fellowhip, 10 mos. Nov. 1, 1958/Aug. 31, 1959	\$6,500.00	
Secretarial and clerical	1,455.99	
Travel Expenses	313.32	
Misc. office supplies and research materials	500.37	
Telephone toll calls	15.35	
Service charges - bank	18.33	
Total disbursements to date	\$8,803.36	8,803.36
Balance held on hand for future	e-expenses	\$ 696.64

This is a true statement of expenses as reported to us.

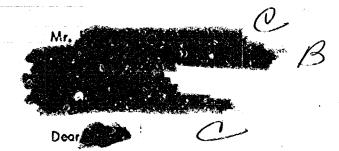
Prepared by

I have examined and approved the submitted expenditures.

TSS/Chemical Division

Date: 1/3 /60

September 19, 1960



It has been one year since the final payment of your grant in the amount of \$9,500.00. At that time, you had agreed to provide a final report. Subsequent to that time, I verbally authorized two delays in the submission of the report, the last of which was to be May 15 of this year. To date we have received no report.

As is required of non-profit funding <u>institutions</u> in <u>state</u>, i formally request both an accounting of the funds received and the report agreed upon in our initial arrangements for the grant.

I feel that it is fitting for me to emphasize that your delinquency in reporting may be detrimental in that the Board of Directors and the scientific advisers of the Society have been informed of your schedule for reporting in previous meetings and must, of course, be given a progress report at our next meeting scheduled for early November. I would urge you to consider the consequences of further delay.

Sincerely yours,

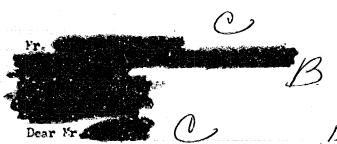
Executive Secretary

JLM:eb

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90-4

September 1, 1959



Enclosed please find the check in the amount of \$2,375.00 which represents the final payment on the grant given to you for the study of science in the

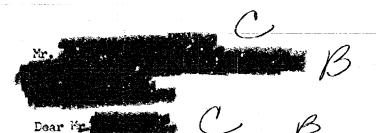
Sincerely,

Assistant-Treasurer

Enclosure

xxxxx 1-8666

March 2, 1959

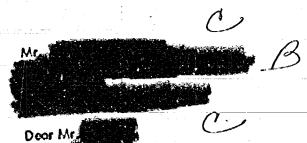


Enclosed please find the check in the amount of \$2.375.00 which represents the second quarterly payment on the grant given to you for the study of science in the

Sincerely,

Enc.

November 17, 1958



Attached is our check in the amount of \$2,375,00 which is the first of four payments of a grant from the for the completion of your study of science in the

It is acknowledged that \$3,000.00 of the total grant of \$9,500.00 is designated as compensation for stenographic and clerical assistance. The Board has recommended that additional funds in the amount of \$2,500.00 for travel and compensation of consultants be made available upon your request at travel and compensation of consultants be made available upon your request at a later date after your plan for research has been further defined, these funds to be administered by the staff under terms designated by the Executive Secretary.

The only condition that applies in the utilization of this grant is that any technical reports or papers which grow out of the study supported under this grant shall contain the following notices: "This study was supported in part by a grant from the

The Board of Directors joins me in congratulating you upon receipt of this grant. We are pleased to be able to facilitate work of an important nature to be accomplished by young Americans of great potential.

Sincerely yours,

Vice President

Enc: 1

10 December 1953

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

: MKULTRA, Subproject No. 90, Invoice #1
Allotment 9-2502-75-902

l. Invoice #1 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$12,000,00, payable to

- Z. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Wednesday, 17 December 1958
- 2. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Acting Chief
TSS/Chemical Division

Attachments:

Invoice & Certifications

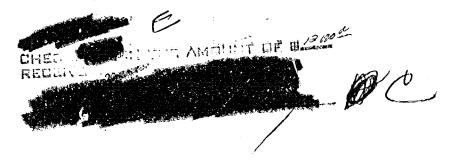
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- TSS/FASB

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AUGUST OF COURT



18 November 1958

MEMORANDUM FOR: COMPTROLLER

ATTENTION

Finance Division

SUBJECT

: MKULTRA, Subproject No. 90

Under the authority granted in the memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memorands, Subproject 90 has been
approved and \$12,000.00 of the over-all MKULTRA project funds
has been obligated to cover the subproject's expenses. This
obligation of funds should be charged to Allotment 9-2502-75-902.

Chief
TSS/Chemical Division

Approved for Obligation of Funds:

Research Director

AVENOTIENS CHICK

Date:

Distribution:
Orig & 2 -- Addressee

Y - TSS/FASB

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I hereby acknowledge receipt of the following:

Treasurer's Check No.

December 18, 1958, drawn on the payable to the

6)

3 90-9

10 December 1958

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

MKULTRA, Subproject No. 90, Invoice #1
Allotment 9-2502-75-902

1. Invoice il covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$12,000.00, payable to

B

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Acting Chief
TSS/Chemical Division

Attachments:
Invoice & Certifications

Distribution:

Orig & 2- Addressee

1 7 TSS/FASB

/2 - TSS/CD

SS/ (10 Dec 1958)

A

INVOICE

For Services



CERTIFICATIONS

(1) It is hereby certified that this is Invoice #1 applying to Subproject 90 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is filed in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Acting Chief, TSS/Chemical Division

Date:	
MRULTRA which was do	that this invoice applies to Subproject 90 under ly approved and that the project is being carried to memorandum dated 13 April 1953 from the DCI
to the DD/A, and the ext	ension of this authority in subsequent memoranda.
	Research Director
Date:	±

18 November 1958

MEMORANDUM FOR: COMPTROLLER

ATTENTION

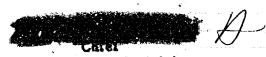
: Finance Division

SUBJECT

MKULTRA, Subproject No. 90

Under the authority granted in the memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda, Subproject 90 has been
approved and \$12,000.00 of the over-all MKULTRA project funds
has been obligated to cover the subproject's expenses. This
obligation of funds should be charged to Allotment 9-2502-75-902.



TSS/Chemical Division

Approved for Obligation of Funds:

	*
Research Director	
Date:	
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Orig & 2 ~ Addressee	· · · · · · · · · · · · · · · · · · ·
1. TSS/FASB 2. TSS/CD	
TSS/ (18 Nov 1958)	any contract the contract of t





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Scientist in the

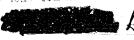
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PRIME TREETS

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TOP SECTION



DRAFT/P

MEMORANDUM FOR: THE RECORD

SUBJECT

MKULTRA, Subproject 90

1. The title of this project is "A Study of the Scientist in the

The purposes of this project are (a) to produce a

descriptive model of Scientists who are likely to come into

contact with Americans, and (b) to specify methods and strategies

for evaluating and influencing such scientists. The project is under
taken in response to requirements for research support from Chief,

(attached) and from the Deputy Chief, Staff for

training materials.

2. Mr.

currently associated with

has submitted to the

a proposal (attached) for research which will satisfy

these requirements.

3. A grant from the for the

will be made to Mr. as an independent investigator. Cover for the grant will be the interest in the psychological, sociological, cultural, and political determinants of individuals occupying critical roles within various societies.



the in the regular manner. Accounting for the funds expended will be according to the procedures previously established for the remaining at the conclusion of the unwitting agents. Any unused funds remaining at the conclusion of the project will be returned to the Agency. It is not anticipated that any permanent equipment will be acquired during the project. Travel funds will be accounted for in a manner consistent with the established practice of the

5. The total cost of this project for a period of one year commencing 1 November 1958 will be \$12,000.00. Charges should be made
against Allotment 9-2502-75-902.



Chief
TSS/Chemical Division

Approved for Obligation of Funds:

Date: 12/1/18

Attachment:

Research proposal & Memo from

Distribution:
Original Only





Estimated Cost for one year:

Principal investigator's salary

\$ 6,500.

Secretary and clerical

3,000.

Consultants

2,000.

Travel

500.

Tota

\$12,000.

	ROUTING	i AND	KECOKI	J SHEEL STANDARD STANDARD
UBJECT: (Optional) Request for Rese	arch Suor	ort		
ROM:				NO SR/6-58-511
Rn (C)	Exti 🚄			DATE 17 September 1958
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5.				
TOS/CD/II	7			
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SR/6-58-541

17 September 1958

MEMORANDUM FOR: Chief, Chemical Division, TSS

ATTENTION

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SUBJECT

Requirement for Research Support

- 1. In accordance with our several oral discussions, therewith requests that your office undertake the following research projects. It is immaterial whether these are undertaken solely within the Agency or appropriately cleared consultant sources are utilized.
 - 2. a. Given a model or prototype of citizen, in accordance with certain specifications, it is desired that guidance be provided as regards the most effective way or ways in which repressed and rationalized anti-regime motivations may be aroused or, more properly, re-activated. The "specifications" of this model or prototype are:
 - (1) Age -- 35 to 45 years.
 - (2) Sex -- male.
 - (3) Family -- children, possibly in university.
 - (4) Profession -- scientist.
 - (5) Status --- a-professional "comer."
 - (6) Political and Ideological Beliefs -- while in youth an idealist, perhaps a didealist, who became critically disillusioned and disgusted in early twenties. Sought escape and release in profession. As result of family responsibilities and increasing professional prestige and status, has repressed and rationalized his doubts and opposition sentiments. Now prefers to avoid any type of political involvement or perhaps even discussion, due to operation of his internal "security" or anxiety system.

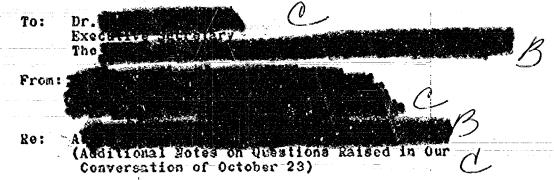
b. Given, on the other hand, a model of a who is now a member of the so-called "inner emigration," or otherwise meets the criteria of the "alienated" person (as developed by what criteria can be developed for spotting and assessing such persons as potential agent recruits, and how should their development be conducted.

3. The purpose of the above projects will be to sharpen our sights and methods as respects the spotting, development and recruitment of selected types of citizens. It is necessary to provide sharper guidance, and a more sophisticated awareness of certain key criteria, for personnel engaged in recruitment operations against the

h. It is recognized that you may desire to develop these requirements orally and at length. We will be glad to participate in further discussions and guidance on these requests and provide such assistance as may be necessary.

SUPPLEMENTARY MEMORANDUM

October 27, 1958



I. Relationship of the luterview project to the proposed study.

The proposed project is a new conception, and not only was not contemplated but also was not possible within the limits of the project. In the course of that study much important material was collected which could not be used directly in carrying out the mandate of the Foundation, and which could not yield its value if it were to be used in isolation. In combination with other resources, however, the otherwise hard-to-systematize insights gleaned from the interviews can support an illuminating analysis and description. A portrayal of the scientist in society, wing a role-model analytic scheme and a broad ecological orientation, goes far beyond the purposes; the interviews alone could not form a sufficient basis for such a portrayal, though they contain data indispensable to the investigation.

The project was conceived as "a study in international communication" which would have a "service function" for the scientific community. (Letter-from to CB)

The main objectives were 1) "to systematize the information and impressions which ... American (and scientists bring back with them both about scientific achievement and about the social and political environment in which makes this possible, " and 2) "to disseminate information on the experiences of scientific travelers among the wider scientific community in this country." (letter from the wider scientific travelers among the wider scientific community in this country." (letter from a fuller estimate of the position of the sciences in the and to gather material (both from and about our panel) which would be helpful in maximizing the values from the exchange and translation programs.

Thus the report to the will begin by describing our interview group in detail and analyzing their evaluation of the level of work in science, distinguishing among various specialties and times of visits. Then it will report on observations concerning the institutional structure of research and development facilities, and it will conclude with a consideration of the communications aspects of the visits, with emphasis on implications for future exchanges of scientists and translations of scientific information.

II. The Interview

The material collected necessarily extends beyond this report, however Our interview procedure was to begin by explaining

our interests and asking the informant to comment on whatever in the general areas seemed most significant to him. Then it was found possible, by probing with caution, to touch on all our areas of interest without tending to limit the respondent to routine categories or sterotyped replies. In this way we obtained not only a large body of internally reliable data amenable to internal comparisons, but a wealth of relatively idiosyncratic insights, anecdotes, and comments which were highly suggestive and wide ranging.

The following list of questions is suggestive but not exhaustive of the topics we covered consistently. (It is copied from the "conclusion" section of a long early memorandum in which I listed in some detail questions we hoped to learn more about.)

- 1. What about your visit struck you as most noteworthy or interesting?
- 2. What is your evaluation of the level of work in science in your field?
 - a. What were your opportunities to observe?

 1. Your itinerary?

 2. Your specialities?
 - Comparison with the U.S.?
 Comparison with other countries known to you?
- 3. How would you account for the present level of science? Francisco (social or other) affect science, in general? In this instance?
- 4. At what points do you think it makes a difference to the scientist that his society is what it is?

 a. What are the salient aspects of the society?

 b. Comparisons with American situation and with that in other kinds of societies?
- 5. What factors do you think really determine the choice of research problems in science?

(Role of administration; basic vs. applied; theory and experiments; informal or de facto table of organization; organization of labs in terms of authority, etc.; channels of recognition, publication, etc.)

- What kinds of people are most productive in science?
 Why? (Socio-economic recruitment; training; posture with
 respect to regime and ideology, factors making for productivity in science.)
- 7. What were your conversations with scientists like? How were your conversations different than they might have been if these scientists had been their counterparts in another country? (U.S., neutralist?)
- 8. What kind of information do you wish you had had before you went, or did you find most valuable to have had?
- 9. Since your return, with what sorts of people have you talked about science? What were they interested in? What did they miss inquiring about? Nere any of your statements subjected to distortion, e.g., in the press? Why do you think this happened? (Systematic factors, such as popular fallacy or stereotype?)
- 10. What recommendations have you concerning future exchanges?

 Who should be sent? How can the value of such exchanges be maximized? Risk minimized?
- 11. What do you think should be done about the problems of exchange of scientific information? (Science and values: freedom of communication; security systems; social consequences of science; responsibility of scientists for policy; science and economics, and welfare, and nationalists, and war and peace?)

In addition to these topics we collected personal data on each respondent, including such things as his command of languages and his travel experiences, as well as the kind of biographical information ordinarily supplied from Who's the and American Men of Science. We also summarized all his published statements on relevant topics, using the My Times Index and the Readers Guide to Periodicals, in addition to our general collection of articles, diaries, and unpublished reports, which I mentioned in my earlier note.

This collection of material can be utilized as a contributory resource for a number of inquiries which range beyond the immediate purpose for which they were collected.

Thus there are tenative plans at the Center to re-examine this material in connection with studies of the attitudes of American scientists on crucial problems of contemporary policy, and as a part of a minute examination of strengths in research and development it is plauned to cull from the interviews specific references to personnel and installations which may serve as an adjunct to the shards information gathered from other sources.

In summary, the proposed project would subject the data to re-analysis in terms of a specific question which would be difficult to answer without this wunique kind of data from direct and expert observation, but which would be equally difficult to deal with from these data alone.

It takes advantage of existing files white gathering new material into a quite different mode of analysis.

III. Relationship of the proposed study to the

The second question you raised was whether the advantages of carrying out the project within the Center would be worth the additional expense. I believe the larger investment would be well justified, especially because of the unique opportunities for sharing of material and cross-

fertilization of ideas which exist here. In particular, the Center members with whom I would work most closely are engaged in the following studies: a series of crossnational comparisons of elite groups the inter-relations of science and policy , a C comprehensive and detailed assessment of research and development efforts to a sociological study of professional education, particularily as a factor in social change and a study of the process of coercive paramasion in countries Furthermore, to be affiliated with a very well-known institution such as would facilitate obtaining further /3 interviews on such a potentially delicate subject, and with certain hard-to-get-hold-of respondents. There are many other ways, of course, in which a research organization is helpful.

Valuable as it would be for this project to be a part of the Center's program, it is not indispensable to a worthwhile result. I may use my data in any case, and my personal relationships with the people here would keep me in touch with their work. But I do believe that, if circumstances permit, it would be advisable (though not absolutely necessary) to carry out the study in the manner proposed.



18 November 1958

MEMORANDUM FOR: THE RECORD

SUBJECT

: A Study of the Scientist in the

1. The attached proposal originally envisioned supporting this project through the with which organization the investigator is presently associated. In subsequent conferences the investigator agreed that many of the advantages of association with could be obtained without the formal arrangement and excessive overhead payments. The grant is therefore made to Mr. as an independent investigator. The revised Estimate of Costs for one year therefore is:

Investigator's salary
Secretary and Clerical Assistance
Consultants
Travel
\$6,500.
2,000.
500.

Total_____\$12,000.

- 2. Payments to the investigator for salary and secretarial—clerical expenses will be made quarterly. The final installment payable upon delivery of an acceptable final report. Travel and commitments for paid consultations must be authorized by the advance of obligations.
- 3. Supervision for administrative purposes will be provided by the Executive Secretary of the Technical supervision will be provided directly by Dr. consultant to the and Staff, who has arranged plausible cover arrangements with Dr.
- 4. The principal investigator is not witting of Agency interest, but with an eye to future potential utilization of this individual a covert clearance has been requested.

TSS/CD/III

Distribution:

Orig & 2 - TSS/CD



18 November 1958

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Investigator's	salaty	•		\$6,500.
Secretary and	Clerical As	eistance	•	3,000.
Consultants				2,000.
Travel		38.	ما سود مردون	500.

\$12,000. Total

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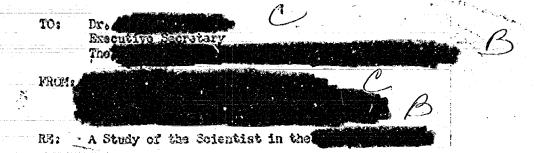
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MESORANDUM

October 11, 1958



I. Purpose of the Study

Much attention has been given to scientists by Western coservers, especially since the recent successes in dramatizing their growing capacities for vorting at a very high level of proficiency. Our scholarly efforts have gone towards describing the level of attainment in various fields of science, the details of the educational system from which potentiate are drawn, and the formal structure of the and the related research institutes and universities through which ecientific work is administered. Most of the discussion has been concerned with evaluating their technical capacity and especially with assessing its economic, military, and political implications. Yet our understanding of the functioning of the intellectual worker in the in the context of those ideological, political, economic, and other esoft as wall as those social forces which are popullar to the characteristic of all industrialised scoleties) remains somewhat vague. For example, the previously widely accepted formula, that science languishes in an environment which limits freedem of inquiry, has now been replaced by the equally truistic and overeimplified slogan, that science flourishes in an environment which rewards it generously. Each of these aphorisms expresses a part of the truth, of course, but it remains to describe in detail the

90-18

interrelations of scientists with their social environment. The purpose of this study is to charpen our picture of the scientist in the sociological and psychological aspects of his role in

II. Resources for This Study

Such a pertrait should not only synthesize the relevant material from the literature of the various applicable disciplines, but should draw upon direct observation and questioning of sectionists at work, at home, and in other social situations. The best investigators for this phase would be destorn scientists whose professional statuses and interests enable them to becommisse most directly with their colleagues.

a substantial body of such material has already been sollected by and sysolf, on behalf of the We interviewed more than 100 scientists who had visited that ettend scientific meetings, to lecture at the invitation of the to visit inheretories and universities, to mast colleagues with when they had corresponded, to see the country as tourists, or to so all of these. The group was selected as "observers with agestal qualifications for expert reporting en the seciology of pecisnes, a end included non and weren from all parts. representing every main field of the of the United States and physical, biological, and scelal sciences, including various branches of engineering and technology; our informance ranged from 23 to 7h years old, from MaD. Our typical respondent was American, between er serebitance 40 and 60, a professor at a large university in a Northeast, Merth Contral, or Word Goet mainopolis, and a man with on international regulation in cos of the spinners. The interviews everaged close to two hours in length, and in most cases ters transcribed verbatin from electrical retordings. In addition to the datervious, our informants gave up dozens of detailed, unpublished reports,

including a number of hour-by-hour logs of their visits, in which every execunter and observation was noted. This material can serve as a rich source for the study of the scientist.

The proposed study would develop this topic much more intensively than dees our report to the which is also concerned with reveral other topics, which is also concerned with reveral other topics, such as the pattern of communication of scientific information formed by the visits, and the implications for planning the exchange and termslation programs. Furthermore, the proposed study would not be limited to what has been learned by returning kestern coientists, as was the project, but would utilize all other appropriate means for studying the scientist.

Such means would include an intensive examination and synthesis of the relevant literature, including work on the recial organization of relevant (e.g.,), the social and psychological characteristics of asignification (e.g.,), the contemperary intellectual history of the contemperary (e.g.,), and the current status of socience (e.g.,) floation, for topics such as the image of the scientist in contemperary floation, and the public statements of the scientists themselves, about receive attention.

A substantial proportion of the available literature on each of these topics has already been studied.

New interviews should be senduated with informants not proviously utilized, such as some students of the season who have not been assent the visitors, and endaged socialists and substance. There will seem become available a number of travilence who have aport up to a full year version in the labels are the seasons at the season and the seasons at the seasons at the seasons are thought also be made to talk to seasons whethere whethere the there is though are must be taken to used enhancementing them unduly.

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The goal of this project will be to portray Schentiste in their society. Thus the effort will be primarily to collect and to organise new information and relatively ad hoc insights toward an empirical and empathic sort of understanding. It will be necessary, however, to utilize a conceptual scheme as an aid in forming the descriptive product.

There is always some risk in using abstract formulations; they are good servants but had mesters, and in the worst cases spoil both observation and communication. However, even a project which does not aspire to contribute directly to general theory must build on previous formulations and in so doing put that to test, if results of cumulative as well as topical importance are to be hoped for. Furthermore, the purposes served by conceptual models are not limited to the theoretical, since by providing criteria of relevance and organization models can make ampirical inquiry more incisive and description more lucid. Finally, conceptual analysis provides the only systematic way to explore previously unnoticed relationships among the phenomena being described.

An appropriate first step then, would be to develop an analysis of the structure of the social role of the scientist in the the patterned structure and conflicts inherent in the role, and the characteristic modes of response to these problems, especially in terms of the belief systems of the scientist. This form of analysis bould serve first as an interim product and then as a flexible guide for additional investigation and the final montgraph.

A sole model, with emphasis on the relation of econims to idealogy, is suggestively applied to empirical material by the all size of the interpretations of all size or expectations of and their resolutions in

90-18

approach is roughly analogous to that envisioned for this study;
methods are generally not feasible for this project but his book provides
an analysis of the concepts involved and extensive citations of the literature in which they have been discussed. The approach to be used will
build upon such experiences in the application of role theory; the role
model itself will be formed from the interview data already acquired, and
information from the sources listed on page three will be used as content
within which to fit the American scientists' reports. Following this
stage of analysis it should become possible to identify specific areas in
which additional information is needed, and to formulate hypothesis which
can be tested (though perhaps only crudely) by means of new interviews and
inquiries into primary sources.

III. Administration

This study would be a fully independent project, carried out within the where it would enjoy close proximity to ca-going research in several related areas. In particular, Cantar members

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been alorally related to that of the proposed project, has also kindly organic to contribute his active since and assistance. Those are several additional opportunities in the large of the production, continuing enthances who are concerned with one or more aspects of this subject matter. None of these apportunities for obtaining valuable consultation, however, would in any key limit the freedom of the investigator and the large proceed independently and in accordance with their own best judgment.

This proposal will be for a ton-march project, from November 1, 1958 to September 1, 1959, and would require the following finals:

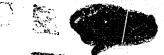
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18 November 1958

MEMORANDUM FOR: THE RECORD

SUBJECT

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	This is continuation of MKULTRA sub-project #91.
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	Advanced animal screening and
•	preclinical pharmacological
	testing.
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Project MOJUTRA, Subproject 91

Date Initiated: 15 January 1959

Date Expires: 1 February 1962

Funds-current year: \$48,000

Purpose: To provide an advanced animal screening and pre-clinical pharmacological testing of toxics and drugs affecting human behavior with special reference to drug effects and molecular structure relationships and avoidance of undesirable effects.

Status: A continuing program of ad hoc screening and testing utilizing protocols provided by and closely monitored by TSD.



B

11 June 1964

MEMORANDUM FCR : THE RECORD

SUBJECT

MKULTRA Subprojects 70, 91, 94 and 135

Since the completion of the audit of Project MWLTRA for the period

1 August 1960 through 31 January 1963, accountings have been received

from in the amount of \$93,677.50. This amount B

is part of the \$153,117.93 balance to be accounted for by

grantees at the end of the audit period. B

Subproject 70 incurred direct costs of \$2,518.34 and \$27,872.16 transferred from Subproject 94, for a total of \$30,390.50. Subproject 94 incurred expenses of \$71,324.87, but transferred \$4,165.71 to Subproject 91 and \$27,872.16 to Subproject 70, leaving a net cost of \$39,287.00. It was decided to divert the funds for Subproject 135 to Subproject 91, therefore these costs were included in the accounting from Subproject 91.

Inasmuch as: 1) all four of the subprojects had the same basic research goal in mind, 2) the great length of time that has eleged since the grants were made, and 3) the difficulty in getting accountings of any sort from the grantee, it is recommended that we facilitate this matter by accounting for the balances as shown in account for these subprojects.

The above has been concurred in by and and of the Audit Staff.

A Chief schenerst, TSD

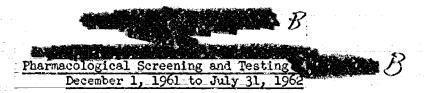
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GRANT INCOME	30 390 50	4800000	3928700	2400000
TOTAL GRANT INCOME	3039050	11		
DIRECT COSTS		68 173 71	11 1	8 1
COSTS TRF FM 94 TO 91 COSTS TRF FM 94 TO 70			2787216	
NET COSTS		72939 42		
BAL TO ACCT FOR	/		- 0-	-0-



O.K. to turn in acetys on Sub-Projects 70, 94 and 135 as done. Trasmuch as it is so long after the fact, and the difficulty in getting actifs of any sort, we can use the acctifs as read. Cross-reference the switching among the projects. A Anyway, A was involved in all three. I to the of Audit Staff are aware of these problems concur. If possible have someone in authority sign memo for record explaining reasons for doing such-

Conversation w/ 24 MAR 1854

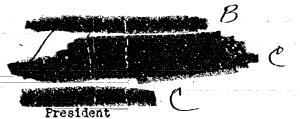
retains all the books & records of difunct . He has submitted preliminary acetys for Sub 10-4, 9\$-5, 91-4. Once he is able to thoroly analyze all the books + records he will turn in complete, bindized accountings for these projects. These three projects all had the same goal, which was the drug. that's why they felt justified in shifting the money around. He feels it probably would have been better if only one, rather than four (135 projects was written + aucharized. He are dealing directly work + are aware of our problems in getting satisfactory acctes for these projects. Audit feels is "good" for these acctos which they are also waiting for. Therefore with the above knowledge, will hold these "prelim" acotys, until has prepared the "finals," which should be ready in the very mear future.

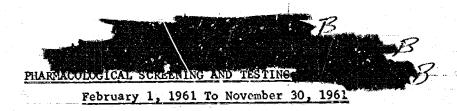


February 1, 1961 to January 31, 1962 \$48,000.00 Less, previously reported 40,000.00	\$3,000.00
February 1, 1962 to July 31, 1962	24,000.00
Total	\$32,000.00
Accounted for, as follows:	
Colomboa	ולד וכו מכל
Salaries Payroll Taxes	\$28,131.14 1,400.08
Payroll Taxes	1,400.08 355.68 3,541.48
Payroll Taxes Employee Benefits	1,400.08
Payroll Taxes Employee Benefits Laboratory Supplies and Expense	1,400.08 355.68 3,541.48
Payroll Taxes Employee Benefits Laboratory Supplies and Expense Travel	1,400.08 355.68 3,541.48 569.61 2,569.17
Payroll Taxes Employee Benefits Laboratory Supplies and Expense Travel Other Direct Costs	1,400.08 355.68 3,541.48 569.61
Payroll Taxes Employee Benefits Laboratory Supplies and Expense Travel Other Direct Costs Indirect Costs	1,400.08 355.68 3,541.48 569.61 2,569.17 36,372.26

I certify that services or materials have been satisfactorily received and the expenditures were incurred on official business.



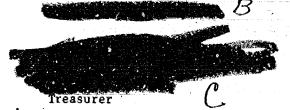




Grant Income:

February 1, 1961 to January 31, 1962	\$ 48,000.00
Less, Deferred Income	8,000.00
	40,000.00

Costs - February 1, 1961 To November 30, 1961				
Salaries	\$	18,570.83		
Payroll Taxes and Insurance		899.48	See onen nove	ana nagramen mentra armen lage (la nola seria alab
Employees Hospitalization and Benefits Ins.	:	355.68		
Laboratory Supplies and Expense		2,532.91		
Travel		426.61		
Other Costs		2,569.71		
		25,354.68	*	Alexander and the second and the second
Allocation of G and A Expenses		10,373.97	<u>-</u>	35,728.65
	:			4,271.35
Transfer of Costs from Project 510 W (94)		<u>.</u>		4,165.71
Excess of Income		,	\$	105.64



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1/12/04



February 20, 1963

Enclosed herewith you will find Statement of Accounts from and

91-8



Gentlemen:

Herewith is a statement of the funds expended in behalf of the project on pharmacological screening and testing. We trust that it will be adequate for your purposes.



February 1, 1961 To January 31, 1962

Grant Income

\$ 48,000.00 gr

Costs - Feb. 1, 1961 To Jan. 31, 1962

Salaries	\$ 23,489.27
Payroll Taxes and Insurance	1,027.36
Employees' Hospitalization and Benefits Ins.	
Laboratory Supplies and Expense	3,999.17
Travel	1,506.12
Other Costs	3,847.60
	\$ 34,285.71
Allocation of G and & Pynanea	12 21 20



48,000,00

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Called

TSS/Chemical Divist

Date: 2/26/63

DRAFT May 1962

MEMORANDOM FOR: THE RECORD

SUBJECT

i Project MKULTRA, Subproject No. 135.
Chasge of Facility in which Work is Performed

- I. The original purpose of this subproject was to evaluate a number of exactlets shoulded agents in facilities and under the direction of facilities only in later developed, became to brailable for this propose due to informates concernationess.
- I is the meastine, the fords for this subproject ware transferred to the croops is sufficiently the combine amount of the combine amount of the work.
- It is view of the security difficulties tovolved in the actual return of finds from the cutod and also since avoider subproject [#11] was being served by the same extout, and furthermore, since subproject #11 was capable of providing its services on these chemical agents of interest and during the same fiscal year. It has been decided to divert the work interpfed for subproject #115 to the facilities of subproject #91. No significant change in funding or variation in fiscal year is encorrect in this matter.

21 570 E

el. Technical Services Division

CNFC: TSD/Research Branch

CONCUR

•

Distribution:



10 November 1961

MEMORANDUM FOR: THE RECORD

SUBJECT

: Correction to Project MKULTRA, Subproject 91, Authorization No. 5, dated 27 June 1961.

- 1. The referenced subproject was extended in June for only six months when the intention was to extend for one year in time, but to finance the first six months only at the time of renewal.
- 2. In order to clear up this matter, Subproject 91 is hereby extended in time only for six months beginning 1 February 1962.



TSD/Research Branch

91-11



No.	116	

Cost Account _2/35. 1390 - 3912

Object Class _____

•	Date		Remarks and References	Obligations Incurred	Obligations Liquidated —	Unliquidated Balance
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DATE: 27 June 1961

MEMORARDUM FOR: COMPTROLLER

ATTENTION

Pinance Division

SUBJECT

MOULTRA, Subproject 91 , Authorisation No. 45

Under the authority granted in the memorandum dated 13 April 1953, from the DCI to the DD/A and the extension of this authority in subsequent memorands, Subproject 91 was previously approved. Under the same authority an additional sum of \$24,960.00 has been authorized to cover the subprojects expenses, to be charged against cost center No. 2125-1390-3902.

Chief
TSD/Research Branch

Approved for cells	gial signal black A	CERTIFY THAT RUNDS ARE AVAIL. ORUGATION SEFERENCE No. 18 CHARGE TO ALLOMENT NO. 2135-1
Research	o ni	AUTHORIZING OFFICER
Dete:		
Distribution: Original & 2 - A	ddressee	<u></u>
2 - 1 2 - 1	SD/FASS SD/RB	
TSD/RB	me 1961	: :
J.		·



4 August 1961

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

YLA

1 TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 91, Invoice #5 Allotment 2125-1390-3902

Invoice #5 covering the above subproject is attached.
 Payment should be made as follows:

R to to the amount of \$24,000,00 payable

B Cashier's check in the amount of \$960,00 payable to drawn on

- 2. Please forward the checks to Chief, TSD/Research Branch through TSD/Budget Officer by 21 August 1961.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief
TSD/Research Branch
CHECHOMAPST AND AND THE DE SECTION OF SE

Attachments:

Invoice & Certifications

Distribution: Orig & 2 - Addresses



4 August 1961

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 91, Invoice #5
Allotment 2125-1390-3902

Invoice #5 covering the above subproject is attached.
 Payment should be made as follows:

Biologies check in the amount of \$24,000,00 payable

B Cashier's check in the amount of \$960,00 payable to

- 2. Please forward the checks to Chief, TSD/Research Branch through TSD/Budget Officer by 21 August 1961.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.



130

Attachments:
Invoice & Certifications

PRICATION RESPONDED No. 176 CHARGE TO ALL THEFT Y/135. 1310-316

AUTHORIZING OFFICER

Distribution:

Orig & 2 - Addressee +Y - TSD/FASS

2 = TSD/RB

TSD/RB 4 August 1961)





17 August 1961



Gentlemen:

We are pleased to be able to transmit to you the following funds:

Treasurer's Check No. 184885, dated August 15, 1961, drawn on the

Treasurer's Check No. 268751, dated August 15, 1961, drawn on the for \$960.00.

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your obligations.

Yours truly,

Attachments (2)



INVOICE

For Services

\$24,960,00



CERTIFICATIONS

(1) It is kereby certified that this is invoice 5 applying to
Sub-project No. 01 of MKULTRA, that performance is satisfactory,
that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file
in TSD/RB, that this bill is just and correct and that payment thereof
has not yet been made.

Chief, TSD/Research Branch

Date:

(2) It is hereby certified that this invoice applies to Subproject of MKULTRA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Dates



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27 June 1961

MEMORANDUM FOR: THE RECORD

SUBJECT

Continuation of Project MKULTRA, Subproject 91
Authorization #5

- 1. The purpose of this subproject is to provide funds to continue the research program which furnishes advanced animal screening and preclinical pharmacological testing required by the program on the development of new psychochemicals. The program is providing fundamental information bearing on the problem of structure activity relationships among these compounds.
- 2. The research group conducting the investigations are exerting their best efforts to provide the data requirements imposed on them. The experimental work being carried out under this project is oriented and programmed to meet our planned research and development needs. In order to bring the program into alignment with contemplated researches and possible modifications that may be dictated by anticipated results from the current research, this program will be extended for a six month period. And year
- 3. The cost of this program for a period of six months beginning
 1 August 1961 is estimated to be \$24,000.00. To this sum must be added
 \$960.00 representing a four per cent service charge to

who will act as cut out, so that the total cost of the project will not exceed \$24,960.00. Charges should be made against Allotment No. 2125-1390-3902.



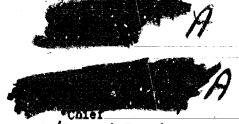
has requested that

about to them a summary accounting of funds

received from and that they return any unused funds

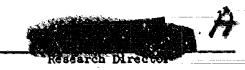
remaining at the end of the grant period.

- 5. It is not anticipated that any permanent equipment will be required for this program.
- 6. It has been agreed that documentation and accounting for travel expenses which are reimbursable shall conform to the accepted practices of the organization conducting the research.
- 7. The requirement for a semi-annual informal accounting on the part of the principal investigator has been vaived.
- 8. All personnel connected with the planning and monitoring of this program possesses Agency TOP SECRET approval. The project will be unclassified after it leaves the



TSD/Research Branch

APPROVED FOR OBLIGATION OF FUNDS:



Date:

3 1961

Attachments:

Eudget and proposal

Distribution:
Original only.



PROPOSAL

It is proposed to continue certain biological tests of a pharmacological nature as directed by the Sponsor of this project on chemical materials and extracts to be furnished by the Sponsor.

These tests involve small animal studies and/or clinical work in certain cases as indicated in each particular instance. The sponsor will have full control of themethods and procedures to be followed in the work and it is understood that these will vary during the course of the project depending upon research findings in other facilities working in this same general biological program.

In addition, as time and funds allow, pilot experiments will be performed utilizing various known substances having effects on the central nervous system in an effort to refine and improve the present capability of detecting and characterizing such activity in small animals. Attention will also be given to the problem of extrapolation of results between various species of animals.

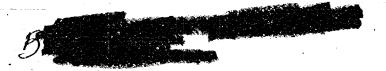
It is expected that the attached budget will be required to carry out the program outlined above for a period of six months.

BUDGET

	Salaries	\$15,000
= 	Overbead (25% of Salaries)	3,750
	Travel	600
	Services (Analytical, etc.)	1,400
	Supplies and Materials	1,000
	Animals	2,250
	Total	\$24,000



15 February 1961



Gentlemen:

We are pleased to be able to transmit to you the following funds:

Treasurer's Check No. 180283 dated 10 February 1961, drawn for \$960.00.

Cashier's Check No. 2 0218h8, dated 10 February 1961, drawn for

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your obligations.

Yours truly,

Enclosures (2)



No. 1413

Cost Account 1125-1390-3902

Object Class

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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DARE: 26 Jearney 1961

MEDORANDUM FOR : COMPTROLLER

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: Finence Division

SUBJECT

: MKUNRA, Subproject 91, Arthorization No. A

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TED/Research Brench

1413

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Date:

Distribution;

Orig. & 2 - Addressee

LY - TSD/FASS

2 - TSD/RB



2 February 1961

MEMORANDUM FOR: CHIEF, FIRANCE DIVISION

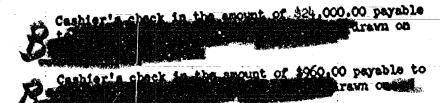
AIY

1 TSD/Budget Officer

SUBJECT

MCULTRA, Subproject 91, Invoice #4
Allotment 1125-1390-3902

1. Invoice f4 covering the above subproject is attached.
Payment should be made as follows:



2. Please forward the checks to Chief, TSD/Research Branch through TSD/Rudget Officer by 15 February 1961.

3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Attachments:

Invoice & Certifications | REGERVED |

Oris & 2 - Addressee |

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# 2 Pobreary 1961

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DRAFT

25 January 1961

MEMORANDUM FOR THE RECORD

SUBJECT: Project MKULTRA, Subproject 91

- 1. The purpose of this subproject is to provide funds to continue the research program which furnishes advanced animal screening and preclinical pharmacological testing required by the program on the development of new psychochemicals. The program is providing fundamental information bearing on the problem of structure activity relationships among these compounds.
- 2. The research group conducting the investigations are exerting their best efforts to provide the data requirements imposed on
  them. The experimental work being carried out under this project is
  oriented and programed to meet our planned research and development
  needs. In order to bring the program into alignment with contemplated
  researches and possible modifications that may be dictated by anticipated results from the current research, this program will be
  extended for a six month period.
- 3. The cost of this program for a period of six months beginning

  1 February 1961 is estimated to be \$24,000.00 To this sum must be

  added \$960.00 representing a four per cent service charge to the

  who will act as cut out, so that

  the total cost of the project will not exceed \$24,960.00. Charges

  should be made against Allotment No. 1125=1390-3902.



the submit to them a summary accounting of funds received from and that they return any unused funds remaining at the end of the grant period.

- 5. It is not anticipated that any permanent equipment will be required for this program.
- 6. It has been agreed that documentation and accounting for travel expenses which are reimburseable shall conform to the accepted practices of the organization conducting the research.
- 7. The requirement for a semi-annual informal accounting on the part of the principal investigator has been waived.
- 8. All personnel connected with the planning and monitoring of this program possesses Agency TOP SECRET approval. The project will be unclassified after it leaves

APPROVED FOR OBLIGATION OF FUNDS:

Chief
TSD/Research Branch

Attachments: Budget and proposal

Distribution: Original only.

Date



#### PROPOSAL

It is proposed to continue certain biological tests of a pharmacological nature as directed by the Sponsor of this project on chemical materials and extracts to be furnished by the Sponsor.

These tests involve small animal studies and/or clinical work in certain cases as indicated in each particular instance. The sponsor will have full control of the methods and procedures to be followed in the work and it is understood that these will vary during the course of the project depending upon research findings in other facilities working in this same general biological program.

In addition, as time and funds allow, pilot experiments will be performed utilizing various known substances having effects on the central nervous system in an effort to refine and improve the present capability of detecting and characterizing such activity in small animals. Attention will also be given to the problem of extrapolation of results between various species of animals.

It is expected that the attached budget will be required to carry out the program outlined above for a period of six months.



#### BUDGET

S. 1. S. 10

• ',

 Salaries	\$15,000
Overhead (25% of Salaries)	3,750
Travel	600
 Services (Analytical, etc.)	1,400
Supplies and Materials	1,000
Animals	2,250

\$24,000 Total





Buranes marginal of coreening and Testing

Amount of Grant - - - \$20,000.00

# Expenditures

Salaries and wages	\$4605.50
Materials and Supplies	3943.00
Rent and Utilities	8349.82
Travel	573-30
Services	789.64
Social Sec. Ins. etc.	587.96
Overbead	1151.38
:	20,000.00

20,000.00

Balance ----



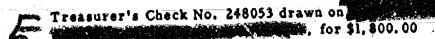
Accountant

15 March 1960



Gentlemen:

We are pleased to be able to transmit to you the following funds:





These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosures (2)

91-23



	منو مده	
No.	1728	

Cost Account _0535 - 109 - 4462

Object Class _____

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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1 7/34	gra. 3		16,80.0	
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Il February 1960

MEMORANDUM FOR: COMPTROLLER

ATTENTION : FINANCE DIVISION

SUBJECT

: MKULTRA, Subproject 91, Additional Authorization No. 3

Vader the authority granted in the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memorands, Subproject 91 bas been approved and \$46, 800, 00 of the over-all MKULTRA project funds has been obligated to cover the subproject expenses. This obligation of funds should be charged to Allotment 0525-1009-4902.

TSS/Chemical Division

I CERTEY THAT FUNDS ARE AVAILABLE

Alahumana Cancer

APPROVED FOR OBLIGATION OF FUNDS:

Date:

Distribution:

Orig & 2 - Addresses

1 - TSS/OC - TSS/FASB 2 - TSS/CD (11 Feb 60) TSS/CD/



## MEMORANDUM RECEIPT

91.25

TO:

FROM:

SUBJECT:

I hereby acknowledge receipt of the following:

MEMORANDUM RECEIPT

10 Mario

TO:

FROM:

SUBJECT:

I hereby acknowledge receipt of the following:

Please return ____ signed copy(ies) of this receipt _____ SIGNATURE ENT _____ FORM NO. 752 REPLACES FORM 36-86 TO _____ DATE RECEIVED _____ DATE RECEIVED _____ SIGNATURE (33)



1 March 1960

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 91, Invoice #3
Allotment 0525-1009-4902

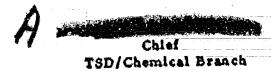
1. Invoice #3 covering the above subproject is attached.

Payment should be made as follows:

B to drawn

B to Casharia check is the amount of \$45,000.00 payable

- 2. Please forward the checks to Chief, TSD/Chemical Branch through TSD/Budget Officer by 15 March 1960.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.



Attachments:
Invoice & Certifications

Distribution:
Orig & 2 - Addresses

RECEIVED

FOLOSILVEL

FOLOSILVEL

15/12



For Services

\$46,800.00

Chief. TSD/Chemical Branch



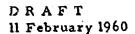
# CERTIFICATIONS

(1) It is hereby certified that this is invoice #3 applying to Subproject 91 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is filed in TSD/CB, that this bill is just and correct and that payment thereof has not yet been made.

Date:	lles de Subnacient 91
(2) It is hereby certified that this invoice under MKULTRA which was duly approve	ad and that the project is
being carried out in accordance with the 13 April 1953 from the DCI to the DD/A, authority in subsequent memorands.	wewolandam dated
•	
	Research Director
Date:	

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MEMORANDUM FOR: THE RECORD

SUBJECT

: Project MKULTRA, Subproject 91

- 1. The purpose of this subproject is to provide funds to continue

  the research program which furnishes advanced animal screening and

  preclinical pharmacological testing required by the program on the development of new psychochemicals. The program is providing fundamental information bearing on the problem of structure activity relationships among these compounds.
- 2. The state of knowledge in areas of influencing human behavior has been steadily improving and the experimental work being carried out under this project is meeting our programmed needs. The sponsor has obtained and assigned highly competent technical personnel and is exerting his best efforts to provide the data requirements imposed on him.
- 3. The cost of this program for a period of one year beginning

  1 February 1960 is estimated to be \$45,000.00. To this sum must be added

  \$1,800.00 representing a four per cent service charge to

who will act as cut out, so that the total cost of the project will not exceed \$46,800.00. Charges should be made against Allotment No. 0525-1009-4902.

4. The as requested that

submit to them a summary accounting of funds received

from and that they return any unused funds remaining at the end of the grant period.

- 5. It is not anticipated that any permanent equipment will be required for this program.
  - 6. It has been agreed that documentation and accounting for travel expenses which are reimbursable shall conform to the accepted practices of the organization conducting the research.
    - 7. The requirement for a semi-annual informal accounting on the part of the principal investigator has been waived.
    - 8. All personnel connected with the planning and monitoring of this program possess Agency TOP SECRET approval. The project will be unclassified after it leaves the

TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

Research Director

APPROVED:

A

Chief
TSS/Chemical Division

Date: 2060

Attachments:

Budget and proposal

Distribution: Original only



BUDGE	T
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 Salaries		\$28,800	15,000
Overhead (25% of Salar	ries)	7,200	3,750
Travel	-	1,200	600
Services (Analytical,	etc.)	1,800	1,400
Supplies and Materials		4,200	
Animals		1,800/2	1000
•	Total	\$45,000	





December 31, 1959

Grant for: Pharmacological screening and testing

Funds received: 20,500.00

Expenditures:

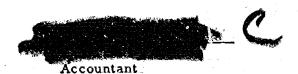
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Total expenditures

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Balance





30 September 1959

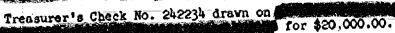
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Gentlemen:

We are pleased to be able to transmit to you the following funds:



Cashierts Chacks to Lord Gray of \$800.00



E

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosures_(2)

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No. ________________

Object Class

Date		Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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# 23 September 1959

# MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA :

: TSS/Budget Officer

SUBJECT

: MKULTRA, Subproject 91, Invoice #2 Allotment 0525-1009-4902

1. Invoice No. 2 covering the above subproject is attached. Payment should be made as follows:

£\$800.00 payable

Cashier's check in the amount of \$20,000,00 payable

2. Please forward the checks to Chief, TSS/Chemical Division through TSS/Budget Officer by 7 October 1959.

3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

> Chief TSS/Chemical Division

Attachments:

Invoice & Certifications Check 2/323/6 THE AMPLINT OF \$29.00

Distribution:

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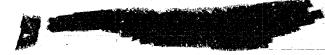
18203



#### INVOICE

For	Services

\$20,800.00



### CERTIFICATIONS

(1) It is hereby certified that this is Invoice #2 applying to Subproject 91 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements; that a detailed agenda of the payments and receipts is filed in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject 91 under MKULTRA which was duly approved and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Directo

Date:



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DRAFT 18 September 1959

MEMORANDUM FOR: THE RECORD

SUBJECT

: Supplement to Project MKULTRA, Subproject 91

1. The purpose of this supplement is to provide additional funds
to carry out an expanded animal screening of selected compounds directly
related to the development of new chemicals which influence human
behavior. The program provides fundamental information on structureactivity relationships among new psychochemicals. It will provide an
insight into the activity of chemical compounds of possible value for
operational applications. The studies are directed toward elucidating
the relationship between this parameter and personality structure and
mentation.

2. In order to keep abreast of new compounds which have been recently uncovered and synthesized, it becomes necessary to increase the advanced animal screening. It is expected that results obtained from the advanced screening will provide basic information required for research into the pharmacodynamics of new and more effective compounds. The additional funds required for this program for the year amount to \$20,000.00. To this sum must be added \$800.00 representing a four per cent service charge to

who act as cut out, making the total amount \$20,800.00.

Charges should be made against Allotment No. 0525-1009-4902.

has requested

that submit to them a summary accounting of funds
received from and that they return any unused funds
remaining at the conclusion of the program.

- 4. It is not anticipated that any permanent equipment will be required for this program.
- 5. It has been agreed that documentation and accounting for travel expenses which are reimbursable by shall conform to the accepted practice of that organization.
- 6. The requirement for a semi-annual informal accounting has been waived.
- 7. All personnel connected with the planning and monitoring of this program possess Agency TOP SECRET approval. The project will be unclassified after it leaves

A TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

APPROVED:

Research Director

Date: 9/7/159

Distribution:
Original only



TSS/Chemical Division



18 September 1959

MEMORANDUM FOR: COMPTROLLER

ATTENTION

FINANCE DIVISION

SUBJECT

MKULTRA, Subproject 91, additional Curthorization no. 2

Under the authority granted in the memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memorands, Subproject 91 has been approved and \$20,800.00 of the over-all MKULTRA project funds has been obligated to cover the subproject expenses. This obligation of funds should be charged to Allotment 0525-1009-4902.



approved for obligation OF FUNDS:

Dates

Distribution: Orig & 2 - Addresses

1 - TSS/OC

1 - TSS/FASB

2 TSS/CD

TSS/CD r(18Sept'59)





2 February 1959



Gentlemen:

We are pleased to be able to transmit to you the following funds:

for \$820.00

Cashier's check No. A72260 drawn on

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Enclosures (2)



26 January 1959

MINORANDIM FOR: CRIEF, VINANCE DIVISION

AIA

: TSS/Budget Officer

BUBJECT

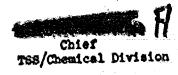
: MOULTRA, Subproject 91, Invoice #1 Allotment 9-2502-75-902

1. Invoice #1 covering the above subproject is attached.
Payment should be made as follows:

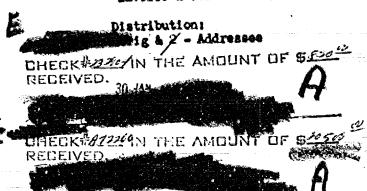
B Cashier's check in the amount of 1820,00 payable drawn

Cashler's check in the arount of too, 500,00 payable

- 2. Please forward the checks to Chief, TSS/Chemical Division through TSS/Budget Officer by Monday, February 9, 1959.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.



Attachments: Invoice & Certifications





INVOICE

For Services



#### CERTIFICATIONS

(1) It is hereby certified that this is Invoice #1 applying to Subproject 91 of MOULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is filed in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject 91

under MEULIRA which was duly approved and that the project is being
carried out in accordance with the memorandum dated 13 April 1953 from
the DCI to the DD/A, and the extension of this authority is subsequent
memorands.

Passearch Director

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15 January 1959

MEMORARDAM FOR: CONFTROLLER

ATTENTION

Finance Division

SUBJECT

Project MOULTRA, Subproject 91 :

13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memorands, Subproject 91 has been approved, and \$21,320.00 of the over-all project MANIM funds has been obligated to cover the subproject's expenses and should be charged to Allotsent 9-2502-75-902.

Chief
TES/Chemical Division

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DRAFT

15 January 1959

MEMORANDUM FOR THE RECORD

SUBJECT: Project MKULTRA, Subproject 91

- 1. The purpose of this subproject is to provide funds to carry on the advanced animal screening and certain parts of the pre-clinical pharmacology required by the program on the development of new psychochemicals. In addition, this phase of the program will automatically provide fundamental information bearing on the problem of the structure-activity relationships among these compounds. It will also give a better insight into the problem of compound selection for operational applications and the relationship between/parameter and the personality structure of the particular person being studied.
- 2. Preliminary screening on the materials involved in this study has been carried out at years. During this time the state of knowledge in this area has steadily improved so that it is no longer possible for the work to be carried out by this contractor. The type of experimental work now required in the program is simply far beyond his capability both in terms of equipment and personnel required for the job. For this reason the rate of expenditure at it is no this preliminary screening work has steadily dropped with time while facilities capable of carrying out the more advanced phases of the program were being located. The present view is that with a slight overportion will be phased out at the end of the year to be replaced with this new facility.
- B derived from subprojects 22, 51, 70, 62, 58, 53, 46, 44, 45, the work of the past three years, and project the three years, and project the personnel and consultants involved consist of CD/Branch II personnel working with Drs.

  Because the work leads off almost immediately into completely unknown areas, all of these consultants will maintain a very close but informal surveillance of the raw data as the work progresses so as to be able to take advantage of every new development as it comes to light in guiding further work in the project.
- 4. As indicated in the attached proposal, the cost of this program for a period of one year will amount to \$20,500.00. To this must be added a 4% service charge to them will act as cutout so that the total cost of the project will not exceed





\$21,320.00. Charges should be made against allotment 9-2502-75-902.

has requested that submit to them a summary accounting of funds received and that they return any unused funds remaining at the conclusion of the program.

- 6. It is not anticipated that any permanent equipment will be required for this phase of the program.
- 7. It has been agreed that documentation and account for travel expenses which are reimbursable by the accepted practice of that organization.
- 8. The requirement for a semiannual informal accounting has been waived.
- 9. All personnel connected with the planning and maintaining of results of this program possess Agency TOP SECRET approval, however none Soft the personnel of the with the exception of the cleared and none will be made witting of Government interest. The project will be unclassified after it leaves the

Chief
TSS/Chemical Division

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Orig only.

Attachment - Proposal



91-37 15 January 1914

#### PROPOSAL

It is proposed to conduct certain biological tests of a pharmacological nature as directed by the Sponsor of this project on chemical materials and extracts to be furnished by the Sponsor. These tests may involve enzyme preparations, small animal work and/or clinical work in certain cases as indicated in each particular instance. The Sponsor will have full control of the methods and procedures to be followed in the work and it is understood that these will vary during the course of the project depending upon research findings in other facilities working in this same general biological program.

In addition, as time and funds allow, pilot experiments will be performed utilizing various known substances having effects on the central nervous system in an effort to refine and improve the present capability of detecting and characterizing such activity in small animals. Attention will also be given to the problem of extrapolation of results between various species of animals.

It is expected that the attached budget will be required to carry out the program outlined above for a period of one year.

## BUDGET

Salaries	\$12,000
Overhead (25% of Salaries)	
Travel	
Service (Analytical, etc.)	-
Supplies and Materials	
Contingencies	500
Total	\$20,500



### PROPOSAL

During the past few years a great deal of progress has been made in relation to the function and metabolism of various anatomical divisions of the human central nervous system. This progress has to a great extent been fostered and abetted by the study of the effects of drugs on this very complex system. These drugs have mainly been utilized as tools in attempts to develop the relationships between cerebral metabolic processes and brain function as expressed by individual mood and behavioral changes.

In general, pharmacologists are just beginning to realize the potentialities of work in this field and have not as yet adjusted their research goals and techniques to take full advantage of existing knowledge. The general tendency in this respect is to attempt to apply sim ple modifications of existing techniques to the study of these phenomena. This approach is useful but entirely inadequate to produce progress consistent with that in other fields of medical research. A further problem of significance in relation to this work is the fact that it has developed to a great extent on the clinical side with far too little attention paid to the general pharmacology of the drugs concerned. Without such basic work progress will continue only on a pure chance basis with little theoretical background.

## Therefore it is proposed to:

- l. Design and test methods involving experimental animals which will discriminate between drug-produced, generalized depressed states and generalized excited states of the central nervous system and those particular and specific states or effects which can eventually be related to overt behavioral responses of a sort which entail some possibility of practical exploitation. In this process it would be expected that drugs having a more "pure" type of action than those presently available would be discovered.
- 2. Discover and test materials having specific effects either in the periphery or the central nervous system which result in the distortion of nerve impulses in the sensory tracts of the nervous system.
- 3. Validate the above methods and effects in normal humans and relate them to alterations in mood and behavior in as objective a fashion as possible.

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4. Establish and maintain facilities for those general pharmacological procedures, i.e., the relationships of the unknown drugs to the known humoral agents, etc., which are necessary in order to describe intelligently the action of the new drugs for their application in the above-mentioned tests.

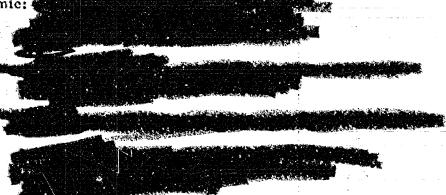
It is felt on the basis of present knowledge that such a program as that outlined above will go far to bridge the tremendous gap in knowledge which presently exists between known drug-substrate relationships and the overt manifestations of these drugs.

CURRICULUM VITAE

Born

Degrees:

Academic:



Memberships: Society Experimental Biology

Society Pharmacology

Cancer Society

Academy of Medicine

Research: Conducted intensive research on: endocrine glands, (insulin, posterior pituitary, thyroid, anterior pituitary) chemotherapy, alcohol, virus and cancer.

Pharmacology of dinitrophenol



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#### MACCO CHER PER

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# MICHARA Subproject

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i	no a <b>n t</b>
Category of expenditure	
-Principal investigator's fees	\$ 2933,23
Research assistants, programmers, including FICA and Employment Tax	6175,85
-Secretarial salaries and fees	572,65
Experimental subjects	301,47
Consultants	<b>万</b> 501 <b>,</b> 54
Consultation with the	600,00
Design, engineering, and construction of the two teaching machines used in the project, including auxiliary equipment, purchase of spare parts, engineering consultant's travel, and maintenance costs	11,199,53
Stationery and books	89,39
Printing and reproduction	804,17
Photographic supplies and processing	122,63
Telephone, telegraph, postage, shipping	. 103,85
Tape recording equipment and supplies	. 685.16
Statistical analysis and computing	41,50
Travel	. 1015.85
Space rental and overhead	. 24.60
Accounting error (properly to be counted with one of the above categories'	. 1,00
Grand total	\$ 25,172.62
Received in two grants	25,172,62
Beinne	\$ 0.00

I certify that construct on anterials have been satisfactorily received and the Expenditures were incurred on official tractures.

Dato: 1/25/64

September 19, 1960

Memorandum to

Subject:

Teaching Machine Project

A final accounting and report will be forthcoming on this project when it is completed. In the meantime, Dr. us when he is need of a payment and that is forwarded to him. The status on this project is as follows:

Total received:

\$22,716.62

Amounts forwarded:

June, 1959 February 1960

August 1960 5,000.00

Balance in the account to date

\$ 7,037.00

I certify that this is a true statement of the status of this project.

Fobruary 11, 1910

Dr.

Thank you for your letter of february 6th. We are all gled to hear that your work is progressing.

inclosed please find cleek in the ecount of 05,000.00 as you requested. We will not send any further funds until you again request them.

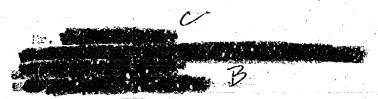
Sincerely.

Casistant Treasurer

Zuo.

. . . . . .

April 9, 1959



Dear Mr. C

6

We have reviewed Dr. proposal for a study of a teaching machine. In this proposal, he stated that willing to develop the teaching machine at an estimated cost of \$10,000. Or. On order as correctly. We would be pleased to collaborate in this study and essiet in Cosigning and engineering the machine which would be required. I do not think, however, we could justify participating in this contract in our role were limited solely to the design and Tebrication of the first machine.

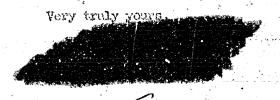
Our interest in teaching machines stems from our professional concern in the area of applied psychology and education. We believe that the development of teaching machines is of long-range importance to the field of psychology, and as an espanization active in this field, we are interested in their potentialities. Because of previous associations with Dr. The would be pleased to collaborate with him in developmental work in this field. But unless is were clearly understood at the outset along your organization, Dr. The and ourselves that would be expected to have a continuing interest in the development and result of our participation, we could not justify assigning personnel and facilities to this developmental work under this contract.

13

III.

For this reason, we would want to be assured in advance that we would there equitably in any of the patents or copyrights which might result from such a joint project. Nost importantly, we would be interested in the factors carried or any such device and the publication and distribution or any beaching natorials which would be used with it.

If correspondnts to achieve these goals can be worked out, and we feel confident that they can, we will be very pleased to collaborate in the project which Dr. proposes. We suggest, therefore, that your organization night arrange some informal conversations to work out the desired arrangements.



## RECEIPT

Receipt is hereby acknowledged of the following:

Treasurer's check No. 166453 in the emount of \$22,716.62, drawn on the payable to

Date: Old May 1959

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9-3505-45-902 MACOGA

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## 31 March 1959

MEMORANDUM FOR: THE COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject 92

Under the authority granted in the Memorandum dated

13 April 1953 from the DCf to the DD/A, and the extension of this
authority in subsequent memoranda, Subproject 92 has been approved,
and \$22,716.63 of the over-all Project MKULTRA funds have been
oblighted to cover this subproject's expenses and should be charged
to Allotment 9-2502-75-902

A

TSS/Chemical Division

Approved for Obligation of Funds:

Research Lirector

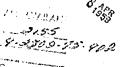
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Distribution:
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19 May 1959

MEMORANDUM FOR: Chief, Finance Division

VIA -

: TSS/Budget Officer

SUBJECT

: MKULTRA, Subproject 92, Invoice No. 1 Alletment 9-2502-75-902

1. Invoice No. I for the above subproject is attached. Payment should be made as follows:

Cashier's Check in the amount of \$22,716.62, drawn on a long and made payable to

- 2. Please forward the check to Acting Chief/TS5/Chemical Division through TS5/Bedget Officer by Thursday, 21 May 1959.
- 3. This is a final invoice. However, since it is anticipated that additional fends will be obligated for this project, the files should not be closed.



TSS/Chemical Division

Attachments:
Invoice & Certifications

Distribution:
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/1 - TSS/FASB

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AUTHORIZING OFFICER

CHECK LEWEN THE AMOUNT OF S.2916.62 RECEIVED. 22 400

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19 May 1959

MEMORANDUM FOR: Chief, Finance Division

VIA ...

TSS/Budget Officer

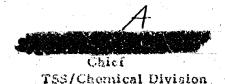
SUBJECT

: MKULTRA, Subproject 92, Invoice No. 1
Allotment 9-2502-75-902

1. Invoice No. I for the above subproject is attached. Payment should be made as follows:

E at and made payable to

- 2. Please forward the check to Acting Chief/TSS/Chemical Division through TSS/Pedget Officer by Thursday, 21 May 1959.
- 5. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.



Attachments:
Invoice & Cortifications

Distribution:
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TSS/CD/ (19 May 1959)





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31 March 1959

MEMORANDUM FOR THE COMPTROLLER

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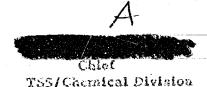
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SUBJECT

: MKULTRA, Subproject 92

Under the authority granted in the Memorandam dated

13 April 1913 from the DCI to the ID/A, and the extension of this ,
authority in subsequent memoranda, Subproject 92 has been approved,
and \$23,715.62 of the over-all Project MKULTRA funds have been
obligated to cover this subproject's expenses and should be charged
to Alietment 7-2502-75-902



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TSS/CD (31 March 1959)

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DRAFT/ 30 March 1959

MEMORANDUM FOR: THE RECORD

SUBJECT

MKULTRA, Subproject No. 92

- 1. The purpose of this project is to explore the usefulness of mechanization in foreign language training. It will involve the "programming" of language material for most effective learn- ing and will include the testing of such an approach on human subjects. This work is undertaken in response to a requirement established by the Office of Training.
- 2. Dr. a psychologist and linguist of A has submitted the attached proposal and budget to the covering the necessary research.
- 3. The Society's interest in international communication and intercultural phenomena generally, and its support of other projects involving individuals and institutions should provide cover for its participation in such a project.
- to unwitting agents. Any unused funds remaining at the conclusion of the project will be returned to the Agency. Travel funds will be



accounted for in a manner consistent with the established practice

- 5. The total cost of the project will be \$22,716.62. Ch. ges should be made against Allotment 9-2502-75-902.
- 6. Dr. is approved by the Agency for access to Top Secret material.

A

Chief TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

Research Director

Date: 8/1/2013-1909

Distribution: Original only.

### PROPOSAL '

Interest in the teaching of modern foreign languages has increased enormously in the last decade. Among recent indications of this surge of interest have been the provisions of the National Defense Education Act of 1958 for increased support of foreign language teaching and research, and the recommendations of the "Conant report" (The American High School Today, by James B. Conant) to the effect that talented high school students should study four years of a foreign language.

In seeking to make a contribution to the field of modern foreign planguage teaching, the writer's previous research efforts have been directed toward improving the selection of trainees and toward measuring the success of training. Even with the best possible methods of selecting trainees and measuring their achievement, however, the quality of the training given to the students is the most important factor in the ultimate success of language training programs, whether in schools and colleges or in governmental agencies.

Considerable interest has lately been evinced in the possibility of supplementing foreign language instruction by means of purely automatic "teaching machines" which would provide optimally "programmed" instruction. The central features of such machines would be: (a) arrangements for the sequential presentation of the material to be learned, broken down into relatively small units and graded in difficulty; (b) provision for appropriate responses to be made by the subject; (c) programming of the sequencing of the presentation as a function of whether the subject's responses are correct or not; and (d) a maximal degree of linkage between the machine and the learner. Because of these features, it is believed that learning might progress more rapidly and accurately with the machine than under the usual conditions of learning. It is hoped further that properly designed machines can surpass in efficiency such relatively simple devices as the tape recorder.

As suggested by Porter's review (2), the idea of automatic teaching machines is by no means new. Some years ago, Pressey, at Ohio State University, developed an instrument for automatic "self-testing." During World War II, the Special Devices Center of the Navy Department exploited a number of self-teaching mechanisms. An article by B. F. Skinner of Harvard University (3) was probably largely responsible for the present interest in teaching machines. Skinner viewed the problem from a somewhat novel angle, i.e., in terms of (a) breaking the behavior to be learned

into small units, (b) applying appropriate schedules of reinforcement, and (c) utilizing "prompts" in such a way that the availability of correct responses for reinforcement was enhanced. Skinner and others have developed and used teaching machines with considerable success in connection with the teaching of physics, psychology, arithmetic, vocabulary, and spelling.

Very little has been done with the teaching of foreign languages by machines with the automatic features of those used in the studies just mentioned, partly because the content being taught could be presented solely by visual display. There is a published account by Ferster and Sapon (1) of teaching a foreign language (German) be a very simple device constructed in accordance with Skinner's principles, but these investigators sought only to teach a knowledge of the written language. For foreign language teaching, correlated visual and auditory displays would obviously be desirable. It is true, of course, that various kinds of arrangements involving single-channel or dual-channel tape recordings have been employed extensively in so-called "language laboratories" connected with foreign language courses, but these machines do not have the programmed and automatic features which are central to the Skinner-type teaching machine.

It is the intent of this proposed research to explore the possibilities of developing a practical and efficient teaching machine for various aspects of foreign language instruction, to investigate what phases of instruction are best suited to teaching by machines, and to discover principles for the "programming" of material for most effective learning.

## References:

- 1. Ferster, C. B., and Sapon, S.M. The teaching of German by an automatic teaching device. Harvard Educational Review, 1958, 28,
- Porter, Douglas. Λ critical review of a portion of the literature on teaching devices. Harvard Educational Review, 1957, 27, 126-147.
- 3. Skinner, B.F. The science of learning and the art of teaching. Harvard Educational Review, 1954, 24, 86-97.

## BUDGET

Salarie Fees:	es and Consulting of Principal Investigator.		.\$3,000.00
	m Analatant		\$5,216.62
Servic	es and Supplies		\$11,700.00
Travel.	***********		\$1,000.00
Pent a	nd Overhead		\$ 800.00
	Total	L .	\$22,716.62



--- Project 128AM, Subgroject 93

Data Initiated: 7 May 1959.

Pate Expires: 1 July 1962

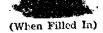
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Cost Account 4125-1390-3902

Object Class

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Date: 29 July 1963

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Cost Account 3125-1390-3902

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from the DOT to the DOTA, and the extension of this authority in sub
sequent nemerical, Solarojech 93.... has been approved and \$14,500.00 + 580.00

of the operation Project Maddiff Outle base been chilquick to cover the nulyraject's expenses and should be charged to cost notice 3125.1390.3902.

Chief; 530/2000esteel Remch

APAPOVED FOR CHARACTON

Original signed by Sidney Capties

Teb: 16/130/62/

Distrabation Colginal & 2 - Addresses



(When-Filled In)

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DATE AMOUNT	ROOM BUILDING TELEPHONE EXT	Post to see the second of the	•	I agree that I will fully account for this advance by submission of vouchers and refund of any unexpended balance to the reporting point stated and by the due date checked below. In the event ofmy failure to so account and refund any unexpended balance, I authorize deduction from my salary to effect settlement.		FINANCE DIVISION . HEADQUARTERS			APPROVED	DATE SIGNATURE OF APPROVING OFFICER	CERTIFIED FOR PAYMENT OR CRED T	DATE AUTHORIZED CERTIFYING OFFICER	SPACE BELOW FOR EXCLUSIVE USE OF FINANCE DIVISION	REVIEWED BY	47.52 09LIG. PEF. NO.	D LIO. ACCT. NO. YR ACCT. NO.	1871431		1/18/12	
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No. 142

Cost Account 3/25- 1390 - 3702

Object Class ____

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(When Filled In)



24 May 1961

MEMORANDUM FOR: THE COMPTROLLER

MOTENTION

Finance Division

EUDJE02

: IMULTRA, Subproject 93
Additional Authorization #3

Under the authority granted in the Memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority is subsequent memoranda, Subproject 93 has been approved and \$14,820.00 of the over-all Project INULTRA funds have been obligated to cover this subproject's expenses and should be charged to Allotment No. 2125-1390-3902.

Chief
TSD/Research Branch

CERTIFY THAT FUNDS ARE AVAILABLE

AUTHORIZING OFFICER

OPLIGATION REFERENCE No.

AFFROVED FOR OBLIGATION OF FUEDS:

Resourch Director

Date:

12486

Distribution:

Original & 2 - Addressee

-1 - TSD/FASS

2 - TSD/RB

*******



12 July 1961

Barches for Chef, pings division

VIA

: 200/Suiget Gillear

SECTION 1

: NUMBA, Subproject 93, Involve \$3 Allough 2123-1320-3302

1. Invoice Do. 3 covering the chore subgregate is attached. Payment should be made as follows:

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- 2. Planes formal the checks to Chief, The/Ameered Brench, Crowch The/Ameered Crimer, so later then the July 1961.
- 3. With in a first invoice. However, since it is enticipated that addition it foods will be obligated for this project, the files should not be closed.

Otter 155/Sessorch Bronch

Adaphants: Jacobs A Cartifications

Motellation: Colg & 2 - Adoresse 1 - TSD/FASS 2-TSD/FB ORIGATION REPRODUCT NO.

CHARGE TO ALLOTADING NO.

AUTHORICING OFFICER







INVOICE

For Services

211,620.00



#### CERTIFICATIONS

(1) It is hereby certified that this is Invoice a applying to sub-project; ho, of MADIATRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSD/RB, that this bill is just and correct and that payment thereof has not yet been made.

Chief, 180/Research Branch

M(t)

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(2) It is hereby certified that this invoice applies to SubProject 93 of MNATA which was duly approved, and that the project is being carried out in accordance with the mesorsadum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:



12 July 1961

Theropasium for: Chief, filmeco divicus

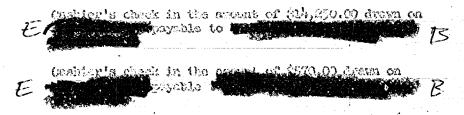
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: TED/Fudget Officer

NUMBER .

: MINIMEA, Subproject 93, Invoice \$3 Allowert 2125-1300-2002

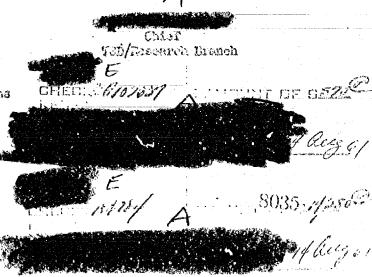
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- 3. Whis is a final invoice. However, since it is enticipated that religional funds will be obligated for this project, the riles should not be closed.

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Cost Account 1525- 1808- 1803

Object Class

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18 May 1960

MEMORANDUM FOR: THE COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MRULTRA, Subproject 93
Additional Authorization #2.

> Chief TSD/Chemical Brauch

I CERTIFY THAT RINDS ARE AVAILABLES

CHARGE TO ALLONGEN No. 1600 - 100

AUTHORIZING OFFICER

APPROVED FOR OBLIGATION OF FUNDS:

physical signal is

Herearch Director

Distribution: Orlg & 2 - Addresses

100

1 - TSD/OC A TSD/FASS

2 - TSD/CB

TSD/CS/CS/CAR

	MEMORANDUM RECEIPT	7/20	
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#### 21 July 1960

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MICHOR ANDUM	FOR:	CHIEF.	FINANOR	73.T A 1723 W.C. * A

: TSD/Budget Officer

: MKULTRA, Subproject 93, Invoice #2

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Allotment 1525-1009-1902

1. Invoice No. 2 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$14,250,00 drawn on E payable to

Cashier's check in the amount of \$570.00 drawn on k, payable to 13

- 2. Please forward the checks to Chief, TSD/Research Branch, through TSD/Budget Officer, no later than 26 July 1960.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

A Beech

PAID

JUL 25 1960

Chief TSD/Rosearch Branch

WENT NO. 19 1525 - 1009 - 1962

Attachments: Invoice & Certifications

Distribution:

Crig & 2 - Addressed

1 - TSD/FASS Z - TSD/RB

AUTHORITY & STRICER

I CERTIFY THAT FUNDS ARE AVAILABLE

RECEIVED.

IN THE AMOUNT OF SHEET

THE MITTHER OF B.



No. 3664

Cost Account 9. 2501. 75. 901

Object Class ___

Date	Remarks and References	Obligations Incurred	Ohligations Liquidated	Unliquidated Balance
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28 July 1959

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSS/Budget Officer

SUBJECT

: MKULTRA, Subproject 93, Invoice #1
Alletment 9-2502-75-902

1. Invoice all covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$13,500.00 payable to

Cashler's check in the amount of \$540.00 payable to awa

- 2. Please forward the checks to Chief. TSS/Chemical Division through TSS/Budget Officer by 3 August 1959.
  - 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief TS3/Chemical Division

Attachments: Involce & Certifications

Pictribution: Orig & Addressed



#### 28 July 1959

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TS3/Budget Officer

SUBJECT

: MKULTRA, Subproject 93, Invoice #1
Allotment 9-2502-75-902

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Cachier's check in the amount of \$13,500.00 payable to the drawn on a

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- 2. Please forward the checks to Chief, TSS/Chemical Division through TSS/Budget Officer by 3 August 1959.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief
TSS/Chemical Division

Attachments:
Involce & Certifications

Distribution:
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TSS/CD/ (28 July 1959)

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#5	5 Aug 59	\$15,600.00	24,200.00
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Project Halfand, Eudproject 94

Date Initiated: 5 December 1959 .

Date Expires: 1 Jamesry 1962

Funda-current year: \$40,000

Purpose: To investigate techniques and brain locations essential to systems utilizing conditioning and which provides optimus directional control of selected species of unicals. Specimens of selected species will be projected for use in related progress. Fortizent biological data will be developed as required.

Status: This to a continuing investigation. Specimens of three appeales will be some ready for use in related studies. Work has been started to develop experimental biological data request.

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# INSTRUCTIONS

Line or Section

- Enter on line 1 the amount of cash on hand at the beginning of the period ä
- Enter on line 2 the amount of outstanding advances made to third parties, brought forward from the previous accounting period. ai
- Enter in this section the amount of each receipt during the accounting period showing pertinent data, i.e., method or source of acquisition and applicable rate of exchange, if indigenous currency. If more space is required to explain receipts, prepare receipt form, number and In every case, completely identify the source of receipts. attach hereto.
- Enter on this line the amount to be accounted for which shall be the sum of amounts shown in and 3. **-**
- receipt obtained from the payee or in lieu thereof a certification explaining the lack of a receipt. Each amount listed in this section shall be supported by a voucher consisting of either the If the number of entries exceeds the available space they may be consolidated as one entry in section 5 and supported by a listing of the individual entries on a separate sheet. 'n
- the amount of any refunds of advances by the advancee indicating whether by cash, check, or money order. Enter on this line v.
- When accountings for advances are obtained, list as expenses Advances made to third parties which remain outstanding at the end of the accounting period shall be consolidated and the total entered as a single amount on this line supported by a Final credit will not be given for disbursements which are or refunds of cash, as appropriate. advances to be accounted for. listing on a separate sheet. <u>.</u>
- Enter on this line the amount of cash on hand, or if the amount of the disbursements exceeds the amount advanced the balance due the advancee shall be shown in parenthesis, and treated as a minus amount in arriving at the "Total Accounted For", line 9. တ
- Reflect on this line the "Total Accounted For" which must agree with the amount shown on "Total To Account For" ó

16 February 1967

MEMORATOWN FOR : The Record

SUBJECT

: FKULTRA Subproject 94

1. HOLERA Subproject 94 was tensineted in November 1962. The accounting submitted by the project officer reflected expenditures of \$55,931.45 equinst an advance of \$55,222.90. The remaining funds held by the project officer were refunded by check made payable to . H

- Note that the land bank account reveals that this reNorth was not recorded in the land bank account. The custodian
  H of the peak account has agreed to make a refund of this amount or to make this amount available for use by the Agency.
  - 3. As the activity has been closed an amount of \$291.45 should be closed from the Memorendum Account (760.0) and the previously recorded expenditure, 2125-1390-3902 MOR-974.

A TED/DF

11 Jun 1904

KATTRA ALTER : THE PERIOD

Chris

: National Subgrapheets 70, 91, 94 and 135

B (1. Acrost 19.6 through 31 Armony 1963, accountings have been received in the period in the countings have been received in the period of 193,677.90. This armont is period of the latest of the enterior for by armone of the counting period.

inarconstitute informed direct costs of \$2,518.35 and \$27,612.16 inarconstitute informed the information of \$1,500.50. Indirect the information of \$11,330.67, had transformed \$4,169.71 to information of \$11,330.67, had transformed \$4,169.71 to information of \$11,670.46 to information 70, heaving a not cost of \$39,837.60. It was decided to example the funds for indirected 135 to subproject 91, therefore thair costs were included in the accounting from the project 91.

Thereselves 1) all four of the subprojects had the sens brain remember 1 and in which, 2) the great length of that that has elapsed alone the proofs were units, and 3) the dividently in getting accountings of any and from the reverse, it is recommend that we facilitate this aution by account for the balances as about in the facilitate this Edward Common for these subprojects.

The above has been concurred in by the second of the Audit

A Galendat, 250

		SUBMITTED BY	Find the state of	TO HEL TELLES	•	70>	VOUCHER NO. (Finance use	e only)
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- rade to third parties, enter the total of such advances outstanding at the beginning of the accounting period If funds, in the form of other than U.S. Dollars were on hand, received, or disbursed during the accounting have been If advances period, all pertinent data, 1.e., rate, method of acquisition, etc., must be shown. --<del>-</del>1
- If more space is required to explain receipts, prepare receipt form, number and attach hereto. In every case, completely identify the source of receipts. ď
- When a receipt is not obtained, prepare a certificate and attach as a and enter the total under item 3. If advances to third parties are outstanding at the close of the accounting period, attach an itemized list and enter the total on line 3a. sufficient to list all vouchers, prepare a listing on a separate sheet Attach a voucher for each expenditure and assign a number thereto innumerical sequence. the receipt obtained from the payee. When space on form is not က်
- When accounting Final credit will not be given for disbursements which are advances to be accounted for. for advances are obtained, list as expenditures or refund of cash, as appropriate. ..<del>.</del>†
- Total receipts entered on the line "Total to Account For" must agree with the total disbursements entered on the line following "Total Accounted For. Š

3

NEUROPHYS TOLOGICAL FUNCTIONS OF THE DOG 4

October 1, 1960 to November 30, 1961

Grant Income

\$39,287.00

Costs	October	1.	1960	to	November 30, 1961

Salaries	\$14,580.17
Payroll Taxes and Insurarca	740,25
Enployees' Hospitalization and Benefits Ins.	235,77
Laboratory Supplies and Expense	11,158.25
Travel	6,082.63
Other Costs	18,404.18
:	51,201.25
Allocation of G and A Expenses	20,123.62 71,324.87
Allocation of G and A Expenses	•

#### Overdraft_

Deduct:

Transfer of Costs to Project (7)

Transfer of Costs to Project (70)

4,165.71

27,872.16

32,037.87

(32,037.87)

\$ ~ <del>~</del> ~

I certify that received or enterials have been satisfactoring to include the expenditures were incorred on the latest because.

Treasurer

Moderate of America of the State of the Stat

20 August 1963

MEMORAHDUM FOR: Deputy Chief, Audit Staff

SUBJECT:

modern to the land of the second

MKULTRA, Subproject 94 with

1. In response to your inquiry regarding the relationship under Project MAULTRA which existed between TSD and Rive are submitting to you the following information from the draft Memorandum for the Accord dated 22 November 1961 which provided a grant is aid of research in the amount of \$55, 222.90 to

2. The same principles were adhered to in establishing Subproject 94 as any of the other MKULTRA Subprojects. A memorandum for the record was written to this case remeding continuation of Subproject 94. The memorandum aliquiates the cover for the Subproject. The memorandum also provides for a terminal summary accounting and the handling of accountings for travel expenses in a manner consistent with the established practices of the completion of the project were to be returned to the project were to be returned to that no permanent equipment was anticipated for this program.

3. A memorandum from the dated 14 December 1962 transmitted an accounting for \$54,931,45 and the refund of winsed funds in the amount of \$201.45. The accounting for funds and the work performed was in accordance with the memorandum for the record and the general agreement relative to this work. The overall performance by the lighty satisfactory in all respects. A copy of the budget proposal, the memorandum for the record and the accountings are on file in TSD and may be viewed by proper chickels.

A — Ch. Sci. TSD/D&E

Distribution:

Origh Li I - Addresses

1 - C/TSD/SS

1 - Project File

1 - Chrono



14 December 1962

Gentlemen;

Approximately one year ago.

a grant-in-aid from for \$55, 222.90 to support our work on new approaches to pharmacological assay techniques. It was understood this support would relate to project expenses facured on and after 1 December 1961 and that a financial report would be rendered to that a financial report would be find this report enclosed.

Since has found it necessary to terminate all activity on this project as of 30 November 1962 and since this coincides with the completion of a grant year, we find that in accordance with our agreement, the unexpeaded balance of funds in the amount of \$291.45 is due and returnable to the conclused.

Your support in this important area of research has been greatly appreciated. May we express the hope that possibly sometime in the future some other area of research may be determined to be of mutual interest.

Yours very truly,

Secretary

2 Encl.

~ γ

## FINANCIAL REPORT

PROJECT(7)

Original Budget -- \$55,222.90 1 December 1961 - 30 November 1962

Direct Labor	\$12,810.26
Overhead @ 36.8% of Direct Labor	4, 731. 15
Direct Materials	6,731.53
Indirect Expenses	
Rent \$ 20,000.00	
Utilities 677.73	
Telephone 893.15	
Repairs and Maintenance 407.34	
Insurance 343.35	
Office Supplies 2.00	
Travel 3,454.73	
Automobile Rental and Expenses 4,092.00	
Subscriptions 61.54	
Payroll Taxes 726.67	
Total Indirect Expenses	30,658.51
Total All Froject Costs	\$54,931.45

I have executed to expenditures.

Tes/Chomical Division

No. 974

Object Class __

Date		Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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2. Places framed the charles to Ohtel, Tip/Reasonch Francis, Gerough Widenlyss Officer, on even as possible.

3. This is a first invoice. Icomor, since it is entiring the collisional facts will be collected for this project, the files should not be closed.

Chief The/Recearch Besselh

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130/13/ (24 Reverber 1961)

Secreto House

11 DE 1220893

C.

C

in Surge

94-10



#### INVOICE

For Services

\$57,431.82

24 November 1961

B

### CERTIFICATIONS

(1) It is hereby certified that this is invoice 5 applying to Sub-project No. 24 of MKULTRA, that performance is satisfactory, that performance are being accomplished in accordance with mutual agreements, that a detailed agends of the payments and receipts is on file in TSD/RB, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSD/Research Branch

Dates

Research Director

Date:



#### RECEIPT

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94

94-12

#### RECEIPT

Receipt is hereby acknowledged of Cashier's check dated December 11, 1961, drawn on in the amount of \$2, 208.92, payable to

Date

## ***********

Date: 22 November 1961

MEMORANDUM FOR: THE COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject #94
Additional Authorization #3

Under the authority granted in the memorandum dated 13 April 1953, from the DCI to the DD/A, and the extension of this authority in subsequent memorands, Subproject 94 has been approved, and \$57.431.62 of the over-all Project MKULTRA funds have been obligated to cover the subproject's expenses and should be charged to cost center 2125-1390-3902

Chlef
TSD/Research Branch

AUTED CONSTITUTE

APPROVED FOR OBLIGATION OF FUNDS:

135. 1310-3402

A

Research Director

Date:

SH PSP

Distribution:

Original & / Addressee

1 - TSD/FASS

2 - TSD/RB

22 November 1961

MEMORANDUM FOR: THE RECORD

SUBJECT

: Project MKULTRA, Subproject No. 94

1. The purpose of this subproject is to provide a continuation of activities in selected species of animals. Miniaturized stimulating electrode implants in specific brain center areas will be utilized.

2. Initial biological work on techniques and brain locations essential to providing conditioning and control of animals has been completed. The feasibility of remote control of activities in several species of animals has been demonstrated. The present investigations are directed toward improvement of techniques and will provide a precise mapping of the useful brain centers in selected species. The ultimate objective of this research is to provide an understanding of the mechanisms involved in the directional control of animals and to provide practical systems suitable

r application.

18 Oct '60 Ind se

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who will submit to

as cutout and cover for this subproject. The research and development will be conducted in facilities provided by

Any unused funds remaining at that time will be returned to

4. The cost of the program for a period of one year beginning 1 December 1961 is estimated to be \$55, 222.90. To this sum must be added \$2, 208.92 which represents the 4% service charge du The total cost of the project for a period of one year will, therefore, not exceed \$57, 431, 82. Charges should be made against allotment number 2125-1390-3902.

B

- 5. It is not anticipated that any permanent equipment will be needed for this program. Documentation and accounting for travel expenses which are reimbursable by will conform to the accepted practices of that organization.
- 6. The requirement for a semi-annual informal accounting on the part of the principal investigator is waived.

7. All personnel connected with the planning and monitoring of this program possess TOP SECRET approval. The project will be unclassified after it leaves.

A Chief

TSD/Research Branch

APPROVED FOR OBLIGATION OF FUNDS:

Research Director

Date: 24 1961

Attachment:
Proposal and Budget

Distribution: Orig. only

()

20	September 1961	
BUDGET - Annual - 20	September 1901	
Salaries		
3,600.00 1,660.00		45.54 ¹
(Person to be added) 10,635.00		
	15,895.00	
Taxes		
Payroll	1,587.90	
Physical Plant		
Rent Repairs & Maintenance Insurance (Liability & Equipment)	20,000.00 2,000.00 500.00	
Operating Expense		
Automobiles (1 ea. Corvair & Pick-up)  Laboratory Supplies & New Equipment  Experimental Organisms  Animal Food & Veteranary Services	3,140.00 4,000.00 2,000.00 1,000.00	
Utilities Telephone Postage Miscellaneosus (Laundry, Office Supplies, etc.) Travel and Express	750.00 500.00 100.00 300.00 2,400.00	
Fringe (Employee Insurance)	350.00	
	\$ 55,222.90	

## B - AND THE RESIDENCE OF THE PARTY OF THE PA

#### PROPOSAL

It is proposed to conduct investigations as directed by the sponsor of the action of localized neurological and physiological stimulants on the balance mechanisms in mammals and bird. The sponsor will have full control of species of animals to be utilized together with methods and procedures to be followed in the researches,

Special investigations and evaluations will be conducted toward the application of selected elements of these techniques to man.

Pilot experiments will be performed under field conditions to permit the critical evaluation of methods and procedures. The parameters of effectiveness and the action of potential interfering phenomena will be determined.

The following budget is required to carry out the program outlined above for one year.

Hovember 15, 1960



Gentlemen:

We are pleased to be able to transmit to you the following funds:



These funds represent a contribution for the use of your directors in corrying out the very worthwhile research goals of your organization.

Yours truly,

Encl. Checks (2)

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94-16

No.

Cost Account ... 1195-1104-1402

Object Class

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### 28 October 1960

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSD/Budget Officer

SUDJECT

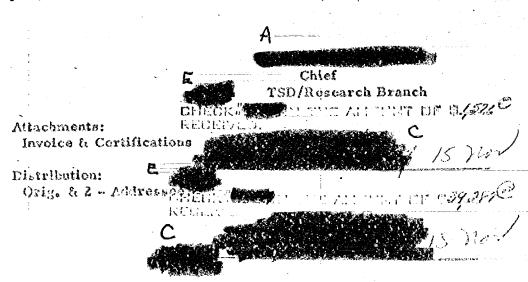
: MKULTRA, Subproject 94, Invoice #5
Alletment Numbers 9-2502-75-902 and
0525-1009-4902

1. Invoice #5 covering the above subproject is attached. Payment should be made as follows:

Cashior's check in the amount of \$39, 287, 00 payable to drawn on

Cashior's check in the amount of \$1,571,00 payable to

- 2. Please forward the checks to Chief, TSD/Research Eranch, through TSD/Budget Officer, no later than Friday, 11 November 1960.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.



## 20 October 1960

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject 94. Invoice #5
Allotracut Numbers 9-2502-75-902 and ,
0525-1009-4902

1. Invoice #5 covering the above subproject is attached. Payment should be made as follows:

Cashier's check in the amount of \$39, 287,00
payable to

Cashier's check in the amount of \$1,571.00
payable to

drawn on

E

- 2. Please forward the checks to Chief, TSD/Research Branch, through TSD/Budget Officer, no later than Friday, Il November 1960.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief TSD/Research Branch

Attachmente:
Invoice & Certifications

Pistribution:
Orig. & 3 - Addresses
1 - TSD/PASS
2 - TSP/RB A

(28 Oct. *60)

94-17

#### INVOICE

For Services

\$40,358.00

B

#### CERTIFICATIONS

(1) It is hereby certified that this is invoice \$5 applying to Subproject 94 of MIULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is filed in TSD/Rb, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSD/Research Branch

Date:

(3) It is hereby pertified that this invoice applies to Subproject 94 under MKULTRA which was duly approved and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

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#### 18 October 1960

MEMORANDUM FOR: THE RECORD

SUBJECT

: Project MKULTRA, Subproject No. 94

- 1. The purpose of this subproject is to provide for a continuation of investigations on the remote directional control of activities in selected species of animals. Miniaturized stimulating electrode implants in specific brain center areas will be utilized.
- 2. Initial biological work on techniques and brain locations essential to providing conditioning and control of animals has been completed. The feasibility of remote control of activities in several species of animals has been demonstrated. The present investigations are directed toward improvement of techniques and will provide a precise mapping of the useful brain centers in selected species.

  The ultimate objective of this research is to provide an understanding of the mechanisms involved in the directional control of animals and to provide practical systems suitable for

application

functions

as cut out and cover for this subproject. The necessary research and development is being conducted through

who will submit to

conclusion of the program. Any unused funds remaining at the conclusion of the program will be returned to

- 4. The cost of this program for a period of one year is estimated to be \$39,287.00. To this sum must be added \$1,571.00 representing a 4% service charge to The total cost of the project for one year will not exceed \$40,858.00. Charges should be made against Allotment 1525-1009-1902.
- 5. It is not anticipated that any permanent equipment will be needed for this program. Documentation and accounting for travel expenses which are reimbursable by will conform to the accepted practices of this organization.

CHANG.

B

- 6. The requirement for a semi-annual informal ac-
- 7. All personnel connected with the planning and monitoring of this program possess TOP SECRET approval. The project will be unclassified after it leaves.

A Chief
TSD/Research Branch

APPROVED FOR OBLIGATION

OF FUNDS:

B

3 40 44

Research Director

Date: 24 1860

Distribution: 'Orig. only

# ESTIMATED BUDGET

## SALARIES:

	Principal Investigator	\$ 8,000.00
	Medical Investigator	2,000.00 5
	Pharmacologist	5,000.00
	Research Technician	4,000.00
	Animal Caretaker	2,300.00
в	State Unemployment Ins.	1, 830.00
	Supplies and Expendable Materials	3,000.00
	Animals and Feed	2,600.00
	Technical Services	1, 200,00
	Travel	700.00
	Reproduction Services	800.00
	Sub-total	\$31,430.00
	Overhead (25% of total)	7,857.00
	Total	\$39,287.00



## 18 October 1960

MEMORANDUM FOR: COMPTROLLER

ATTENTION

: Financo Division

SUBJECT

: ACCULARA, Subproject 94, Additional Aethorisation No. 3

Under the authority granted in the memorandom dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 94 has been approved and \$40,859.00 of the ever-all MKULTRA project feeds has been obligated to cover the subproject expenses. This obligation of funds should be charged to Allohnent 1925-1969-1902.

TSD/Research Branch

VERTEY THAT PERS ARE AVAILABLE.

Research Livector

Dictributions · Orig. & 2 - Addresses

1 = TSD/OC OF TSD/FASS Z=TSD/RB

TSD/RB

(18Octe 60)

B Grant for: Neurophysiological Functions of the Dog

Amount of Grant ---- \$18,272.00

# Expenditures

Overhead	18,272.00	\$18,272.00
0 1 1	1427.07	
Secial Sec. Ins. etc.	728.38	
Services	847.37	
Travel	376.82	
Materials and Supplies	9184.08	
Salaries and wages	\$5708.28	

Balance .....

Accountant

A series and the series of the

10/17/60

January 4, 1960

B. Aller and the second 
Grant for: Supplementary pharmacological screenings and testings (1959)

Funds received: 15,000.00

Expenditures:

 Wages and salaries
 8,685.67

 Equipment
 2,070.21

 Supplies, expendables
 1,982.84

 Atimals
 985.67

 Overhead
 1,338.94

 15,063.33

77 94

Total expenditures:

15,063.33

Balance: (deficit)

(63.33)



I was a created and approved the submitted

A Chief

Aller (Complete Land Complete 
10800 13 January 1460

94-23

December 30, 1959

β

Grant for: Neurophysiological determinations in the dog

Funds received:

20,000.00

Expenditures:

 Wages and salaries
 9, 234. 27

 Equipment
 3, 740. 97

 Supplies, expendable
 2, 821. 99

 Animals, dogs
 540.00

 Overhead
 3, 710. 00

 20, 047. 23

Total expenditures:

20, 047, 23

Balance (deficit)

(47.23)

C

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13 January 1960

8 94.24

Cost Account . 9- 2503. 25- 402

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Date	· ·	Remarks an	d References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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October 5, 1959

B



Gentlemen:

We are pleased to be able to transmit to you the following funds:

E Treesurer's Check drawn on for \$728.00, dated 1 cet. 59.

E Treasurer's Cheek drawn on for \$18,272.00, dated 1 Oct. '59.

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Encl. Checks (2)

8 May 1959

MERCRIPULIFOR: MES CONTROLLES

MISSIM

Pierreo Division

CONTRA

1 KAMAA, Dabyrojact 94

Under the authority granted in the Mercrendum dated 13 April 1993 from the DOT to the DD/A, and the extension of this authority in subsequent necessarily. Subproject 94 has been approved, and \$45,000. Of the over-old Project MANATA funds have been abligated to cover this subproject's expenses and should be charged to Allotsent 9-2502-75-902.

A-Charles Division

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24 September 1959

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

EVIA

: TSS/Budget Officer

SUBJECT

- : MKULTRA, Subproject 94, Invoice \$4 Allotment Numbers 9-2502-75-902 and 0525-1009-4902
- 1. Invoice \$4 covering the above subproject is attached. Payment should be made as follows:
  - Gashlar's check in the amount of \$13,272.00 payable to drawa on

Cashier's check in the amount of \$728.00 payable to drawn on

- 2. Piense forward the checks to Chief, TSS/Chemical Division, through TSS/Dudget Officer, no later than Thursday, 8 October 1959.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files favored not be closed.

Attachments:
Invoice & Cortifications

Distribution: - Crig & 2 - Adiressee

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TSS/CD

Chief
T39/Chemical Division

COMMENT TO THE STATE AVAILABLE \$ 5,000.00 OF CHARACTER FOR THE STATE STA

AUTHORITION CHICKS

10,400.10

582 0535-1197-4402

A

94-31

### INVOICE

For Services

\$19,000.00

8

### CERTIFICATIONS

(1) It is hereby certified that this is Invoice \$4 applying to Subproject 94 of MKULTRA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agonds of the payments and receipts is filed in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject 94 under MKULTRA which was duly approved and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:

## DRAFT 22 September 1959

MEMORANDUM FOR: THE RECORD

SUBJECT

: Supplement to Project MKULTRA, Sub-

project 94

1. The purpose of this supplement is to provide additional funds whereby investigations on the remote directional control of activities of selected species of animals may be continued and extended.

A system of localized stimulation of the brain is being utilized.

- 2. Initial biological work on rechniques and brain locations imparting specific stimulation which permits directional control of rats and burros will be extended to dogs. The feasibility of remote control of activities in two species of mammals has been demonstrated by limited trials. In order to capitalize on this technical break-through further investigations are necessary. The investigations are being directed toward refinement of techniques with the ultimate objective being to provide practical systems suitable for operational application.
- cut out and cover for this subproject. The necessary research and development is being conducted by the who will submit to the assumption of a summary accounting

B

of funds at the conclusion of the program. Any unused funds remain-

- 4. The program will require a minimum of two years for completion. The additional funds required for the first year are \$10,000.00. To this sum must be added \$400.00 representing a four per cent service charge to.
- 5. Total cost of the project for one year will not exceed \$55,400.00 of which \$45,000.00 has previously been obligated.

  Charges should be made against Allotment No. 0525-1009-4902.
- 6. It is not anticipated that any permanent equipment will be needed for this program.
- 7. Documentation and accounting for travel expenses which are reimbursable by will conform to the accepted practices of this organization.
- 8. The requirement for a semi-annual informal accounting on the part of the principal investigator is waived.

9. All personnel connected with the planning and monitoring

of this program possess Top Secret approval.

APPROVED FOR OBLIGATION OF FUNDS:

A TSS/Chemical Division

Research Director

Date:

9)24/59

APPROVED:

A

TSS/Chemical Division

Distribution:
Original only

94 - 33

# RECEIPT

Receipt is hereby acknowledged for Treasurer's checks
for \$15,000.00 and for \$600.00 dated 27 August 1959,
drawn on and payable to

C_6 Asst Secty/Treas

dated 2 September 1959

22 September 1959

MEMORANDUM FOR: COMPTROLLER

ATTENTION

.: Finance Division

SUBJACT

: MECULTHA, Subproject 94. Additional Authorisation No. 2

Dedor the subbority granted in the monorandum dated

13 April 1753 from the DCI to the DD/A, and the extension of

this authority in subsequent memorande, subproject 94 has

been approved and \$19,400.60 of the over-all MEULTRA project

funds has been obligated to cover the subproject expenses. This

obligation of funds about to charged to Alletment 0525-1009-4902.

Chief
TES/Chemical Division

Approved for obligation of fulls:

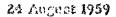
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MUMORANDUM FOR: CHEF, FINANCE DIVISION

MIN

: YUS/Budget Officer

SUBJECT

: ARULTRA, Subproject 76, Invoice §3
Allotment 9-2502-75-902

1. Invoice #3 covering the above subproject is attached. Payment should be made as follows:

Cachier's check in the emount of \$15,000.00 payable to track in the emount of \$15,000.00 payable to Cachier's check in the emount of \$600.00 payable to

2. Please forward the checks to Chief, TSS/Chemical Division through TSS/Budget Officer by 4 Regtomber 1939.

Chief
TSS/Chamical Division

Attachment:
Involce & Cestifications

Distribution:
Orl: & 2 - Addresses

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94 35

#### INVOICE

For services

\$15,600.00

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## CERTIFICATIONS

(1) It is hereby certified that this is lavoice #3 applying to Subproject 94 of MKULTRA, that performance is satisfactory, that
services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on
file in TSS/CD, that this bill is just and correct and that payment
thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject 94 of MKULTRA which was duly approved and that the project is being carried out in accordance with the measurandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent racmorands.

Date:

14 August 1959

8.

Gentlemen:

We are pleased to be able to transmit to you the following funds:

Treasurer's Check drawn on for \$15,000.00.

Treasurer's Check drawn on for \$600.00.

These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly,

Encl. Checks (2)

94-37

### RECEIPT

E Receipt is hereby acknowledged for Treasurer's Checkers for \$15,000,00 and the for \$600,00 dated August 12, 1959, drawn on the formula of t

Date

Jay 24-59

MEMORAHUMI FOR: CHIEF, FIRANCE DIVISION

VIA

: TS3/Budget Officer

SUBJECT

: MAULERA, Subproject 94, Invoice #2 Allotant 9-2:02-75-902

1. Invoice #1 covering the above subproject is attached. Payment should be made as follows:

S Cashier's check in the amount of \$15,000.00 payable to

β Cashler's check in the amount of \$600.00 payable to

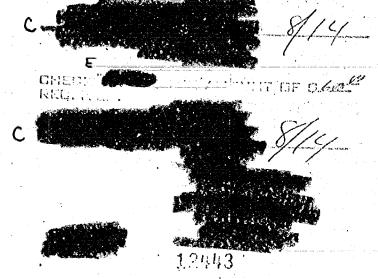
2. Please forward the checks to Chief, 588/Chemical Division through 988/Budget Officer by 20 August 1959.

Chief TSS/Chemical Division

Attachments: Invoice & Certifications

Distribution: \(\text{\ODE}\); & 2 - Addressee

REDRIVEL.



# 5 August 1989

HE COUNTRY FOR CREEF, FIGURES DIVISION

VIA

1 253/hudget Officer

SUMMER

: ENTAGA, Endorroject 94, Invoice (2); Aliotecut 9-2502-75-902

1. Involue A covering the above subproject is attached. Payment should be rade as follows:

B to drawn on

6 Continue which in the enount of \$600.00 payable to

2. Phose forward the checks to Chief, 503/Chemical Division through 505/Didget Officer by 20 August 1959.

Chief TSS/Chewical Division

Attichments: Lavolca & Cortifications

Distribution:

Origi & 2 - Addresses

1 - TSS/FASB

2 - TSS/CD

TSS/CD/ (5 Aug. 59)

A



For Services

\$15,600.00

8.

### CERTIFICATIONS

(1) It is hereby certified that this is Invoice (2 applying to Subproject 9% of LAULTIA, that performance is satisfactory, that services
are being accomplished in accordance with mutual agreements, that a
detailed agends of the payments and receipts is on file in TSS/CD,
that this bill is just and correct and that payment thereof has not
yet been made.

Caler, 125/Charles Division

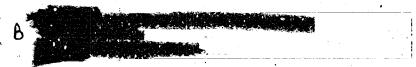
DAME:

(2) It is hereby certified that this invoice applies to Subproject 94 of MMATA which was duly approved and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

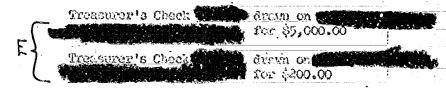
DATE

July 24, 1959



Gentlewen:

We are pleased to be able to transmit to you the following funds:



These funds represent a contribution for the use of your directors in corrying out the very worthwhile research goals of your organization.

Yours truly,

Prol. Checks (2)

# RECEIPT

Receipt is hereby acknowledged for Treasurer's Checks
for \$5,000.00 and
for \$200.00 dated July 22, 1959, drawn
on
and payable

Date: 7/27/59

13 July 1959

HEROTANDEM FOR: CIDEF, FINANCE DIVISION

VIA

: TSS/Eudget Officer

SULLECT

: YEULTRA, Subproject 9't, Invoice #1

Allotment 9-2502-75-902

1. Theolog \$1 covering the above subproject is attached. Feyment should be made as follows:

B Cachieria check in the amount of \$5,000.00 payable irava

Contor's check in the exount of \$200.00 poyable

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2. Please forward the checks to Chief, TO3/Chemical Division through TO3/Indget Officer by 27 July 1959.

A Chief
TSS/Chemical Division

Attackeenta: Invoice & Certifications

Distribution:
Orig & 2 - Addresses
LT - TSS/FASB

CHARGE TO AUDITION IN E-2503-12-

AUTHORIGHED OFFICER

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For Cervices

\$5,200.00

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#### CERTIFICATIONS

(1) It is hereby certified that this is Invoice it applying to comproject 9% of MAUDIA, that performance is auticiactory, that services are being accomplished in accordance with mutual agreements, that a detailed agends of the payments and receipts is filled in TOS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TJS/Chesical Division

Dates

(2) It is hereby certified that this invoice applies to Subproject 94 under HAUDINA which was duly approved and that the project is being carried out in accordance with the memorandum dated 13 April 1953 from the BUI to the BD/A, and the extension of this authority in subsequent personnia.

Research Director

Botos



94-42

To: TSS/00

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8 Pay 1959

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ALTERIAL STATES

coltivid county

FERENCE

: PROBLEM, Subgroject 54

Under the enthantly greated in the Manurendon dated

13 Lydii 1953 first the PCI to the PO/A, and the extension of

this embersty in subsequent accordary, Subproject 94 has been

expressed, and (15,000, of the over-all Project Martin funds

have been obtlighted to cover this enthanter's expenses and

should be thered to Allotsent 9-2302-77-903.

A Chief

ACCIOND FOR COLUMNICA OF PONDS:

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Platellettess a Reference

1 - 335/00

1 - 508/FASB

2 - 188/00

\$78/CD/ # 76/3/59

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0 94-44

DRAFT A

7 May 1959

MEMORANDUM FOR: THE RECORD

SUBJECT

: Project MKULARA, Subproject 94

- 1. The purpose of this subproject is to provide for a continuation of investigations on the remote directional control of activities of selected species of animals including mammals and feathered vertering brates. A system of localized stimulation of the brain which has positive and negative motivational effects will be utilized.
- 2. The initial research phase has been completed by They have worked out techniques and brain locations for imparting specific stimulation which activates and maintains directional control of selected mammals. The feasibility of remote control of activities including speed and direction of movement has been demonstrated by limited laboratory and field trials in two species.
  - operating on funds allotted by letter Order No. 59-26062 having completed the initial research phase have elected to discontinue work in this area. This decision was made on the premise that they have worked out the principle for this Agency and cannot justify further work in an area foreign to their mission. The implications of this technical breakthrough and its potential value to intelligence operations establishes a need for continuation of these investigations, their extension to other species of animals and refinements in instrumentation and stimulation techniques. The ultimate aim



of this investigation is to complete work which will permit the practical application of the system to problems.

who will submit to

- 8 3. Vill function as cut-out and cover for this Subproject. The personnel and consultants involved consist of CD/Branch II personnel working with Dr.'s and ... The necessary research and development will be conducted
- a summery accounting of funds received from 8
  and will return any unused funds remaining at the conclusion of the program.
  - 4. The program will require approximately two years for completion.
  - 5. This project will be funded for the first year at an estimated cost of \$43,200. To this sum must be added \$1,800. representing a \$45.85 service charge to making the total amount \$45,000. This amount of money represents about a 70% cut over that expended in the previous year.
    - 6. Total cost of the project for one year will not exceed \$45,000. Charges should be made against Allotment 9-2502-75-902.
    - 7. It is not anticipated that any permanent equipment will be required for this program.
- 8. Documentation and accounting for travel expenses which are reimbursable by will conform to the accepted practice of that organization.

- 9. The requirement for a semi-annual informal accounting on the part of the principle investigator is waived.
- 10. All personnel connected with the planning and monitoring of results of this program possess TOP SECRET approval, one of the personnel of will possess TOP SECRET approval

and be witting of Government interest or true purpose of the program.

TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

Research Director

Date: 5/12/59

Distribution: Original Only

## BUDGET

Salaries	\$25,000.00	e de la companya de l
Supplies & Materials	4,000.00	
Animals	3,000.00	
Travel	3,000.00	
Telephone	200.00	
Use of Test area/year	8,000.00	en e
TOTAL	\$43,200.00	



#### DIVOCOS GERCA LAGO

# MINIMA Emphrolect

Ab Date of Criginal Inthorization	Period Compad	Time Entended	Alleinens Briter	Assumt of Oplication
23 July 1959	1 year		0525-1009-4902	\$56,500.00
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Na 0	le Months		H25-1390-3902	\$15,000.00
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Purpose: To study cross cultural meaning systems as a technical support to political activities (MEULIRA 95).

Initiated: Obligations approved in March and July, 1961. (Inits is the second year of support for work that was expected to take three years.)

Contractor:

are a grantee of

Cost: \$63, 390.00 (Previous year's budget was \$56, 500.00).

Etotus: Continuing on schedule.



July 13, 1964

Memo to

C Re:

Accounting

Attached please find a copy of an accounting from This is a summary accounting for the years 1960 through 1964.

We have received a check in the amount of \$5,921.02 from and this has been deposited to our Regular Account rather than Special because we need the money.

You can clear this one out now.

Best regards,





TERRINAL ACCOUNTING REPORT JANUARY 1, 1960 - APRIL 30, 1964

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Direct coals:				76	797	10	
Personnal			•	2	434	20	
Retirement		•			635	49	
Workmen's compensat	ion			1	762	63	
Permanent equipment		,	÷	4	688	57	
Expandable supplies				38	713	41	
Travel							
Other expenses -			17 667 64				
- Honoraria - foreign	a staff		6 998 91				
Computer			11 876 59				
Planning conference	0	•	Security Contract Con			-	
•	•			36	543	24	

Total other expanse

Total direct costs

Total receipts over direct costs Less indirect costs

31 001 70

161 683 84

25 170 78

5 931 0

Caph balance, April 20, 1964

This report was prepared in and agrees with the records of the Accounting Division of

56,500,00 Y Inv 15,000,00 Inv 48,390.00 Lov 35,009.20 INV

38,076,36 192, 975.56

REFUND OF \$5,921.02 TO APPLY AGAINST COVER GRANT Chief Accounters

I certify that services or materials have been satisfactorily received and the expenditures were incurred on official business.

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April 15, 1964

Dear 💮

Here are some more goodies.

requested an accounting on which I have attached. He also requested an accounting from I have written to the University for it.

Also, attached please find accounting for the year 1963.

Please give these to . There is no need for you to have copies to clutter up your files_since I keep duplicates here.

One of these days we will be completely organized and then we will go out of business.

Best,





 $\bigcirc$ 

Date_23 July 1962

Branch III Category Bobas	dor Prediction and Control (V-b)
Project Title Cross Cultural Meaning. Systems	Item Classification None
Project Crypto SECULTRA	Crypto Classification None
Branch Project No. 2-72	Project Engineer.
Contractor	
Contract No. MULTRA 898	Task No. No.
Type of Contract ARTHERA	Date Initiated March 1962
Cost \$50,450.00	Completion Date March 1963

Purpose: The scope of this project involves the study of verbal communication channels between several different cultural groups in some critical geographical areas. Knowledge of the "hidden" values and cues in such systems is of interest for propaganda and other purposes.

Status: The study is on schedule in its final (third) year and will be completed on schedule. Data from six countries will be available.





# RECEIPT

Receipt is hereby acknowledged of treasurer's check No. 0001032 drawn on the dated May 1, 1962, payable to the in the amount of \$35,009.20.

Date 10 They 1962

No. 1861

Cost Account 2125-1390-3907-

Object Class

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
12 APR 1862	MKULTRA-Sub Proj 95	3.5,009.20		35,009.20
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Brand of the latest and the latest a			and the second s	no. 10 de la Communicación de Administración. No esta la confesión de descripto de
				1

Date: 20 March 1963

MEMORANDUM FOR: THE COMPTROLLSR

ATTENTION

: Finance Division

SUBJECT

: MKULTRA, Subproject 195

Under the authority granted in the memorandum dated 13 April 1953, from the DCI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 95 has been approved, and \$35,009.20 of the ever-all Project MKULTRA funds have been obligated to cover the subproject's expenses and should be charged to cost center 2125-1390-3902

Chief
TSD/Research Branch

A

CHARLE TO AUGMON RE. 2/25-1390-3982

Chief, Technical Services Division

Dates

11185

Distribution:

Original & Z - Addresses .

1 - TSD/FASS

2 - TSD/RB

AUTHORIZEDS OFFICER



16 April 1962

MEMORANDUM FOR: CHEEF, FINANCE DIVISION

VIA

: TSD/Budget Officer

SUBJECT

: MKULTRA, Subproject #95, Invoice #4.

Allotment 2125-1390-3902

1. Invoice #4 covering the above subproject is attached. It is requested that payment be made as follows:

> Caphier's check in the amount of \$35,009,20 drawn on a local bank, payable to

- 2. The check should be forwarded to Chief, TSD/Rosearch Branch, through TSD/Budget Officer, as soon as possible.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief TSD/Research Branch

Attachmenta:

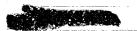
Invoice & Certifications

CHECK# IN THE AMOUNT DE \$35009.30

Metribution:

Crig & 2 - Addresses

RECEIVED.



#### INVOICE

For Services

()

\$35,009.20

B

## CERTIFICATIONS

(1) It is hereby cordited that this is invoice f4 applying to Subgroject No. 95 of MKULTRA, that performance is satisfactory, that corvices are being accomplished in accordance with mutual agreements, that a detailed agonds of the payments and receipts to callle in TSD/RB, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSD/Research Branch

Date:

16 April 1962

(2) It is hereby certified that this invoice applies to Subproject 95 of INKULTRA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953, from the CDI to the DD/A, and the extension of this authority is subsequent memorands.

Chief, Technical Services Division

		CONFIDENTIAL	Z	FUNDS	POSTING VOUCHER	YOUVAER					
YOUCHER NO. 7-12		DATE 2-6			`		VOUCHER NO.	0. 7-12			
DESCRIPTION ALL OTHER ACCOUNTS 13-33	34.39 STATION CODE	40-42 F	45.46 PAY	47-52 OBLIG. REF. NO.	53 54-57 GENERAL	SB. 67 ALLOT. OR COST ACCT. NO.		68.70 DUE DATE		71.80 AMOUNT	manuficture ( ) particular security ( ) particular sec
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29 March 1962

MEMORANDUM FOR: THE RECORD

SUBJECT

: Project MKULTRA, Subproject 95

1. The purpose of this Subproject is to support for an additional year the work of

in the field of cross cultural meaning systems. Although this fundamental work is being carried out within an abstract conceptual framework, its results can be directly relevant to Agency problems in the technical Support of political activities.

- 2. When this project was proposed, it was anticipated that the work would take three years. The work has progressed very satisfactorily and, even though expanded in scope, has remained on schedule. The second annual progress report is attached.
- 3. This project will be funded through

  for security and cover purposes and the accounting

  for funds expended in it shall conform to the established practices

  of that organization. It is not anticipated that any permanent

  equipment will be required for the project.



- 4. Travel funds expended under this project and normally reimburseable by shall conform to the accounting practices of that organization.
- 5. The total cost of this program for a period of one year is estimated not to exceed \$50,150.00. Unexpended funds, amounting to \$15,140.80 and held by vill be applied to the 1962 request. Therefore, the net cost of the project for the year will be \$35,009.20. Charges should be made against Allotment 2125-1390-3902.
- 6. holds an Agency covert approval. All other project personnel are unwitting and the project will be conducted as an academic research program.

Chief
TSD/Research Branch

APPROVED FOR CELICATION
OF FUNDS:

Chief, DD/P/TSD

Date:

Date:

Distribution: Original only





April 2, 1962

Dear

Enclosed is copy of accounting which should be attached to renewal request 1 left with you last Wednesday. We had sent you a copy of progress report on January 5, 1962.

The cashier's check you wanted sent should have arrived at its destination today.

-

Enclosure



• •	Estimated Budget 1961	Expended 1961	Obligated 1961	Balance 1961	Estimated Budget 1962
Personnel.	30,917.00	28,741.74	<b>)</b> 	2,175.26	22,916.00
Retirement	1,896.00	873,60	1 200 - 200 - 200 - 200	1,022.40	1,086.00
Workmen's Comp.	309.00	188,68	<b>)</b>	120.32	138.00
Supplies & Equip.	2,000.00	537.03	1,085.00	377.97	2,000.00
Travel	10,000.00	6,517,94		1,782.06	3,000.00
Haver	7,000.00	8,210.25		(3,510.25)	10,730.00
B	3,000.00	2,542.01		457.99	4,000.00
Indirect Costs	8,268.00	8,268.26		(.26)	6,580.00
Misc.	· · · · · · · · · · · · · · · · · · ·	266.08		(266.08)	A 100 (March 1980) The 1 Make Apple College (March 1980) a supplied
riisc.	63,390.00	56,145,59	5,085.00	2,159.41	50,450.00
	and the second s		2.		,
	Balance 19	61	2,159.41		
	Balance 19	60	2,317.30		
	Travel Fun		643.09		
			5,119.80		5,119.80

This is a true statement of

financial status as reported to us.

Requested

45,330.20

I have expended and approved the submitted expended on potes 4/5/62

February 27, 1962

B accounting Jan. - Dec. 1961

Personnel-Salaries	28,741.74 873,60
Retirement	188.68
Workmen's Compensation	1,622.03
Supplies and Equipment	8,217.94
ravel	10,510.25
	2,542.01
	266.08
Miscellaneous Indirect Admin. Costs	8,268,26
AIMIAI COO	4 60 000 50

Total Expenses for 1961 \$ 61,230.59

This is a true statement of the expended and obligated funds of the grant for 1961 as shown by the University.

C

Prepared by

I have examined and approved the submitted expenditures.

GATOR A

Chief Tes/Chemical Division.

Dates 4/8/62

## RECEIPT

Receipt is hereby acknowledged of the following check:

ŗ,

Cashier's Check No. 2-064726, dated August 15, 1961, in the amount of \$48,390,00. drawn or

Date: August 17,1961

WHEN MILE

TO: TSD/CC

While is a continuation of Subproject No. 95.

A. Purpose of Projects

To study cross cultural watning

systems.

8. Project Munitor:





ARTES A

DRAFT/

8 March 1961

MEMORANIUM FOR: THE KECORD

SUBJECT :

Project MKULTRA, Subproject 95

1. The purpose of this Subproject is to support for an additional year the work of

the field of cross cultural meaning systems. Although this fundamental work is being carried out within an abstract conceptual framework, its results can be directly relevant to Agency problems in and the technical support of political activities.

- 2. When this project was proposed, it was anticipated that the original work would take three years. The planned work is on schedule and the results have been very satisfactory. The first annual progress report is attached.
- 3. This project will be funded through the Barrier and cover purposes and the accounting for funds expended in it shall conform to the established practices of that organization. It is not anticipated that any permanent equipment will be required for the project.
  - h. Travel funds expended under this project and normally reimbursuable by the secounting practices of that organization.  $\mathcal B$



year is estimated not to exceed \$63,390.00 as indicated in the budget attached. However, at the present time the project will only be extended for a period of four months. The cost of this project for this period will not exceed \$15,000.00. Charges should be made against Allotment 1125-1390-3902. It is anticipated that the remainder of the funds for the project year will be made available from FY-'62 money when available.

project personnel are unwitting and the project will be conducted as an academic research program.

			A				
APPROVED FOR (	delication of Funds:		ne enterior a su	Chi TSD/Rea	lef earch	Branch	
		A				• .	

285 55

APPROVED FOR ADDITIONAL ODLIGATION
OF FUNDS: (\$48,390.00 against
Allotment 2125-1390-3902

Research Director

Research Director

Date 14,561

Attachment: Budget & Progress Report

Distribution: Original Only





Cost Account _3135 - 1390 . 5402

Object Class

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
24 Jul. 74	Sta Let 95 with "3	18,370.00	P/W:	48.390.00
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Pate: 11 July 1961

HEHORANDUM FOR: THE COMPTROLLER

MYFRETION

Finance Division

CONTAUS

: MULTRA, Subproject

Additional Authorization # 3

Under the authority granted in the memorandum dated 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subacquent nemorants, Subproject 35 has been approved, and \$40,330.00 of the over-all Project MANITEA funds have been obligated to cover the subproject's expenses and should be charged to cost center 2125-1300-3702.



APPRIATED FOR OFFICATION OF FUNDS:

Research Director

I CERTIFY THAT FUNDS ARE AVARABLE QUIGATION RETERRICE No. 144 CHAPOL TO ALLOWER 12125-1310-3902

AUTHORIZING OFFICER

14306

Distributions

Octginal & 2 - Addressee

A - TSD/FASS

2 - TSD/RB



17 July 1961

HEROMETUR POR: CHIEF, PILARUE DIVISION

VIA

: Tan/Eudjat Officer

SULTICT

: MANIARA, Subproject 97, Invoice #3
Allowant 2025-1390-3902

1. Invoice #3 covering the above subproject is attached. It is requested that reprent be used as follows:

Carbier's check in the assemt of \$13,390.00 drawn on companyable to

2. The check abould be forwarded to Chief, TSD/Research Brench, through 100/Redget Officer, no later than 11 August 1961.

3. This is a final invoice. However, since it is enticipated that additional funds will be colligated for this project, the files should not be closed.

Chief 580/Assearch Branch

8 100

Atiochments: Invoice & Certifications

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TSD/RB: 17 July 1961

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AUTHOR-ZING OFFICER

I CERTIFY THAT FUDIOS ARE AVAILABLE

OBLIGATION RESERVED No.

17 July 1961

KENDAMBANI POR: CHINE, PILABOR DIVIDION

VIA

: The most Cilicor

CLOHNE

: FINITAL Exproject 95, Invoice #3 Allotsant ELEG-1397-3902

1. Invoice #3 covering the above subproject is attached. It to requested that payont be made as follows:

deren es check in the assemble of (188,390.00

2. The check should be forwarded to Chief, 180/Research Branch, through 180/Endget Ciffeor, no later than 11 August 1961.

3. This is a final invoice. Powever, since it is enticipated that additional funds will be obligated for this project, the files should not be closed.

A Chief
LDD/Ausearch Drouch

Attachments: Invoice & Cortifications

Pistelbution: Cals & 2 - Adresses RECLIVED.

16 acc 1861

INVOICE 48:300.00 For Services CERTIFICATIONS (1) It is hereby certified that this is Invoice 3 applying to sub-project Eo. 95 of HEULERA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSD/RB, that this bill is just and correct and that payment thereof has not yet been made. Chief, TSD/Research Branch (2) It is hereby certified that this invoice applies to SubProject 95 of MINITEA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DOI to the DD/A, end the extension of this authority in subsequent memoranda. Research Director

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#### RECEIPT

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Receipt is hereby acknowledged of the following check:

Treasurer's Check No. 181461, dated 3 April 1961, in the emount of \$15,000.00, drawn on payable to the

april 10,1961

95-21



No

17/2

Cost Account __ 1125-

1125- 1380 - 380.

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DATE: 8 Forch 1961

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COUNTROLLER

ATTENTION

: Finance Division

SUBJECT

: MINIMA, Subproject 95, Authorization No. 2

Under the authority granted in the macorenium dated 13 April 1953, from the DCK to the ND/A and the extension of this authority in subsequent memorenea, Subproject 95 was previously approved. Under the case authority an additional sum of \$15,000.00 has been authorized to cover the subprojects expenses, to be charged against cost center 1125-1390-3902.

Chief TCD/Research Branch

Approved for obligation of funds:

CHIGATION MILLICONO.

CHAPGE TO AUGUSTA 150

CHAPGE TO AUGUSTA 150

CASTE JOSEPH S. C. P. P. C.

23,867

Distribution:

Orig. & 2 - Addressee



23 Earch 1961

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de enount of \$15,000

- 2. The check should be forwarded to Chicf, Thit/Research Pronch, through Tod/Rodger Officer, no later than 7 April 1961.
- 3. This is a final invoice. Ecover, since it is caticipated that idditional funds will be obligated for this project, the files should not be closed.

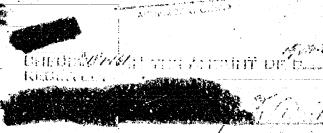
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## CHENNÝCANALIS

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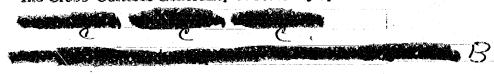
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A PROGRESS REPORT: JANUARY 1, 1960 -- DECEMBER 31, 1961
The Cross-Cultural Generality of Monning Systems



#### BUMMARY

The first year of research under our grant has been devoted primarily to

(a) establishing contacts and making arrangements for collaboration in various

countries. (b) preparing a basic list of translation-equivalent substantives for

eliciting qualifiers in each language to be studied, and (c) collecting and analysing

data for Phase I (see below) in most of the countries in our our original sample.

For a variety of reasons to be given in this report, the number of countries partici
pating in this project has been tentatively expanded to nearly double the original

number; to handle this increase will require a relatively small increase in budget

for the second and third years of the project, approximately \$7,500 per year for

expansion (see budget section below).

Progress to date may be summarized as follows: (1) Using groups of subjects bilingual in English and one of six other languages being studied in our project, an original list of 200 "culture-common" substantives has been paired to 100 terms which meet the criteria of ease and uniqueness of translation for all languages. (2) Elicitation of qualifiers of these substantives, as stimuli in a modified word-association procedure, from 100 junior high school level males has been accomplished in the field for seven countries. (3) Computer analysis of the frequency/diversity characteristics (the H measure) of the sample of qualifiers has been finished for five of these countries, and the further ordering of qualifiers in terms of H and ghi (index of qualifier similarity) has been concluded for four countries.

- (4) Elicitation of common opposites for these ordered qualifiers, to a total of 50 usable scales, has been accomplished in the field for four of these countries.
- (5) Collection of data from 200 similar subjects, with each scale related directly to every other scale, and factor analysis of these data or has been completed

9

and the U.S. control). Although it is too early to for two countries report firm conclusions, (a) correlational analysis of the ordering of qualifiers (by H) as translated, is high (.81) between and English and appears by inspection to be equally high for other samples, and (b) the unrotated factors for and English display obvious similarities.

Since Phase I is by all odds the most complex and time-consuming of the three phases in this research, we feel that we are just about on schedule with regard to collecting and processing our data. However, to collect and analyse data from the expanded sample will require the addition of another computer assistant  $^{\prime}$ and several field workers (to assist senior people in new countries).

 $\mathcal{B}$  --- Belection of the countries with which to work followed the general criteria established and the should in February, 1960: that they should represent "high cultures," by definition literate, possessed of a stabilized and normatively-directed language and literature, of a recorded and generally known history, and of an educational system employing the indigenous language; that they provide a maximum of diversity in both language and culture with a minimal number of countries sampled; that they be reasonably accessible relative to each other; that they have social scientists and institutions capable of collaborating in the research.

Accordingly, the following six countries were selected for study: with the UNITED STATES serving as a common control). These research locations and the languages represented are given in the upper part of Table 1. This sample offers six different major language families (Finno-Ugric, Japanese, Sino-Tibetan, Dravidian, Semitic, and Indo-European) and a variety of cultures. April, 1960, and the remaining countries in July, 1960. In each country excellent arrangements for research cooperation were obtained.

High interest in this project has been expressed by social scientists from a number of additional countries. Considering that one of our purposes is to develop comparable instruments for measuring subjective culture, and also that adding to the number of participating countries does not add proportionately to the expense and work-load of our own staff, we have entered into arrangements for cooperative research with three additional countries, but under a single senior monitor trained

is responsible for collecting data in and have made provisional arrangements for three more where excellent local supervision has been offered. plans to develop

the research in his extended period i

n the course of s year; contacts were also made by

with social scientists in the for possible cooperative research there, but there has been no indication of favorable response to date. With the exception of where the first phase data collection and enslysis is well underway, these additional countries are "under advisement."

Work if while in these areas this spring and summer: the direct efforts of while in these areas this spring and summer: living their visits to and will and will be given

has been a visiting professor in the Institute during this year and will be given full instructions before returning home. In each of these lest three cases provisions for a graduate student assistant will be necessary.

## PROGRESS ON PHASE I

The steps in preparing materials, collecting data, and analysing data for Phase I fall rather naturally into seven stages. These stages are described below, and Table 2 provides a graphic summary of progress to date in each country (areas where arrangements have not been completed are omitted from this table). Each of these stages will be described in terms of field method and/or computational procedures and in the order of their completion. It will be noted that Phase I involves several exchanges of infonzation between the field workers and the computational crew

# Stage 1: Relection of Easic List of Substantives

search was made for sources of culturally neutral (i.e., the so-called "culture-fair" or "cultural universal") stimuli. This resulted in a list of 200 selected substantives as stimulus items to be used in the elicitation of modifier associations. Grammatical analyses of the relevant languages were performed to provide a uniform description, to identify the forms which the modifier-substantive relationship would take, to identify the regularizable morphological variations, and to establish compatibility with the American data (the so-called noun-adjective relationship). It was taken as axiomatic that all field procedures would be replicated exclusively in the indigenous language, without reference to translation.

The 200-item list was then field-tested (in the United States and with native speakers of each language, both to acquire assured and uncontested translation-equivalents, and to immediately eliminate any terms which were diffuse, ambiguous, vague or otherwise culture-bound. Similar tests were made with small groups of 10-15 English/X bilinguals in this country (both in Any substantive which failed to meet the translation criteria for any language was eliminated from the list to be used with all groups.

The resultant list was then further pruned on the basis of variability, productiveness and further intra-cultural checks of uniformity. A terminal list of 100 items was thus derived. These items were of an order to yield a high diversity of modifier-types in testing.

A parallel study of American college subjects was completed at this time, which indicated that the form of the stimulus items did not appear to be a crucial determinant of the quantity and character of the associations elicited. This study employed four distinct stimulus-types: nouns, pictures of simple objects, geometrical forms, and zero-types (i.e., no stimulus at all was offered). Only in the instance of the geometrical forms was there any pronounced tendency for the associations to differ in quantity or character from those otherwise obtained. With this confirmation of the adequacy of the proposed procedures, instructions and forms were prepared for distribution to the field-workers. (A similar study, independently done was later called to our attention, further confirming this finding cross-culturally). In the field, spot checks of translation reliability relative to social dialects, idiom and precision were performed. A sketch of the linguistic factors of the entire project was distributed to field-workers.

### Stage 2: Collection of Qualifiers

As each group offers a unique morphology, and as there is a degree of non-uniqueness in morphological analysis, the method of eliciting modifier—associations decided upon was to employ appropriate syntactical frames in each language for the insertion of modifiers relative to the substantives — rather than to simply request the correct grammatical type. Illustrative frames in each language are worked into the instructions for each group. The resultant criterion of acceptability of any qualifiers is therefore relative to the language in question, not to any arbitrary grammatical scheme. Field workers are instructed to use this criterion in collating their qualifier data; similarly, the field workers are instructed to regularize the possible grammatical variants where such features were irrelevant to the semantic nexus of the response.

A group of 100 young males (roughly 12-16, equivalent of jumor high school) is given the instructions and the list of 100 substantives in their own language; to these items they write down the first qualifier (according to the illustrative frames given in the instructions) that occurs to them for each stimulus. The field worker collates these data, listing all the responses to each substantive (in the orthography of the subjects, in some cases in a standardized form of transcription -- e.g., for Chinese -- and with an English translation) and their frequencies on a single data sheet. The English translations are for information of the computational staff, but are not used in subsequent analyses. These data are then mailed...

The received data are then carefully re-screened to check the identity of grammatically variable but semantically identical items. Hon-clear modifiers and clear non-modifiers are discarded. The remainder comprises the population of qualifier types and frequencies from which selection will be made for eventual construction of bi-polar scales.

# Stege 3: Computation of a Frequency/diversity Indian

Two basic summery measures are calculated for each of the discovered modifier-types: an index of the total frequency of occurrence for each modifier across the 100 stimulus items and an index of the total diversity of stimulus items eliciting the given modifier. It is felt that these two measures are most useful in indicating the relative "linguistic utility" of each qualifier-type, as they take into account both a qualifier's emission frequency and its breadth of usage.

In order to standardize and summarize the total effect of these two indices, the entropy measure, H, is calculated for each qualifier-type. The qualifiers having the highest H thus display the greatest overall frequency and generality of usage, and qualifiers thus ranked (and translated into English) can be compared across all groups. Data already collected and analysed in this manner indicate that the H-ranked qualifiers are well correlated in translation. (Translation comparability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability does not require 1:1 correspondence -- which is practically impossible -- ability

The Pearson-product moment correlation coefficient for the first 200 ranked modifiers of the American and samples was computed to be .81 and indicates that the independently-derived modifier-types have extraordinarily high translation comparability for the two groups. Although the comparable correlations for the remaining groups are still in progress, a rudimentary inspection of the rew data in hand indicates that the same order of comparability will undoubtedly obtain. This result is of considerable importance; it both validates the procedures against certain criticisms and, more importantly, substantiates the hypothesized generality of meaning systems even at the level of selective qualifier usage.

# Stage 4: Selection of a Representative Sample of Qualifiers

This stage involves the procedures used to select the basic qualifier lists for each group from the population of qualifiers obtained. It is, in many respects, the most crucial part of the Phase I analysis. The selection criteria must have, as their and result, the selection of medifiers which fully sample the range of semantic dimensions employed by the subjects, and therefore, by implication, asycholinquistically comprehensive for the language itself.

Furthermore, it is of paramount importance that all procedures be analytic, reproducible ubiquitously, and independent of cultural determinants. Informant-translations, dictionary-translations and closses do not answer these requirements.

After a number of trials, the correlation measure phi was finally adopted. This measure utilizes the character of the distribution of the modifier responses to the substantive stimuli, and indexes the similarity of that distribution between all modifier pairs. This procedure is in many respects similar to the operational definition employed by some schools of linguistics, in attempting to derive an analytic criterion for meaning. The meaning of any given form, in this view, becomes the pattern of distribution of the possible environments in which the form appears within the entire corpus. In the present study, the 100 item stimulus list becomes the corpus (i.e., the potential environment source).

Face validation of this procedure was sought by examining the content of the qualifiers found to correlate highly in distribution. In the main, items with high distributional similarity were those with high judged 'semantic' similarity. Although lexical identity cannot be perfectly achieved, this procedure fulfils the aforementioned requirements closely and was, therefore, adopted. Additional evidence for the validity of the procedure was obtained in the subsequent factoring of the paired adjective similarity measures discussed below.

The procedure as finally adopted correlates the distributional overlap of each of the modifiers with its next higher H-ranking qualifier in order. Lower ranking qualifiers with phi coefficient positive correlations with preceding higher ranking qualifiers beyond the .005 significance level are discarded. This process is continued until 60-70 modifiers are selected or the population is exhausted, each selected modifier being compared with all previously retained modifiers. The selected modifiers constitute the sample of potential terms to be used in the construction of bi-polar scales.

### Stage 5: Elicitation of Opposites

The aforementioned list of 60-70 selected qualifiers is now submitted to the field worker for the elicitation of opposites. The lists are submitted by the field workers to approximately 10 independent informants who are judged linguistically sophisticated in the Mother Tongue. Opposites are selected on the basis of unanimity of judgments. Where identical majority antonyms do not occur, items are re-submitted to informants on a forced cheice basis. Fifty modifiers and their opposites are sought on this basis. Those in excess of 50 are discarded on criteria of linguistic similarity, ambiguity or inappropriateness, where otherwise unanimity has been achieved, but these discards are of items in the lower H-rankings.

# Stago 6: Collection of Scale-on-scale Palationabin Data

To second the factorial structures of the bi-polar scales thus obtained, a second sample of subjects is used in a paired-sample task, (scale-against-scale analysis).

Preliminary investigations on the design of this task have been carried out in the United fittees and The preliminary form amployed all possible combinations of pairs of the 50 scales, combinations varying in the ordering of the binations of pairs of the direction of the opposites. This form contained scales within each pair and the direction of the opposites. This form contained 4,900 judgments obtained from a total of 200 subjects in each country. Each judgment reflected the degree of meaningful relationship felt to obtain by the subject between every scale and every other scale in the total 50 scales.

Analysis of the data indicated that the correlations between the normal and reversed ordering were high. Reliability checks for the American data showed that the reliabilities for all variations in ordering of the constituent pair items were uniform and high. These reliabilities ranged between r = .73 to r = .80. Although the correlations between conditions in these data were high, it was felt that one of the conditions -- that involving a reversal of the direction of the scale-opposite-terms -- was sufficiently low (correlations between judgments obtained for the bi-polar scale in order A-B with those for order B-A being between .84 and .69 after correction for attenuation) to warrant experimental control. Controlling for this one variable and discarding control of the second resulted in the decision to reduce the total judgment task to 2500 items. This new task has been F submitted to and is being completed there and in the USA. The representation of this segment was considered desirable in view of the changed format of the judgment forms, and as an occasion for a second cross-validation of the shortened procedure. The shortened procedure is also more desirable for field techniques.

# Stage 7: Correlational and Factorial Analysis of Phase I Data

The procedures within this segment are entirely uniform and do not depend upon cultural and/or morphological variability. The scale-on-scale judgments are summarized in the form of mean ratings for each of the inter-scale comparisons and returned and for analysis. These mean ratings are then factor-analysed and returned for analysis. These mean ratings are then factor-analysed following Thurstone's centroid model, after the ancillary inter-correlations between each of the scale mean ratings and all others have been computed. The proportion of variance accounted for by each of the extracted factors is inspected and decisions concerning the number of factors are made with regard to the number of factors which contribute to a meaningful summary of the total variance.

The Varimax criterion for crthogonal rotation of factors is being tentatively employed in this terminal segment of Phase I. This rotation scheme was chosen because of its empirically-verified approximation to "simple structure" criteria. The technique tends to redistribute variance in the large first factors produced by the Centroid methods more evenly across the total battery of rotated factors.

The completed analysis on the American data indicates that sufficient numbers of orthogonal scales were present in the scale-on-scale task to display at least three distinct factors. These are identifiable as those component factors found previously, i.e., those termed Evaluation, Petency and Activity. The unrotated stadisplay obvious similarities to the American.

It is clear that the data analysed to date replicate and confirm the findings of earlier investigations. In view of the fact that the procedures developed for the present investigation were in all respects independent of that earlier work, these findings are particularly gratifying. The analyses performed to date in Phase I also support in all respects the predicted generality of the affective dimensions of diverse cultures. Phase II will be initiated to and the USA early this spring, and in several other countries by this summer.

## BUDGETARY CONSIDERATIONS

Table 3 presents a summary of the expenditures for the first year period of the centrect. It will be noted that a balance of \$1,885.30 ever the estimated budget for this period was recorded. These funds represent expenses incurred during the first year period which have not as yet been paid out. Notable among these sa-yet-to-be-paid expenses are the fees and miscellaneous expenses for these sa-yet-to-be-paid expenses are the fees and miscellaneous expenses for the succeeding years' estimates of expenditure.

Table 4... Jeents the summery of the original and revised budget estimates for the second and third years of the contractual period. Items representing increases over the original estimates are designated by "+". The total increase in requested funds is estimated to be \$17.772 for the remaining two years of the contract. This increase coarse the following anticipated expenditures:

Personnal: It is proposed that the salaries of the two full-time contract employees.

be increased by \$500 each, an increase deemed appropriate in view of the quality of their services to date and in keeping with the general increases in academic salaries for persons of comparable rank.

It is also proposed that the salary of the half-time secretary be increased by \$450 in view of the responsibilities and character of this position as it has been defined by the first year's work. Regular salary increases of \$50 have been authorized by the first year's work. Regular salary increases of \$50 have been authorized by for all academic graduate student assistants and have been noted in the table. It is proposed that an additional half-time graduate against be added to the contract personnel in view of the increased work load, the proposed additional assistant, is a graduate student major in statistics with extensive computer experience. Her salary as an assistant is far below that which she could reazonably expect if employed elsewhere.

Retirement and Workmen's Compensation: The increase in expenses covering compensation and retirement funds follows the total increase in personnel salaries. The calculations are as noted in Table 4.

Expendable Supplies: In view of the increased scope of the project an additional request for funds for paper, mimeo stencils and the like amounting to \$500 for each of the remaining two years is made. This increase would cover the necessary paper costs for the extensive subject forms anticipated to be needed.

Honoraria Several additional assistants will be required in anticipated to be included in the investigation sample.

this budget line amounting to \$1,000 for each of the remaining two years reflects the anticipated additional calculation costs. In terms of the doubled sample size the anticipated additional calculation costs. In terms of the doubled sample will this increase is relatively small. It is anticipated that the additional costs will not be great because of the standard and efficient operations already developed for processing the data in the first year's period.

Total Costs per year: The total expected costs are thus estimated to be \$8,886 in excess of the originally allocated funds for each year remaining.

### TARLE J.

Country	Ianguage	Language family	Project status	Field-center	Monitor
U.S.A.	English	Indo-European	in progress		
	Finnish	Finno-Ugric	in progress		
and the same	Japanese	Japanes <b>e</b>	in progress		6900-
	Cantonese	Sino-Tibetan	in progress		
	Kannada	Dravidien	in progress		
	Farsi	Indo-European	in progress		
	Arabic .	Semitic	in progress		
and little	Hindi*	Indo-European	advisement ³	and the same of	-
	Farsi**	Indo-European	advisement		
	Flemish	Indo-European	in progress		
	French	Indo-European	in progress		
	Dutch	Indo-European	in progress		
	Polish	Indo-European	advisement		
	Serbian :	Indo-European	advisement	WHEN !	
	Swedish	Indo-European	advisement		
	Russian	Indo-European	advisement		

### NOTES:

*Hindi will be supplemented with Urdu which is morphologically the same, differs only in script and some items of lexicon, but presents a religio-cultural contrast.

**This national contrast will be supplemented by Pashto when methods for dealing with preliterate-literate equivalence testing have been evoled. The present contrast is cross-national (and historic)

2.

3. "Advisement" refers to several different types of status -- see text.

TABLE 2

# Word Segments of Phase I Completed and in Progress

in Each of the Participating Countries

	•			Stag	e Numb	er		
Country		1	5	3	4 .	5	6	7
USA	:	<b>X</b> .	Х	χ	X	x	X	χ
	:	<b>X</b>	X	X	χ	Χ.	X	Х
		Х	X	X	x	X	c	
		<b>x</b>	X	X	X	X	0	
		. <b>x</b>		X	· · · · · · · · · · · · · · · · · · ·			
	. •	Х	<b>X</b>	Ç				
		X	X	0			•	
		χ	O					
	:	Х	0					

NOTE: See text for identification of work segment numbers. "X" entries indicate work completed, "O" indicates work now in progress.

TANK 3

# Expenditures Ruring Period Regioning Jan. 1, 1960 and Folding Jan. 1, 1961

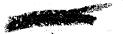
	Estimosd	Espanded	Palanco
Personnel Fayroll	\$19,167.00	<b>\$18,660.85</b>	
Retirezent	1,662.00	h56.03	
Workern's Compensation	227.00	185.25	
Perzument Equipment	600.00	685.03	
Expandable Supplies	1,500.00	637.09	•
Travel	10,000.00	11,076.85	
Homoraria,	F 3,000.00	3,003.62	
Conference	3,000.00	2,623.40	
B	1,000.00	795.57	
Indirect Costs	6,023.00	6,023.36	
Misc. Charges		149.59	
Totals	\$46,179.00	\$44,293.70	\$1,685.30

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# TARLE 4

Estimated Rudg	10t
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	Estimate Est	imate Es	timate	Revised 1/1/62 12/1/62
principal Investigator, Research Assistant Recretary, 1/2 time Clerical help, 25 hours/week TOTAL	\$ 1,667 7,500 7,500 2,400 2,400 2,400 1,500 1,500 1,500	\$ 1,667 8,000+ 8,000+ 2,450+ 2,450+ 2,450+ 2,450+ 1,950+ 1,500	\$ 1,667 7,500 7,500 2,400 2,400 2,400 1,500 1,500	\$ 1,667 8,000+ 8,000+ 2,450+ 2,450+ 2,450+ 2,450+ 1,950+ 1,500 \$30,917
Retirement 9.66% selectes of full-time	staff 1,759	1,896+ 309+	1,759 269	309+
Workmen's Compensation 1% all salaries and wages Expendable Supplies Mimeo stencils, paper, etc Telephone, stemps, etc.	1,000	1,500+ 500	1,000 500 3,000	1,500+ 500 3,000 3,000+
Honoraria, computer faci	5,000 1ities 2,000	3,000+	2,000	3,000+ 1,4,122
Total Direct Costs  Indirect Costs (15%)	47,395 7,109	55,122 8,268 \$63,390	5,459 \$41,854	
Total per Year  Additional Request	\$54 <b>,</b> 504	\$ 8,886		<b>\$</b> 8,886



DATE: 0 March 1961

MENORAMOUN FOR : CONFEROLLER

APPENETOR

: Finance Division

SUBJECT

MGNERA, Subproject 93, Authorization No. 2

Under the authority granted in the memorandum dated 13 April 1953, from the DOI to the DD/A and the extension of this authority in subsequent memoranda, Subproject 95 was previously approved. Under the same authority an additional sum of \$15,000.00 has been authorized to cover the subprojects expenses, to be charged against cost center 1125-1300-300.

Chief TSD/Research Brench

APPROVED FOR OBLIGACION OF FUEDS:

Orig. & 2 - Addressee

Distribution:

A CONTRACT

Feb. 24, 1961

Memorandum to

Subject:

Attached please find a copy of Progress report and new budget indicating an increase of \$8,000,00 over the original estimates for 1961 and 1962.

I am also enclosing a copy of my letter to that was sent in accordance with my instructions from

Please expedite this proposal so we can keep everything lovely. Thanks.

Red 1400 17 March 1761

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Progressy 12, 1961



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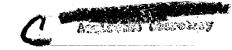
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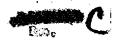
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1 Jaquary 1961.

MEMORANDUM FOR THE RECORD

SUBJECT: Extension of MKULTRA No. 95

Subproject No. 95, expiring 31 December 1960 is extended in time only until the balance of \$10,321.00 is expended.

Chief
TSD/Research Branch

Orig. only

January 6, 1960

In accordance with our letter of December 9, 1959, enclosed please find the check in the amount of \$11,550.75 representing the first quanturly payment to your institution on the grant rade for The Group Gultural Community of Heaning Systems under the directical of

Sincerely,

Assistant Treasurer

Eno.

CISP

Lescasion 9, 1959



The Board of Lincotors of the proposal "The trees Cultural Generality of mains parters" when the direction of a check in the around of Cil. 184.75 which represents the first quarterly payment on the first year's great of 185.179.00 will be forwarded to you clerity after the first of the year.

The following conditions apply to the utilization of these funds:

- In example and informal progress report to be substitted during the month of Beamber.
- 2. An annual accounting of funds to be readered for our records.
- 3. After the confliction of the research, any funds recaining shall be returned to
- h. At the termination of the grant, arrangements for the disjocation of the equipment probased with these funds will be made.
- 5. If, at my point, further research in this area is decised not a second continuity or elicates. In order to negotiate B for termination of the great.
- 6. Any technical reports or papers which provide of the studies, expected water this great shall crucain the following nation:
  "There studies were expected in part by a great from

other than the chore conditions, it is required that fures be encoured entirely for the research deal maked on. That so profice accurate any in Tribal.

The board of livestons and the nebulation advisors to the least of the livestone and the training pour will be train endowed. There exil upon us for any analytement that we may be able to provide.

<u>.</u> .. . . .

1.51

### RECEIPT

Receipt is hereby acknowledged of the following check:

0

Treasurer's Check No. 168390, dated August 13, 1959, in the amount of \$56.500.00, drawn on apple to the

C

Date aug 19,1959

95.32



Cost Account 0525- 1809- 1802

Object Class

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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7 August 1959

MINORANDON FOR: CHIEF, FINANCE DIVISION

VIA

: 188/Autot Officer

CUBJECT

: MANUSTA, Subproject 95, Invoice #1 Alloteent 0525-1009-4902

I. Invoice #1 covering the above subproject is attached. It is requested that payment be made as follows:

Cashier's check in the secunt of \$56,500.00 drawn on a psychle to

- 2. The check should be forwarded to Chief, TES/Chemical Division, through TES/Indget Officer, no later than 20 August 1959.
- 3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief TSS/Chemical Division

Attached: Invoice & Coxtifications

Distribution: __Grig & 2 - Addresses:

E





INVOICE

For corvices

\$56,500.00

B

#### CENTIFICATIONS

(1) It is hereby contified that this is Invoice No. 1 applying to Subproject No. 95 of MUNICA, that performance is cotisfactory, that services are being accomplished in accordance with natual agreements, that a detailed agenda of the payments and receipts is on file in NES/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, 155/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject No. 95 of INDEFA which was duly approved, and that the project is being carried of in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent apportude.

Research Director

Inte:



PREPAR TO THE REVIEWED BY DATE
8/12/8



21 July 1959

METOAMERIM FOR: COSTROLLER

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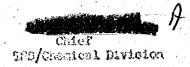
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Hoder the authority granted in the momentum dated

13 April 1953 from the Lui to the DD/A, and the extension of
this authority in ambasquent momentum, Subproject 95 has been
approved and \$55,500.00 of the over-all Maulina project funds
has been abligated to cover the subproject's expenses. This
obligation of funds should be charged to Allotsent 0505-1009-4903.



APPROVED FOR CHICATION OF FUCION

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1	<i>Hogewhell</i>	Director

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TSS/CD/(21 July 59)

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95-35 P

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Cetaber 28, 1959

RETURNS ARROLDS TO The Directors

MILLICE Project Proposal

Category A

adich autline (a possible approach to the solution of busing roblems involved in cross-cultural expensionien.

discussed with (100 considerable while questions new by rested about the theories which endedly research, this considerate, without exception, have the predictionary work be accomplished. You will note that the proposal calls for considerable consultation in the early places which will assure guidence to the training.

It is recommended that this proposed be approved for support by the facility for the limit year preliminary phase in the amount of \$45,177.

Leccutive Secretary

fort 3

## APPLICATION FOR RESHARCH GRAIN

Application is hereby made to:

For a great in the emount of:

\$142,537

For the period:

from JANUARY 1, 1960 to DECEMBER 31, 1962

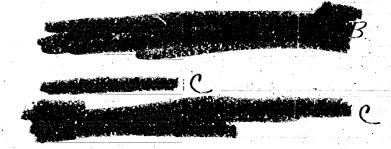
For research on:

THE CROSS-CULTURAL GENERALITY OF MEANING SYSTEMS

To be conducted by:

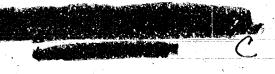
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Under the direction of:



Approval Signatures:

Project Director



Supervisor

Financial Officer



University Authorization

### I. OBJECTIVES

The general purposes of this research are: first, to obtain further evidence on the commenss of meaning systems across various culture and language groups; second, to develop, on the basis of this common semantic framework, standardized instruments for measuring non-material (subjective) culture in different parts of the world; and, third, to apply these instruments to the study of certain critical concepts cross-culturally. Research already completed (see section II below) indicates considerable similarity of commontative meaning factors in groups as diverse in both culture and language as Americans, Greeks, Japanese, and Mavajo Indians. If this can be shown to hold generally, then it becomes possible to construct "common yardsticks" for measuring attitudes, stereotypes and values held by different language/culture groups in directly comparable fashion.

Comparisons across cultures, despite differences in language, are feasible for material traits, like the making of pottery, but extremely difficult for most non-emterial culture traits. How can we assess and compare those things for which language is the chief expression when there are no common reference points in language itself? If the linguistic relativity hypothesis -- that people who speak different languages necessarily think differently, perceive the world differently, and even must formulate different philosophies -- is accepted literally, as it is by some linguistics and emthropologists, then such comparisons are impossible. This may hold for denotative aspects of language (the arbitrary "mapping" of experience into the language code). It does not seem to hold for competative aspects of language (the expression in language of affective reactions to experience). The affective reactions people make to events and symbols are important determiners of their behavior, political, social and otherwise; and some method of measuring affective meaning would, therefore, be useful.

The immediate objective of the research for which this grant is requested is to apply the techniques already developed with Americans to a systematic investigation of meaning systems in six additional countries differing widely in both language and culture (e.g., Using both monolingual and bilingual subjects in these countries, and American control-comparison groups, we will determine the degree of commoness of factor structure, construct semantic differential forms in each language, test their comparability, and then apply them to the measurement of certain critical concepts. Details of the procedure are given in section III.

We have several long-range objectives. In the first place, the simple demonstration of a shared semantic framework, camen to the human species despite differences in both language and culture, would be a contribution to social science theory; it would also indicate limitations on the generality of Wheel's hypothesis of linguistic relativity. Secondly, we feel that this research will be a contribution to improved international commitation and understanding. The development of comparable measures of that things mean to people, and the isolation of clear differences in meanings and values there they exist, should crebte us to do a better job of "getting through" to other countries and understanding that they are trying to cay to us. Thirdly, on nethodological grounds, the measuring

inctruments developed in this research may provide a way of making objective and explicit those subtle attitudes, meanings, values and beliefs held by peoples in other cultures which anthropologists and political scientists, as well as observers, travelers, and foreign service personnel, arrive at by more implicit and intuitive means. Information obtained with such instruments, while not substituting for the consitivity such observers have developed, should serve as a complement to their analyses. Finally, if the results obtained in the present study of six countries, deliberately selected to represent diversity in both language and culture, continue to indicate the essential sameness of meaning systems, we would hope to put this type of research on a continuing basis — to gradually develop a "world Atlas" of connectative meaning systems, along with the translations-equivalent instruments for investigating subjective culture which can be devised from this information.

#### II. PREVIOUS RESEARCH

For the past ten years members of the staff of ave been working on the development of quantitative techniques for measuring meaning. The underlying logic of our approach has been as follows: The meaning of a concept can be represented as a point in an n-dimensional space defined by a set of independent (orthogonal) factors. Difference in meaning can be represented by the distance between any two points in this space. Factor analysis of the correlations among large numbers of bi-polar adjectival scales (e.g., good-bad, hard-nest, quick-clow, simble-complex, predictable-unpredictable, etc.), when these are used in the judgment of samples of concepts, can be used to determine the natural structure of the meaning space, i.e., the major dimensions in terms of which people discriminate the connotations of concepts. In a number of such analyses, using different samples of subjects, scales and concepts, three general factors have repeatedly appeared and together account for about two thirds of the reliable variance -- an evaluative fector, a potency factor, and an activity factor. Measuring instruments, called "sementic differentials," are derived from these factor analyses by selecting a small number of adjectival scales having relatively high and pure loadings on the factors they represent. This early factor analytic work, along with evaluation of the reliability, validity and comparability of sementic differential measures across both subjects and concepts, is described in The Measurement of Meaning (Osgool, Suci, and Tamanbaun, 1957 -- see supplemental materials).

Also described in this book are applications of schantic neasurement in various areas: In the personality area it has been used to trace the changes in meaning that occur in patients during the course of therapy, to measure individual differences in the self-concept, and in a blind analysis of a case of triple personality (cf., The Three Faces of Eye, by Thigoen and Cleckley). In the social area, the technique has been in studying attitude change, including interaction effects (e.g., between source and topic) where comparability in the measurement of attitudes toward different objects to assential. A study was one by Such on the 1952 presidential election, where it was possible to identify significant differences in concept meanings for Republican and Democratic voters and also to predict how "Don't Know" voters would finally cast their ballots (although the number of such voters in the sample was small, unfortunately). Other applications include studies on the development of secentic discrimination in children, psycholinguistic studies

on the semantic effects of combining words into phrases, and studies in the fields of aesthetics and advertising.

Our interest in cross-cultural studies grow out of attempts to demonstrate the stability of semantic factor structure across different groups of subjects. Morning within the American culture and lenguage, we had found no significant differences between makes and families, between voters of different party affiliation, between people undergoing therapy and those not, or even between groups of schizophrenics and matched normal centrols. The most stringent test of the generality of composative meaning systems across human groups should be to compare people the differ simultaneously in both language and culture.

The first study of this type was undertaken by Dr. Kumata (cf., Kunata and Schramm, 1956; Kunata, 1957), using Japanese and Korcan , bilinguals and then Japanese monolinguals. The design was as follows: (1) A large number of bi-polar adjectival scales that had been used in factorial studies with Americans were first translated into both Japanese and Koresn, using one group of bilinguals, and then a different group of bilinguals translated the Japanese or Korean autorials back into Auglich. Only those scales which curvived this controlled back-translation procedure (i.e., vere translation-equivalent) were kept for further use. (2) Two other groups of Japanese/Maglish and Korean/Maglish bilinguals judged a set of concepts against these scales, half of each group taking the English version first and the translation-equivalent native language version about a month later and the other half vice versa; a nonolingual American control group merely took the same test twice over the same interval. Not only were factorial correspondences high for the bilinguals across English and native languages (.98 or better of a maximum possible of 1.00), but these correspondences were as high as for monolingual Americans merely doing the seme task twice. In other words, when the seme individuals are involved, difference in the language code per so has no influence upon the securitic factor structure obtained. (3) Translation-equivalent forms vere then administered to nonolingual Japanese living in Japan and monolingual Americans living in this country; although the factorial correspondences were not as high as for bilinguals (i.e., the sens individuals tested twice), they were very high for the first (evaluative) factor and significant for two others (potency and activity).

A second study was done by Suci (reported in 1959), using Navajo, Hopl, and tuni Indians and Hexican-Spanish in our Scuthwest as compared with separate American controls for each group (this was because the concepts being judged differed scuewhat from group to group). This research was part of the Southwest Project in Comparative Psycholinguistics, supported by the Carnegle Foundation via the Social Science Research Council. Two comment factors were shown to be common across all of these groups and their matched controls -- an evaluative factor and a potency factor. These correspondences, although reaching a satisfactory level of significance, were not as high as between Jupanese and Americans. However, since most of these subjects were illiterate, the tests had to be administered individually and verbally, and the reliabilities were lover.

A third study was done by Triendis and Osgood (1958), comparing memolingual Greek with memolingual Ascrican college students. The back-

translation procedures developed by Kumata were used in devising the forms, but the bilingual test was not made (deemed wancessary, given the Japanese and Korean results). With 20 varied concepts being judged against 30 descriptive scales, and 89 Greeks vs. 43 Americans doing the judging, square root factor analyses yielded three major corresponding factors, identifiable as evaluation, potency, and activity. The indices of factorial similarity were reasonably bigh (.8), .83, and .89 respectively), and these factors together accounted for 61% of the total variance in each group.

The generally high agreement in factors of commotation across language/culture groups does not rule out the possibility of differences in the vesse of particular scales, and these differences could be important in cross-cultural communication. Both Japanese and Koreaus, for example, use delicate-rugged as an evaluative scale, in contrast to Americans for when it is mainly a potency indicator. Such found that all of the Pueblo Indian groups, as contrasted with Americans and Hexican-Spanish, used industrious-lazy as a pure evaluative judgment, while the Navajo alone have a unique usage of fast-slow (and one which fits in with their mythology). The Greeks give much more favorable evaluative commotation to stanish, active, hencements, and this again seems to jibe with what we know accust their culture.

Furthermore, similarity in sementic factor structure does not, of course, mean that concepts must be judged the some way within this framework. In fact, it is the existence of a shared framework that makes it possible to directly compare differences in the meanings of particular concepts. In Suci's study of the 1952 election, for example, Taft Republicans, Eisenhower Republicans, and Stevenson Democrate were shown to have identical political frames of reference (i.e., identical scale relations), yet they differed extremely, and in anticipated ways, in their allocation of concopts like Franklin D. ROOSWELF, TRUMAN, SENATOR MCCARDAY, GOVERNMENT MAPLOYECS, and OUR POLICY IN CHIMA within this framework. Similarly, in the Greek study, it was possible to select a set of scales representing shared factors and then proceed to compare Greek and American meanings of certain concepts; for example, Americans ace FEMALE as much more colordal, excitable, unusual and many then do Greeks, while Greeks see ROSPITAL es more sociable, colorani, warm and public then do Americans -differences which again seen to jibe with what we know about these two cultures.

Cross-cultural studies of visual-verbal syncethetic tendencies have also been made as another way of demonstrating generality of connotative meaning systems (Osgood, 1959). Americans, Mexican-Spanish, Mayejo, and Jopenese subjects were compared. Using a Joch of about 15 cauls, on each of which was a pair of visual displays differing in only one characteristic (e.g., a black circle vs. a write circle, a jacred line vs. a cauved line, a trick cylinder vs. a trin cylinder, etc.), subjects aimly went through pointing to that side of each card which second to go best with a word in their language (e.g., "happy," or "man" or "week," etc.). Fet only were vibids-culture syncathetic agreements high (an everage of 50% of all items showing agreement significant at the

If level), but when between-culture comparisons were made, using only those cases where both groups being compared showed significant within-group agreement, nearly perfect coincidence in the direction of synesthetic choices was found. Hamms generally (to the extent that this semple is representative) think of "hampy" as coloried, thin (vs. thick), and bright; they conceive of "bad" as levero sacous, colorless; thick, dark, and creaked; they think of "loose" as being lany, rounded, and blight - keep in mind that the underlined terms are labels for visually presented alternatives. It was also found that that are meaningfully opposite terms for Anglos, e.g., "heavy-light," "happy-cad," "strong-weak," "black-white," and so forth, are also treated as opposites by the other language/culture groups, as determined from the reciprocal pattern of their visual choices for opposite verbal concepts.

These marked similarities in synesthetic tendencies, and in comotative semantic structure more generally, lead one to ask why. Some of these relationships may be immately determined, perhaps the reflection of tropismic reactions from beneath layers of culture. The regularity with widely judgments on the activity factor parallel the visual spectrum may be a case in point -- reas ere consistently judged hot, noisy, settive, exciting, end the like while blues are judged cool, which, possive, and colming. However, given general similarities of physical cavircament and biological. make-up of humans throughout the world, common principles of learning also would result in the independent acquisition of many relations. The dominant evaluative factor, for example, is presumably based on the bedrock of hesen capacity to experience resards and punishments; the potency factor is probably based on the fact that humans are all equally capable of experiencing variations in sensory intensity (loudness, brightness, beariness, etc.) and required to very the effort and energy expended in reacting to objects, if they are to survive. More specific relationships can also be learned independently, but comonly; for example, it is a Concrel fact about the relation between the physical world and the human organism that as noise generating objects come closer or move away, auditory loudness coveries with vicual size -- it is not, therefore, surprising to find that loud is associated with have while soft is associated with small. The generality we have found so far in comotative meaning systems presumably reflects the accumulation in lenguages of many such regularities based on commoness of physical environment and the species.

### References:

- Numata, N. A factor analytic investigation of the generality of semantic structure across two selected cultures. Unpublished doctoral thesis, University of Illinois, 1957.
- Kunata, II., and Schrom, W. A pilot study of cross-cultural methodology. Pab. Coin. (wart., 1956, 20, 229-237.
- Osgood, C.H. The cross-cultural generality of visual-verbal syncethetic tendencies. 12hav. Science, 1959 (in press).
- Osgood, C.E., Saci, G.J., and Tamenbeur, P.H. The Measure. nept of Hemning. Univ. Illinois Press, 1957.
- tuck, d.J. A comparison of comparison tructures in American

  Coalinest culture groups. J. chapti. sec. Psychol., in press.

Thispen, C.H., and Cleckley, H. The Three Faces of Eve. McGraw-Hill, 1957.

Triandis, H., and Osgood, C.E. A comparative factorial enalysis of semantic structures in menolingual Greek and American college students. J. abnoria. Loc. Psychol., 1958, 57, 187-196.

Whorf, B.L. for wave, Thought and Reality; Scheeted Papers of Bealcain Lie Worf (Carroll, editor). The Technology Press, M.I.T., 1950.

#### III. 125E10DS

The first step in this research will be to hold a Planning Conference, probably during Jenuary, 1950, to which shout 15 outside people will be invited. These will be non who are specialists in cross-cultural research, from anthropological, sociological, linguistic, psychological and commications approaches. From these experts we will colicit help of several sorts: In selecting the six countries to be studied during this period, in choosing appropriate social scientists working in these countries to be contacted as collaborators in the research, in deciding what kinds of subject-camples will be most available and useful, in selecting significant concepts (content areas) for final analysis, and so on. We shall also use this group as a critical sounding-board for the research methods described below, so these nethods should be considered nonewhat tentative, at least in their details.

The data from each country being studied will be collected in three phases. There will be approximately six months between each phase, to allow tire for statistical analysis on IEI of the data previously collected and for collection of comparison-control data from American subjects. At present we plan to use the equivalent of high school students as subjects in all countries; high school students have their our leaguages and cultures well absorbed, but usually have not become very somisticated cross-culturally, and furthermore, they do not pose the difficult problems that locating a rendom or stratified comple in each area would involve. In Prace I we will obtain a large sample of bi-polar linguistic qualifiers (in English, adjectival opposites) and then determine their factorial structure by a paired-comparison technique; in Prace II we will check on the comparability of sementic differentials constructed on the basis of the previous factorial results, using both bilinguals and monolinguals in each country; in Pusse III we will apply these differentials to the measurement of certain critical concepts, both a standard set of ecocopts for all countries and a unique, culturallyconditioned not for each country -- again, with American comparison-controls. Table I outlines these procedures.

### Table 1

## CUTLINE OF DAYA COLLECTION AND ANALYSIS PROCEDURES

## Paperis atel Country

## American Control

## Pessa I:

- (a) compling linguistic qualifiers
- (b) paired-comparisons mong linguistic qualifiers
- (c) PA (factor analysis) of the data from (b)
- (d) back-translation of (e) qualifiers into English
- (e) paired-comparisons emeng these linguistic qualifiers
- (f) PA of the data from (e) and comparison with FA results in (c)

# Pince II:

- (g) bilingual creek on comparability (long form)
- (h) menolingual check on comparability (long fons)
- (i) FA of data from (g) and (h)
- (j) back-translation of (h) forms into English
- (k) monolingual check for comparability (long form)
- (1) PA of the data from (k) and example on (i)
  results in (i)

### Prone III:

- (n) nonolingual measurement of critical concepts (short form)
- (n) monolingual monourement of the same exitical concepts (back-translated, short form)
- (o) committe profile and distance of profile one necessary contributes

Applification of Hable 1. Phase I. (a). A possible criticism of our caulier cross-subjured studies is that, by using back-translation from our Profish scales as the basts for sampling qualifier dimensions in other countries, we may have biased the cituation in fever of finding similarities. In the proposed research we will start "from scratch" in each language/culture erca. Word-association technique, with 'nouns' as stimuli and 'adjectives' requested as responses, will be used to collect a large sample of qualificra. The 50 (approximately) most frequently used qualitiers will be rade into pairs of opposites for further enalysis. (b) In the private commercian method, each bi-polar pair of linguistic Qualifers is paired with every other pair, with subjects asked to indicate the appropriate direction of relationship, e.g., NOT - cold; happy-god -does improve or sed seem closest in merning to the capitalized hor? This method eliminates the binning effects of particular concepts upon the meanings of scales and therefore permits a purer test of scale relations. , (c) Thursteng's Centroid noticed of factoring, with unities in the diagonals, end the Veriuex method of rotation will be used consistently throughout all analyses; (c) The back-translation procedures used by Kumata, in which one group or bilinguals translates from language X into English and another group independently translates their materials back into language X for validation, will be used throughout this research. (NOTE: if there is considerable loss of terms in back-translation, the procedures will be renewed with close synonyms.)

Enge II, (c). The procedures used by Kurata in his studies of Jepenese and Koreen bilinguals will also be used here: essentially, that half of the bilinguals take the form first in their native language and later (about a north) in Eaglish, and vice wersa for the other half. Here (and subsequently) we will use the standard (replie form of differential, in which concepts are judged against Y-step scales, defined by the bi-polar qualifiers. In these checks on comparability, we will use a long form of differential, in which all of the corresponding (translatable) scales appear. For this bilingual test, the concepts will be a standard set which cultural enthropologists would expect to vary minimally in meaning across groups (e.g., MCURTAIN, FIRE, SHOW, FOOD, INFAMT, etc.). (h) The differential given to mosolinguals will be identical with that given the bilinguals above, except that an additional set of concepts, culturally conditioned to a high do ree, will be added. These will be unique for each country studied, e.g., SUICIDE for Japanese, JET for Egyptians, FIREL CASERO for Costan Blooms, and so forth. (1) The correspondence of factors obtained from bilinguels taking the test in kighish and in language X will be determined, and these differences compared with the test-retest reliability values obtained from Americans (see (k) following). (k) Cur American control group will take the some test given to the monolinguals of country X (which includes the concepts and scales given to the bilinguals). They will be (lyen this test twice, about a month spart, to provide a reliability check. (1) Pata for the relatively stable, standard concepts will be factor englyzed, and comparisons of facrican results made with both bilingual and neadlingual results for country X. The scenatic profiles for A Americans ve. country X subjects on the culturally conditioned concepts will be command for the expected differences, as a validity check.

Frace III (m). A more efficient, short form of differential will

be used in this phase. It will include only a subset of those qualifiers whose factorial composition has remained stable in the preceding factor analyses and those factor loadings correspond between American subjects and subject from country X. How samples of monolingual subjects will be used, ond the number of concepts will be increased. The exact nature of the critical concepts to be measured remains to be determined, but the following are suggested as possibilities: (1) national and othnic stereotypes (e.g., JETS, AMERICANS, REGROUS, RUSSIANS, CRIMANS, etc.); (2) various aspects of the American way of Line (e.g., DOLLARS, "CARS", MOVIE STARS, NEW YORK CHEY, FOURISTS, COCA-CORA, etc.); conceptions of the solf and others (e.g., The Kind of Patison I am, the kind of Peason I'd Lice to be, most X's [country label), FOLIÇESEN, DOCTORS, etc.); individual and social institutions (e.g., PRIVADY, PRAYOR, ELECTIONS, THE LAW, MY ANCESTORS, etc.); basic values and orientations (c.g., Life, DMAHH, Time, THE FULURE, PROTRESS, COMPROMISE, etc.). (6) Since the seme set of critical concepts will have been judged by nonolinguals in all countries, but on senantically equivalent neasuring instruments, it will be possible to compare directly both scanntic profiles (e.g., determine which countries place the highest valuation on the selfconcept and which the lowest) and secentic distances (e.g., do Egyptions show a greater difference in neaning between themselves and Americans than do the people of India?).

As time permits, cortain additional supplementary studies will be made. For one thing, we would like to extend our earlier studies on the cross-cultural generality of visual-verbal synesthetic tendencies, using the same emberials and techniques described in section II.

Just completing his doctoral thesis on the cross-cultural generality of sound symbolicm (e.g., that high vowels have commotations of small size and low vowels of large size), would like to extend this work through our sample of larguage/culture groups. So untic analysis of the concepts we have called "culturally stable" cheated yiel, some interesting preliminary information for cultural authropologists and linguists on just what aspects of human behavior are most resistant to cultural impact. Other supplementary studies will undoubtedly occur to us as we proceed and will be undertaken to the extent that they do not interfere with the major program outlined above.

### IV. PERIOD OF THES RESEARCH

The present grant is requested for a period of three years, from January, 1940 through December, 1962. During this period we plan to study approximately six countries. The data collection phases discussed above will be staggored over the three years in the different countries, so as to provide the even flow of data collection and processing, without overlanding our staff and facilities. This will also distribute the foreign travel that is required over reasonable intervals (see note on foreign travel under budget). Table 2 shows how the phaces of data sampling will be distributed over this and countries, according to present plans; Result memerals represent the places discussed above. We expect to be table to start with Phase I in the two South American (one actually in Control Aporton, probably) countries during the spring of the first year, ubile or emisational trips to other eress are being made. By spring of the second year, we will be in rull operation on all places, but in different countries. By apring of the third year we plan to be topering off on take policables and spending most of our time on data analysis old writingeap.

Table 2

DISTRIBUTION OF DATA SAMPLING OVER TIME AND COUNTRIES

Arcas	* *			-	Per	lois		
gyjunga utkapunda After hit		19	50		<b>19</b> 63	l.	1968	2
	S);	ring	Fall		Spring	Fall	Spring	Fall
SOUPL	A	L	11		111			27 44.88
AMERICA	B	r	11		ŢijŢ			
EUROPE	C		r		II	III		
•	D		ı	•	ıı	III		, Ç
ASIA AND	E			•:	1	II.	III	, X
MIDDLE EA	ST   F	-	•		χ	II	III	

		(A)	Y
V. ESSENTED BUDGE.			
	1/1/60 1/1/60	1/1/61 12/31/61	12/31/62 1/1/62
Forecasel:  Proceipal investigator,	1,667	1,667	2,667
Research associate (Pa.D.). (Statistical analysis, cosputer)	<b>6</b> € 3,500	7,500	7,500
Research associate (Ph.D.), X (Ethnolinguist)	7,000	7,500	7,500
Grad. research assistant, 1/2 time	ie, 2,400	2,400	s,100
Grad. research assistant, 1/2 tip Y (statistical work)	e, 800 -	2,100	2,100
Grad. research assistent, 1/2 the Z (statistical work)	ge, 800 /	2,400	2,400
Secretary, clerk-typist, 1/2 time Clerical help, 25 Lours/week	1,500 1,500	1,500 3,500	1,500 1,500
Retirement: (9.007) calaries of all full-time staff *** (X, and secretary)	•	<b>1,7</b> 59	1,759
Workmon's Commencation: (1) all salaries and wages)	551	269	269
Permanent community: Lif inscutive typowriter Two 4 drawer files	450 150		
Expendable samplies: Misso steneils, paper, clips, etc Telephone, telegraph, stamps, etc		1,600 500	1,000 500
Rent, effice space: (	elow) (400)	(3,200)	(1,200)
Provel:	10,600	10,000	3,000
Roseronie,  Planning Conference	, = 3,000 1,000 3,000	5,000 2,000	1,000 2,000
Total Direct Costs:	40,155	47,395	36,395
Indirect Costs (15)	6,023	7,109	5,459
Noted ner veer.	46,279	54,504	42,854

Total Cod: \$12,537 for three year period.

Botes on the estimated budget: (1) The principal (investigator plans to spend approximately 1/4 of his time during the ecodesic year on this research, without pay from the grant, and 1/2 time during the summer, with pay from the grant. (2) Although will contribute to the planning of the project curing the spring of 1900, the load of statistical analysis for which he will be responsible vill not begin until the first ammer, at which time go full-time on the project. (3) Et noting that. We have not secured the man for this position yet, but have several possibilities. I hope to be able to hire the right person as of January or February, 1960. Once foreign contacts are curringed and plans agreed upon with the social science personnel in the countries to be studied, the ethnolinguist will be mainly responsible for deta collection, bandling translation problems, and the like, with the aid of the foreign personnel. (h) linguist in the Middle Past; he will also handle our collection and analysis of background information on the various cultures we are studying. (5) The other two evaduate recearch assistants will work under one being responsible for collection and analysis of the American control data and the other for analysis of the data from other countries. Both will be consistent in the use of IM as is (6) A secretary (1/2 time) is required to handle the project correspondence and to propore the various test forms as they are required. (7) Clerical help (25 hours/week) is needed for IUI key punching of the data and for other incidental chores (minor statistical vork, escendly of forms, etc.).

(8) Retirement. A charge of 9.667% of calaries of all full-time staff poid by the grant is required. It applies to the share of salary poid by the grant, even though the personnel involved are not full-time od the grant itself. (9) Workmen's componention (1%) required on all calaries and vages. (10) Personent confirment. An IBM executivetype typewriter is needed for making print-like stencils for the various test forms we will be using. The files will be used for storing both project data and supplementary information regarding the countries we are studying. (11) Exceedable symplics. The costs here represent the large anounts of missographing that will be necessary for supplying about four different test force to about 100 subjects in each of six countries, plus the American controls in equal mount. There ill also be considerable use of the anils. (12) Reat. Proce is the mod valuable and difficult composity to obtain in moved to larger quarters by the fall of 1960, when the full operation of this project will be gotting underway; in this case, no additional rented apace will be required, so this item has not been added into the totals. However, as discussed with the executive secretary of the Society, and agreed to, we will request the extra funds for this purpose if necessary. In this case, ther would be some reduction in the indirect cost.

Trivel. Foreign travel accounts for a large portion of the budget. The figures are eased on estimates ande by the local travel agency for the following first class car trips: 1200. Trips into South America and around the world indicate fast, and Europe) and the call the standinguist.

120. A trip to South America by the Standinguist.

12.

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by the ethnolic pict; one trip to the Middle East 🖏 A trip to the Hiddle East and India by the ethnolin wist. Fach of these trips includes stop-overs or about two weeks duration in each country being studică.

Other expenses. The miounts for honoraria for are based on \$500 for cash of the three phases of data collection (including help with the back-translation procedures) for each of eix men in the countries studied, i.e., \$9,000 total. The expenses for (including costs of properatory BM raterials and processing) are based of their charge of \$20 per hour. There will be four sizeable factor analyses and rotations for each country, and this must be doubled by the American control in each case; further, there will be subsidiary analyses of profiles and distances, using Finally, the Planning Conference costs are based on en estimate of 15 people at 2200 per person for travel and maintenance; the conference will be held at there the board and ledging expenses are very responsable, considering the excellent conference facilities.

estimates its actual indirect costs for research projects at approximately 25% of total direct costs. However, the figure it will use in this case is 15% (as shown in the budget). The difference is concontribution to the research. sidered part of is eligible for tax-exception privileges.

VI. QUALIFICATIONS OF PERSONNEL AND FACILITIES AVAILABLE

lis major fields of research interest have been in tamen learning, language and compunication. author of a craquate text and co-sittion of a research rook,

He has carried and contributed to several books of an intercialinary nature:

ne to surbor of various research papers in husen describe and langue to behavior. He has been a Speinl Science Research Council Faculty Fellow ( ), a Guyyenheir Fellow ( ), and Pellow the Center for Advanced Study in the Behavioral Sciences He is a member of the American Poychological Association, he is a memory of the Advancement of Science, and the Linguistic Society of America.

last puellinged four revoluter papers, vive and has several regulationed research papers on psycholia printies. has training in psychology, linguistics, experimental phonetics, and nathematical statistics. He is highly competent in high speed digital computer and IL4 data processing, and also in research design. He is a member of the Linguistic Society of America, the American Speech and Hearing Association, the Accustical Society of America, and the American Psychological Association.

He is presently working toward his Pa.D. He has also studied at

He is thene his amone and english, speaks some Hebrev and Amenian, and reads in French and German.

Other Research Personnel. We plan to bring an ethnolinguist into the project was will be presently responsible for the selection and translation of materials in the various language/culture groups being studied and for the collection of the foreign data. Ideally, he will be a young man either with his Ph.b. or in the final thesis stages; he will be competent in descriptive linguistics and in cultural anthropology; if he is fluent in one or more European languages, so much the better; if he has had considerable international travel and cophistication, also so much the better. This man will work with the principal investigator on arranging contacts with social scientists in the countries to be studied and on the setting up and sampling of data in these countries. The two additional graduate research assistants will be under the confection and processing of data from American controls and the other will be primarily responsible for processing of the foreign data. Both will be competent in DM and digital computer operations.

On the staff are people in magnifice, enthropology, psychology, sociology, econoxics, and ross communications. The entire staff contributes its advice and skills to research projects, as needed. The project staff will have seems to high speed deta processing services, which love access 🛂 include the paner line equipment, on BM 650 computer, in operation before the completion of this project. all of the data precessin; operations we now plan to make (correlation retrices, factor analyses, rotations, multiple distance measures, etc.) are avoidable and have been used in our provious work; to provides expert help in Covising new programs should they be needed. is presently exploring ways to acquire the remaining membership in the Russa Relations Arca Files or, if this is not possible, the microfilm series of these files. We will also have access to the complete files in the library of the extra city valuable to our project, both in accuring background inforcation on the publicator erect being studied and in sampling for both standard and culturally-conditioned concepts.

VII. OFUR SUPPORT

To other course of tapport for this cross-cultural research is being considered.



DRAFT 1959

MEMORANDUM FOR: THE RECORD

SUBJECT

Project MKULTRA, Subproject 95

in the field of cross-cultural meaning systems as cutlined in the attached letter of proposal.

While this proposal is couched in very broad terms, it includes those areas of paramount importance to the Agency in connection with problems in and the technical support of political activities.

project have been reviewed and evaluated by

and by a

panel of experts in the particular field of investigation. It was

recommended that the proposal be accepted.

, originally received the

proposal for the Agency and is conducting current negotiations with

pending the transfer of his covert approval to TSS/CD.

expects to plan the details of his research design when

he is able to discuss the project with representatives of TSS/CD.

Actually, few if any changes will be required to direct the work

toward pertinent Agency goals.



- 2 .

for security and cover purposes and the accounting for funds expended in it shall conform to the established practices of that organization. It is not anticipated that any permanent equipment will be required for the project, but should that occasion arise, it will become the property of in lieu of higher overhead charges.

- 4. Travel funds expended under this project and normally reimbursable by the shall conform to the accounting practices of that organization.
- 5. The total cost of this project for a period of one year is estimated not to exceed \$56,500.00 as indicated in the attached budget. Charges should be made against allotment 0525-1009-4902.

personnel are unwitting and the project will be conducted as an academic research program.

Chief TSS/Chemical Division

Approved:

Research Director

Data.

7/23/59

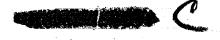
Attachment:
Budget & Ltro of Proposal
Distribution:
Original only



# BUDGET

1959 - 1960

Personnel	\$40,000.00	
Supplies and Materials	2,500.00	
Services (Computer Time)	3,000.00	
Travel and Communication	5,000.00	
University Overhead (15%)	6,000.00	
	TOTAL \$56,500.00	· · · · · · · · · · · · · · · · · · ·





Control Intelligence Assurey Machington 25, D. C.

Dear Transfer

nectings in the leavest and he told to that he had talked to you at the mount one rescarch on the crime-cultural generality of standard dystems and about our plans for future research along these lines. He also encouraged to to write to you directly about the possibility of support for this research through your against one other government experiencies. I unless the expectantly to do this, because I telieve we have developed techniques for obtaining information of value in improving intercultural communication, impact and understanding. Since this is an explanatory letter, and since I do not know what form a formal proposal should take in any case, I chall nearly indicate in general terms the laskspount of our work and the nature of our proposal.

particularly interacted has been in the study of cross-cultural maching systems. Tith the comparation of coveral stuff recisers, graduate students (co.0. thereo), set social commissions located in or preventing through various alloca, to have been side to collect data from Japanece, Espisas, Origin, Particular Sanish, col to Recipe, Hod, and faul Lathme of our own facility. Saling the side of our own

of the falls that these divorce collines and herganic freeds (a price everyny

THE PROPERTY A

April 23, 1959

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of methods is given below) has indicated a currelaing degree of similarity in the latter reparate-discussions within which restricted fulgrants are rate. Although such evidence for cross-liministic and cross-cultural questality of meaning systems is of conditionable theoretical interest in itself, of more practical importance is the fast that this information may make it possible for up to device course 'yardsticks' for constring the attitudes, values, and beliefe of diverse peoples throughout the world.

So far this cross-cultural work has been conducted on a "catch as eatch can" basis, as you can see. I would like to see it put on a systematic basis. I would particularly like to study countries bordering on the "Grow Curtain" -- Country, Poland, Austria, Warisy, India, and so on -- so well as our South Austrian maighbors. This is a large order, however, and would require substantial support. In this connection, it should be pointed out that the exploratory, pilot studies have already been done, as indicated above; what is anxienced is a systematic applications of these techniques to a selected sample of world cultures.

The work in each country studied would fall into two major phases.

these I is the "tool-raking" stage; it involves determining the commic increas used by each group and testing their comparability with those used by Americans. First, we obtain samples of descriptive disconsions (2.6., playery-work, good-lad, quick-slow, etc.) from nativo opeakers in their one language by word-association techniques. Then we determine how those descriptive discussions are intervoluced, (a) with cock other to general (e.g., does abreed, es opposed to week, seem closest in recording to legal or to raisi), ear (b) when used in the judgment of a discussified raw of standard cultural concepts. Each sets of data are factor cradyred.

The injurations along which recovers all decreases are being rade, by people in this country. To test for establish with the Arcrican factor rispeture, the resp faceriptive discusions are beenclated into Inglish by one group of bilitypuls and then translated back into the language of country X by a distingent group of bilinguals to check for ordinary of irrustration. For how of American subjects, rateind with the forci n of wels for ugo, sex, conforcivic status and the like, then do the new tests, and the commencedence in factor simulate is determined. As a little check on the influence of the becomes very pe, a comple of bilizes al adijecto do the tacka cirat in cas langully did than the other, end of the the intellectly of a choose obvertire is tessed. (1178: Minaba's wolf on Jugarene and Homon billingsile dulimates that the factor atmospres oblight of some bill compared results such to be twice in two different languages ore national finder at them has noted by the faither them to be the been In process in absorbed correspondences of Ad for a possible 1.60 for better least colored in both cases.)

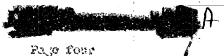
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April 23, 1950

Rago tirros

countries II to the "tool-woing" charge; it involves tothing up countries of a proceeding from the information obtained in Phase I and applying there to the earlysts of the recodings of eightfleant concepts. Assuming that companies factor considers for the various countries being statical law bear to be to the information for the various countries being statical law bear took terrecombing those factors are put together into a single form which are to took guidely and efficiently in each language/entime commutity. Due to the analytic power of the factorial mathed, no few as 10 or 12 scales may took a language pertion of the variance originally displayed by an early as 100 ceales. Since these scales are achosted as representing our particular for measuring the country of concepts cause-calcumity. The ceales used are not necessarily the same for different groups (that is, translation-equivalent), but they do reflect the same basic fautous in necessarily judgments.

Ext purifieder concepts are to be differentiated equiest this executing instrument in the various occurries depends upon the interests of the investigators and the organization supporting this work. The following are careful excepted: (1) harvered and ethala abtractable (e.g., J. B., Millerell, Millerell, Chieff, 18 Miller). It is been be within to know in conjuncto, equatitative town, has people in various consides percuive people of other retions, including our can, and her those images change under the pressure of create (for entagle, the Chinese Consumed invasion er circl). (2) Vortons armeds of the fundamentary of Bille (c.s., Dollars, Co.z., Have sever, Police, Vortons, Co.z., Co.z., Have sever, Police, Vortons, Co.z., Co.z., Law York cury). It should be possible to detendine which espects of our my of life are understood did Viter riconderstood, thich approximate and which rejected, and on their groweds. (3) Compositions of the sold and others (e.g., III KDD CO PROPERTY AND THE STATE OF PROPERTY OF THE X'E / Testion label ]. rome that, recorded, rowself. The rows pools in various countries which of the relyse -- as relatively good or not so good, as relatively retent or importat, as relatively velice or pressive -- should have implications for how they would react to western policies and converse, Discreparates teletion and and fixed califed a jee can also information to to that needs can selb that we night deal with. (4) the individual and mainly inotionmore (e.g., forecy, player, thought, we had, before, those, ik The fine of . For comple, I happen best one of the chief coloralists to togeth order ways of life is the imposerate and identify that to the individual bear toing vo. that given to excisols of institutionalized continuity. (a) It to write a seal order rates (e.g., 1887, vives, 2002, this seal, that I like the first constitution, Appendix, Conroute 3. They e was at bours and do do have their accordances problems, Year, as that was private, of Mile or Grade, his cross of the gode, year the continuous has buring adon at bosomalistics we besited, and no on that they are productive of his probable believies with respect to decoditate



With regard to personnel, I think that a research project of the scope I have cutlined repul regular three funder stail people at the B Pa.D. local to asymptotic true to handle design and excelentical analysis with programs, a cultural authropologist or sociologist to deal with relection of entertals and empling in vertous countries, end a linguist to busile increfation and related problems), two quadrateetulent regulard assistants, and a social scientist located in each of the equipment being similed. Additional funds would be required for use no collect and readlesses in each of the countries studied on the part of the authropologies and linguist, for payment of foreign and Apprican subjects, for proluction of enterials and other incidental expenses, and for everyond. I would exclude the total cost at between \$10,000 and \$50,000 for year, including the calaries of the staff. I think we would be eble to collect, process, and report the data for two countries for mar so this basis, along with the comparison data from Americans. I realissible to one an initial great for three years' work (six language/culture groups), in order to be able to obtain the collibre people to would need for the staff; depending on the value of the infornation buling obtained, the project could be extended to other countries or exied at the terraration of the three-year period.

I have evailable at the state of a top-moteh young psychologics the is just finishing his thesis (in this area of study), is on excellent attaintation, and is familiar with the second. Succeeding the familiar with the second of the formation through the stem forested formation of the familiar vith this type of research, and we have the necessary programs for the factor embyses, relations, and other statistical procedures that would be involved. I also been a number of social scientists in other countries the inferior of social scientists in other countries the allocate who hight be willing to work with us therefore or at least early relation connected with coing studies of this sort in foreign countries. This is they I black it is necessary to work through professional to do the control of the country concerned and who are also interested in the research problem. We have done this careessfully in both the farmes and thesis studies.

Low, in pound, night rescured of this kind be useful to any provinces egony altestly conserved with the production and interpretation of in empirical constitutions? In the first place, this research is designed to take condict there expely attitudes, membring, values, and bollow held by people in other countries tideh observers, travelors

Page fivo

and contest applysts with long fraining and ruch experience may arrive at by more implicit or intuitive means. Although it avoids the biases of particular claervers, it probably loses consthing of the beneitlying they have devalued. It is therefore complementary to, cross-checking and validating, the information obtained from the usual chausels. Secondly, the single depostration of a singed framework for huma thinking, regrailess of race or nationality, should in itself encourage international understanding and reduce puspicions. Thirdly, the clear isolation of ... differences in the regaings of concepts enables us to do a better job of talking to others and understanding what they are caying to us. Intercultural committeeticae are particularly liable to the medianica of projection -- when ye talk about Discensor, isbavious Riches, police SEASE, or even such implease things no FCCD, 18782 and 17822.03, and use such ordinary descriptive terms as marged, high, or devery, we implicitly assess that they have sufficiently similar mannings that translationequivelent boxes will carry our intentions across. But DEMORMON to the Germans still comptes something weak and institutional; BUCCOD ENDIVIDUALISM econotes countding purely had to the Japanese, with more of the potency and pride which we attribute to the tern; severe is a positively evaluated quality to Greeks, although it is correspond in indive to us. Fourth, knowing the impre of the UHIND SEMES and of ANERICANS held by others, porticularly knowing how it varies from place to place and from thee to time, should easble us to do a more effective and selective job of correcting and improving this irruge. Pinally, knowing how people in a particular country view certain artitical concepts, it abould be possible to predict more accurately both went policies they are likely to initiate and apport and what their reactions are likely to be to policies we initiate.

This has proven to be a much longer letter than I had originally intended, and I appleding for the line you must have put into it. However, not incoving exactly that have possible at the rick of some redundancy. I checked a reprint of the ctudy rade with Kerry Triandic of Greek vs. American making systems — the discussion rection includes come concrete caragins of how comparable instruments can yield information on differences in world view (although the Greek study was not designed for this purpose). If you are inserested in captoring the possibility of research along these lines further, I will be glad to have my copies of Dr. Russia's thesis on the Jamanese and Koreans and of Dr. Suci a paper on the Indiana of the Southeast neat to you. I can also send you a cary of



Page six

I will appreciate hearing your reactions to this proposal. If you do not think it is equathing CIA could support, them I would like to have my alternative suggestions you might care to make.

Sincerely yours,



Marian C

Enclosure

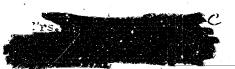
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Mrs.

January 6, 1960



Theolosed please find the check in the amount of 1,503,75 which represents the second quarterly pareaut on the great the check to you for A Preliminary Study of Group Interview Fot of Federal to Litelt Fers had Decision-aking Entrices.

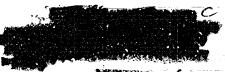
Sincerely,



Fno.



September 30, 1959



Dear Fre.

B

Enclosed please find the check in the account of \$1.503.75 which represents the first quarterly payment on the great that the list saking for "A real inery tady of Group Interview methods besigned to blight Personal mediators laking atrices."

The only requirements that apply to these Aunds are as follows:

- 1. A tended report is to be substited after the completion of the phase of research covered by this grant.
- A terminal accounting of funds expended in obtaining, processing and reporting data shall be provided for our records.
- 3. Any technical reports or papers which grow out of the sharp supported under this grant shall contain the following notices: "Whis study was supported in part by a grant fro

Other than the shows conditions, it is required that the funds be exceeded entirely for the research designated and that no profits accree to any individual.

inclosed place find a copy of the budget that In . . . substited.

To are all very happy that ir. I feeling better.

The board of lineators and the schedulic advisors to join so in wishing you wall in this exceever. These call upon us for any assistance that we may be able to provide.

introvered;

are constant



September 15, 1959



Mr. is sorry that he did not have an opportunity to write to you directly but he was unexpectedly called out of town.

This letter will confirm the conversation that he had with you in which he stated that the prepared to forward to you on or about Cetober lateral parameterly payment in the amount of \$1,503.75 of the total grant being made in the amount of \$6,015.00 for "A Preliminary Study of Crown Interview Methods Resigned to Elicit Personal Decision-Naking Natrices."

We would appreciate your letting us know if this method of payment is caticfactory and whether you wish the payment to be made directly to you or in another wanner.

Sinceroly.



Project Proposal

B

To,

A PRELIMINARY STURY OF GROUP THE VALUE OF THE PROPERTY OF THE

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The later is proceened and shelf connections with the later alvergations of position as from at later later is position as from at later later form for study.

As techniques are developed they will be applied to different national groups of students in both institutions. In the final stage the techniques will be applied through the use discount in order to make sure the procedure can be used abroad. There are several creable foreign groups available on the campus and it should be possible to anticipate most of the basic practical problems which will arise to executing the main project. Is

During this prolinicary investigation the same recording and photographic equipment will be used as is planted for use in the rain project. It is heped to evereese whatever technical difficulties may raise well in advance of the departure of the main project investigators.

Rudgot

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	Camera and supplies	165.60
*	Educalianoons equipment and supplies	200.00
	Cocrotarial help	200.00
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	S S	3,015.00

Respectfully embatted.

Principal Investigator

STORE

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Cost Account 0525-108-1802

Object Class

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4 August 1959

MEMORAPDUM FOR: CHIEF, FINANCE DIVISION

VIA

: 153/Budget Officer

· SURJECT

MKULTRA, Subproject 95, Invoice No. 1 Allotment 0525-1009-4902

1. Invoice No. 1 is attached covering the above subproject. Payment should be made as follows:

E Cashder's Check in the amount of 521, 165 (0) drawn

2. Please forward the check to Chief, TSS/Chemical Division through TSS/Budget Officer by Friday, 14 August 1959.

3. This is a final invoice. However, since it is anticipated that additional funds will be obligated for this project, the files should not be closed.

Chief
Tes/Chemical Division

Attachments: Invoice & Certifications

Invoice & Certification

Distribution: Oris & 2 - Addressee

1 - TSS/FASB

CERTAIN THAT THE THE AVAILABLE 1959
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CHEARCE TO ALL THE DAY OFFICE AVAILABLE 1979. 4402

CHECKS MESON

THE DE 113/1/65:00





April 16, 1962

Summary Accounting of the Phases I and II Combined	ect
Stipends and	\$19,500.00
Equipment and Supplies	1,722.27
Gifts	150.00
Travel	15,766.72
Secretarial Help	168.00
Miscellaneous .	121.10
Total expended on whole project	\$37,428.09
Received	34,465.00
Absorbed from General Grant Funds	\$ 2,963.09

project.

I have examined and approved the submitted expenditures.

TSS/Chemical Division

rates 4/27/62

September 19, 1960

Memorandum to A Subject: roject

We requested a final accounting on this project when it is completed. In the meantime, the following payments have been made:

Paid directly to Mrs. or a preliminary study was the sum of \$6,015.00 for the period Sept. 1959 through August 1960.

Paid directly to bank account beginning in June 1960 the sum of \$7,000.00 ms expenses amounting to \$2,342.93 making the total paid to date to Dr. \$9,342.93.

Amount received for this account \$34,465.00

Total expended to date

15,357.93

Balance in the account

\$19,107.07

This is a true account of the status of the project.



Mayor examined and approved the submitted expenditures.

February 8, 1960



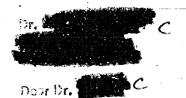
Trush you for your accounting. Please find emplosed which in the amount of (150.57. Tope you are well.

dinceroly.



ilig.

August 12, 1959



I am pleased to inform you that your proposal has been approved, and we shall be forwarding a portion of your grant in the very near future.

I need to know how the funds should be transmitted, and whether quarterly regments will be serisfactory with you, or how you would like the regments arranged.

Two of the directors had some suggestions about the conduct of the latter parties of your work which, I think, are important. But, I feel they can writ until you are ferther along, and until we have an opportunity to visit again, perhaps at the Continuous to seeing you soon.

Sincerely yours,

Executive Secretary

## RECEIPT

Receipt is hereby acknowledged of the following check:

Treasurer's Check No. 168360, dated Apoist 12, 1959, in the amount of \$3h 465.00, drawn on the bayable to



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h August 1959

icarrougha por colly, produce division

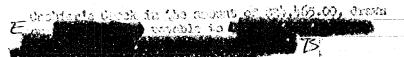
VIA

: Thi/Dulgan Officer

DINES?

: 1235275, Proproject 95, Invoice Ro. 1 Allowers 3025-303-4302

1. Involce Re. 1 is attached covering the chors subproject. Four one should be seen as follows:



- 2. Floure forward the check to Chief, Tos/Charlest Sivision through Tos/Charlest Carley by Paddey, 14 August 1959.
- 3. This is a final involve. Excever, since it is satisficated that additional roots will be collected for this project, the raise should rot be closed.

Crief Tes/Chemical Division

Attachomis: levolos & Certifications

elstribution: Orig & 2 - Addresse



INVOICE

Por services



(1)

(1) It is hereby certified that this is Invoice No. 1 applying to Subproject No. 96 of MAULINA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSS/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject No. 96 of MAULTRA which was duly approved, and that the project is being arried out in accordance with the menorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent menoranda.

Research Director

Date:



22 July 1959

PERDOAGUM POUR THE CONTROLLER

ANTENED TO

. Pinance Division

CUMPAT

: MARKAN, Bubprojest 96

Under the netherity greated in the happroxima dated 13 April 1953 from the DOI to the DD/A, and the extension of this authority in subsequent memoranda, Subproject 96 has been approved, end \$50,805.00 of the over-ell Project MANANA funds have been colligated to cover this subproject's expenses and should be charged to Allotrant 0525-1003-4902.



555/Chemical Division

APPROVED FOR COLLOCATION OF FUELO:

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MEMORANDUM FOR: THE RECORD

SUBJECT

MKULIRA, Subproject No. 96

of personal constructs as developed by Dr. has had successful application in this country and for some time there has been a desire to apply this methodology to foreign cultures; and (2) Dr. saccessibility and acceptability to psychologists will make it possible to secure invaluable data on research attitudes and personality information on researchers. MD/OSI, A&E/OTR, and SOB/DDP have expressed an interest in the results of this project and are willing to support it with requirements and technical support.

2. Dr. is professor of psychology at miversity. He has been a fully cleared consultant to the Agency for four years and has demonstrated unusual sensitivity and perceptivity to Agency needs, particularly in the area of assessment and the psychological support of the has an excellent national and international professional reputation. He is a member of est-president of the

end is the leading contender

He is the

and a consistent contributor to leading professional journals.

- 3. In connection with his duties as a consultant to certain of our projects, it was learned that Dr. was planning the lead study outlined in the attached project proposal and has received preliminary essurance that, in part at least, he could receive the necessary support outside the Agency. However, at our request, he agreed to submit this original request to the could receive the necessary obviously, this type of grant is clearly consistent with the overt aims and purposes.
- h. Funding and monitoring of this project will be handled by

  m the regular

  manner. Accounting for the funds expended will be according to the procedures previously established by the Any unused funds remaining
  at the conclusion of the project will be returned to the Agency. Travel

  funds will be accounted for in a manner consistent with the established—

  practice of the B
- should be used against Allotment 0525-1009-4902. It is noted that Dr.

  ill be on sabbatical leave from University during the
  period of this grant. University does not pay salaries during
  sabbatical leaves, consequently a major portion of this grant includes the
  replacement of his salary during the period. Dr. has indicated that
  he may be able to secure what is known as a Research Quarter beginning
  1 April 1960. Since he will receive his salary during this period, the
  grant will be reduced accordingly. This amount would be approximately
  1/4 of the salary allocation or \$3850.00.



- 3 -

6. Dr. is approved by the Agency for access to TOP

SECRET material. It is anticipated that his wife

be cleared accordingly.

Chief
TSS/Chemical Division

APPROVED FOR OBLICATION OF FUNDS:

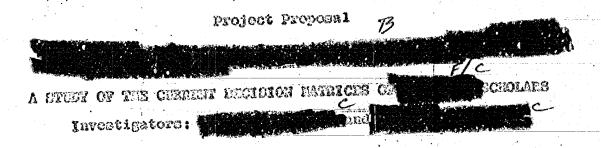
CONTRACTOR AND	
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	<b></b>
Research pirector	

Date:

Attachment: Project Proposal

Distribution: Original only





Introduction

This proposities concerned with the psychological matrices within which scholars currently atrusture their decisions. Within which seems the psychological differences that appear to their their their proposed of carefully in contrast to these characterizes the people of carefully in contrast to these of another, this study is to be idented upon mashers of various scholarly communities and the distinctive features of their current outlooks.

Traditionally psychologists have approached the problem of understanding human behavior by attempting to seek out the notives or forces which seem to impel persons willy rilly along particular lines of action. This kind of psychology attempts to make some out of what people do by omvisioning entra-personal determinants, even though those determinants are often said to reside within the personality.

Fut there is another approach. It may be described as the psychology of personal constructs. Instead of looking for the forces which drive and direct human behavior, the personal construct psychologist looks for the gersonal construct systems which persons erect for themselves and within the limits of which choices between alternatives must be used. These personal construct systems may be regarded as sets of issues which the person has implicitly cast up for himself. They impose upon him a self-devised matrix within which he then has no choice but to channelize all of his decisions.

We say not always be able to tell what a person will do in a given situation, but we can come much electr to an understanding of what behaviors are available to bim if we pay some attention to the system of elternatives he has marked out for himself in advance. Under pressure a person may change his behavior radically. It should be possible to anticipate some of these changes long in advance, not so such by questing the direction of the forces impinging upon him as in terms of what, all along, he has structured as the practical alternative to what he was doing.

For example, a man may protest that he is a liberal scholar who believes in freedom of thought and action for everybody. Every psychological test may show that he has no intention of being

dislodged from this position. But no personal outlook, such as this one, can be psychologically specified until it is clear what is being implicitly denied, so well as what is being emplicitly affirmed. Thus the personal construct psychologist is led by his line of approach to ask what it is that his friend is denying by his protestations of intellectual belief.

Assuming that any person can be pushed to the point where he will re-adjust his posture, it becomes important to find out what alternatives are available to him when he must make now choices. The firmness of his stand may be reassuring, provided he is never disledged from it. But the question is, what direction will he jump if he can no longer stand where he is standing? What is the natrix of potential decisions he has exected for himself, and in a time of real crisis what network of open pathways will it provide for him?

There is reason to helieve that men erect their personal construct system—their matrices of decision—differently. Here-ever, it seems responshe to believe that these matrices will show distinctive sub-sultural patterns. In this study it is proposed that we light enterives to realiers of university communities in Chifferent the common by virtue or their common disciplinary interests and their shared dedication to intellectual inquiry.

Dut within this sub-culture of university scholars everywhere there must be crucial psychological differences of outlook which lie boucath the surface. Will all these scholars veer the same way when their present positions become untonable? We wonder.

# Rathod of Inquiry

mately multicroities in approximately caregive the twoive-month period beginning either April 1.

2000, or Suno 1, 1900. Since one of the investigators is a professor of psychology in an aniversity it should be possible to establish congenial references with follow psychologists in any maive salty. Moreover, since the other investigator is his maive salt in company with groups of their Irisads. It is believed this is the ideal setting in which to explore the more subtle features of the group decision matrix.

Payebologious have a nutual concern for each others' research, and one of the related purposes of the study would be to learn searching of what new approaches to evehological problems are being developed in the vertous academic actings. But beyond this, the more challenging problem is to learn how these psychological and their ceilengues in other disciplines have structural their matrices of decision. From this it should be possible to antickets what salate of position would be open to them in a time of possess or national crimis.

It is possible, we believe, to use the nothed of group discussion, even when conducted through to develop an approximate statement of the decision natrix common to a given group. We be cure, certain standardized discussion techniques would have to be used, and it is proposed that a companion project be supported during the seven menths prior to April 1, 1980, in order to develop these techniques to an optimum level.

It is tentatively planned to use a tape recorder in connection with these group discussions, and later to subject the recordings to paychological analysis. The interludes between periods of active travel would be used for this purpose, as well as the period subsequent to the termination of the supported project. It is also tentatively planned to photograph the participants in the group discussions so as to lead vertaintlitude to the psychological reconstructions of the discussions sessions.

# Analysis of Results

Personal countruct systems may be reduced to the form of grids—called "reservery grids"—which then can be subjected to mathematical analysis.

Equivalences between constructs on to trecrained of constructs applications and known events. A matrix can be factor-analyzed to determine the extent to which it can be reduced to a simple attrocture, as well as to determine the poles of implicit behavior underlying the manifest position of the power whose system is being studied.

It is proposed that the auxlytic motheds already devised from making sense out of the reportery grid be developed further in order to yield as much systematic information as possible about the extential decisions of individuals and groups in time of chargency. This further development, as well as the social and cultural information which it is been the study will address should constitute a contribution to psychological knowledge and to the understanding of ecological factors in manking's decisions

## Itinorary

It is proposed that the itinspary be divided into five sections, each involving from thirty to sixty days of active travel and followed by an equivalent period spent in one place to study data and plan revisions of processures.

Esection 1: April 1, 1860, to June 1, 1960.

Vigit universities and institutes of advanced study in approxi-





Section 2: June 1, 1960, to July 1, 1960.

Visit universities in approximately four of the following cities:

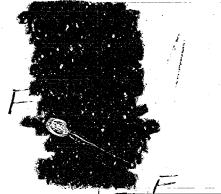


Interlude. July 1, 1960, to September 15, 1960.

A portion of this period may be spent in or in and the remainder used for more leisurely travel esting whatever informal contacts may be possible.

September 15, 1930, to October 15, 1930, to October

Visit universities in approximately four of the following cities:



Interlude a section 15, 1960, to Revember 15, 1960.

Section 4: November 15, 1960, to December 15, 1860.

Visit universities in approximately four of the following cities:

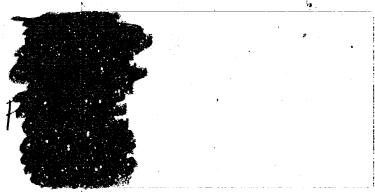


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Entorlude: December 15, 1960, to February 1, 1961.

Section 5. February 1, 1931, to Earch 15, 1961.

Visit universities in approximately six of the following cities:



# Budgot

Stipond: Replacement of Investigators' Normal Econocd Income for Twelve Heaths--Salaries and Not Conculting Foes

\$ 15,000.00

Drawing Ageount:	
For Men Expenses in \$30 per	3,600.00
per Dien Esponses : \$\frac{1}{200} \text{E18} \text{per person for 265 cays}	10,260.000
Airlino and Public Vransportation	2,500.00*
Car Longo: Including Insurance and Travel Documents: 8 1/2 months	805.00
Gas, Oil, and Tolka: 20,000 miles	700.00

Clorical Assistance

the proposed budget.

600.00

Equipment, Supplies, Film Processing, and Excess Engago Charges 1,000.00

. TOTAL

8 34,465.00

Respectfully subultted,



July 27, 1959

MIMOTAMBUM TO: The Directors

SUBJECT: Project Projectal Submitted by Dr. Category A

The attached proposal Dr Invited from St. a conclusive to the experient program that the Rec been conducting. You will note that it thereing again to the extensive exact which, though unused in the light of other trade represent by the section is further in that it will contribute the contribute of the extensive against the interest of the section is the work of the production.

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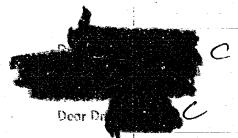
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provide the insertical background enjoys a repetation of high econities and calculated and and regards to our program.

Cocconve bearing

Caci 5

July 27, 1959



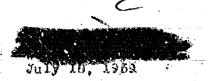
Thank you very much for your letter of July 18. Preliminary conversations indicate that the proposal will be well received. I have no suggestions or recommendation of changes and am putting it into the mill immediately. What this means is described in the briof statement which you have already seen. I should think it will be about two mentis before I will have a reply to offer, but that could be delayed just a bit by summerting vacations of my Board members.

left the less tweek and can hardly wait to hear the rect of the interview. It must have been fascinating.

I'll look forward to seeing you at the fif you don't make it buck this way before that time.

Sincerely yours,

Executive Secretary



ir. Szecutive Rearsters

Dear Er. C

Enclosed are two project represents desired along the lines we discussed in the lear month. The first is to cover the principal mission and the other is to take care of preparatory matters.

I wish you would look them both over and snegest any ravisions you believe should be made. .

There is a possibility I can get to University to give us a "research quarter" next apring. In that case I would be free to so approximately april let, even though the proposed asignal from the would not be effective until June 188 and approximately universities while they were still in their apring costions.

dist tota in the country of the state of the

I we sending a copy of the proposal servell as a copy of this lation, to be

Yours very traly.

#### IMORES CHEK THE

Kanara sulproject 97

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Nov. 1, 1962

Final Accounting

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Balance Sept. 30, 1960

8,247.02

Disbursements:

Salaries and wages Supplies and Services Equipment Travel 4,757.70 1,063.65 2,059.89 365.78

Total Disbursements

8,247.02

This is a true accounting from the University of the on the balance in Dr. Frant.

I have examined and approved the submitted expenditures.

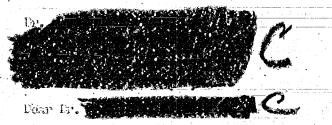
A

Chlef

TSS/Chomical Division

Dater 4/12

September 19, 1960



As you know, we have a requirement on all grants that a final seconding and report be schedited to the final the last two grants each in the amount of (5,750.00 have not been accounted for. I would appreciate it if you could arrange to have the accounting sent to us as soon as possible.

This is purely an administrative matter and if you would prefer that I write to the University directly I shall be happy to do so.

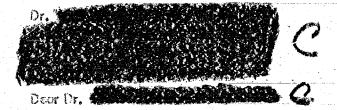
I hope that you had a pleasant sugger and that we will see you in the near inture. Best personal regards.

Sincerely,

Assistant Preasurer



January 28, 1960



Attached is our check for \$4,375 which represents half payment for a continuation of the research task of Or.

This payment is formal netification that support for this research has been extended for an additional 6 month period January 1, 1000 to June 80, 1960.

The conditions stipulated in the original grant apply acqually to this - continuation.

The Found of the condition that project in the initial period. We enticipate a major ecutriousion in the arts of psychotherapy as well as in the basic theories to result from this important study.

Sincerely yours,



fine: 1

Section 18

1524

Cost Account 1525- 1808- 4902

Object Class _

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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23 January 1960

REPORTED FOR CONTROLLS

MOTERATION

. Finance Division

GUNCE

MINITEA, Subproject 97 Authorization (2

Under the authority greated in the Memorandum dated
13 April 1993 from the DNI to the ED/A, and the extension of
this enthority in authorizant approved and (0,790.00 of the over-all Project ISULUEA funds
have been obligated to cover the subproject's expenses and
should be charged to Allotsent 0925-1009-1900.

A 100 Calor Calor TS3/Checical Division

1 FEE

APPROVED FOR COLLECTION

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Data:

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HEMOESTERM FOR: CHEEP, PINANCE DIVISION

VIA

i 730/2003at Officer

CUMINT

: Maulita, Subproject 97, Invoice No. 2 Allotsent 0525-1005-4502

1. Invoice Eo. 2 is attached covering the above subproject. Payment should be made as follows:

Cashler's Check in the amount of \$3,750.00. And on a least, payable to the

Please forward the check-to Chief, TSB/Chemical Division through ESS/Endget Officer by Tuesday, 16 February 1960.

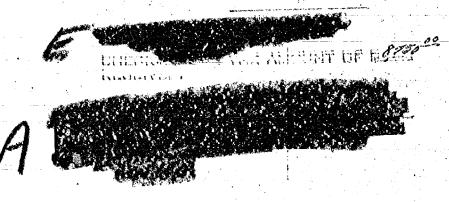
3. This is a final invoice. However, since it is intimipated that additional funds will be obligated for this project, the files abould not be closed.

Ohier
Tes/Chemical Division

Attendent: Involve & Cortifications

Distribution:
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1 - TSS/FASB

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INVOICE

97.7

For services



#### CERTIFICATIONS

(1) It is hereby certified that this is Invoice No. 2 applying to Subgroject No. 97 of INDESTA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TESS/CB, that this bill is just and correct and that payment thereof has not yet been made.

Chief, 135/Charleal Division

Dates

(2) It is hereby certified that this invoice applies to Subproject No. 9? of NAMERA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DUI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:



# RECEIPT .

Receipt is hereby acknowledged of the following:

amount of \$8,750.00, drawn on payable to the



23 January 1960

KS-03 ROW FOR CONFINIER

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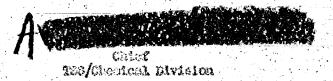
: Winesco Division

PORTEGUE

: 1763AFA, Cobpreject 97 Introducțica șă

Under the authority greated in the Headrandus dated

13 April 1955 from the DOI to the DD/A, and the extension of
this authority in arbaequent mescreeds, Subproject 91 has been
epproved and \$8,750.00 of the over-all Project MAULETA funda
have been obligated to cover the subproject's exposure and
whealth be charged to Alloteent 6525-1009-1402.



APPORTED FOR COLDENIES

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TSS/CD/(28 Jan.60)



O A 97-10

DRAFT
27 January 1900

for security and cover

MEMORANDUM FOR: THE RECORD

SUBJECT

Continuation of MKULTRA, Subproject 97

1. The purpose of Project MKULTRA, Subproject 97 is
to supplement the research program of Dr.

ins

n accordance with the attached proposal and progress

report.

2. Long term support for this study has been provided

by two grants from the The

present request is intended to supplement the project and provide

a mechanism for evaluating certain techniques of influencing human

behavior that may have Agency significance. This support will make

it possible to have continued free access to the project and, when

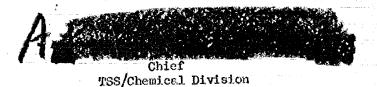
applicable, use the facility for consultation and support.

3. The project will be funded through the

purposes and the University of will supply the with copies of the records of disbursements related to the operation of the project at its termination. Title to any permanent equipment purchased under this project will be retained by the University in lieu of overhead charges. Any unused funds will be returned to the upon termination of the grant.

h. The total cost of this project for a period of six months is estimated not to exceed \$8,750.00. Charges should be made against Allotment 0525-1009-4902.

5. Prof. holds a covert Agency clearance and is witting of sponsorship, all others are unwitting.



APPROVED FOR OBLIGATION OF FUNDS:



Research Director

Date: 2/1/60

Attached:
Proposed Budget
Proposal w/Progress
Report

Distribution: Original Only

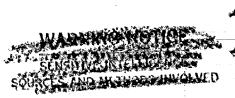


Budget requested from

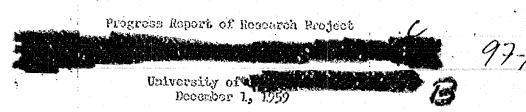
for pariod	1/1/60-	7/3/50

Project Associate, Dra (Partial Salary)		\$2950
Project Associate, Dr. (Fart Time)		1675
Administrative and Research Assistant	i	1800
Research Assistant (Part Time)		1025
Supplies and Equipment-Magnetic tapes, tests, office supplies, misor equipment		1100
		<b>ಆ</b> , ಕ್ಲಾರ್ಡ್ಗಿಂಡ ಪ್ರಚಾರ ಬ
Total		\$8750





97-2



#### Introduction

This is a report of progress during the period July 1, 1958, to

Describer 1, 1959, on the above project. Finds during the period July

1, 1958 to the present have been supplied by two grants from the

Foundation through the University Research

Committee. Additional funds since July 1, 1959 have been supplied by

The majority of

the professional time on the project has been volunteered by members
of the Departments of Psychiatry and Psychology, University of

and members of the staff of hospital. Without this

effective and voluntary cooperation progress on the project would have
been impossible.

# Park I. Sympain of Proposed Research

Full details of the research plm are contained in an earlier proposal. If the reader is thoroughly familiar with thin, he might wish to turn at once to Park II. That follows is a brief statement of the major elements in the research decima.

General Parcose: The general aim of this research is to make an intensive study of the process of change in personality and behavior as it cours in schizophranic and normal individuals during the period of psychotherapy.

# Control Bygothenon:

To The degree and rate of therapoutle charge will be positively constituted with the degree to which the monditions of whorapy crist

in the particular client-therapist relationship. The conditions of therapy are those hypothesized by

 $\bigcirc$ 

97-10

The process of personality change in psychotherapy will be found to be the same in the chronic schizophrenic, the scute schizophrenic, and the well-adjusted normal person.

III. The process of therapy will occur to a significantly greater degree in the group of individuals to whom therapy has been offered than in a control group paired and matched to the experimental group, in which such individual therapy has not been offered.

Design: Each of eight therepists is given a tried of clients which includes an acute schizophrenic, a chronic schizophrenic, and a normal.

Each of these three clients has a matched control who does not receive therapy.

The design is a 3x2x2x2x2 factorial design indicated in the

following chart.		Experimental			9	Controls		
			Acute	Chronic	Normal.	Acuto	Chronic	Mormal
		: High ²	E3	В	И	$\mathbf{x}_{\mathbf{j}^{\dagger}}$	x	×
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FEMA	[8]	High	· II	A	15	x	R	K
	Banok	low	a	Б	В	x .	x	30

^{1.} Old and young refer to ago compared to median for group.

^{2.} High and low refer to adventional occupational status.
3. Letters refer to the therapists, essigned to a randomly

h. Mich control (indicated by E) will receive the same bettery of tests and missures as the experimental individuals, but no therapy.

#### Major Design Variables

- 1. Experimental subjects (2h) and control (2h). 48 individuals in doction.
- 2. Acute Chronic Normal.

Acute: Loss than 8 months total hospitalization, and current

staff diagnosis of schizophrenia.

Chronic: Fore than 8 months hospitalization and staff diagnosis

of schizophrenia within last five years.

Formal: Individuals celected by tests and ratings as well-

adjusted, who match the hospital population on

characteristics below-

All six individuals in any horizontal column of the chart are matched

on the next three items.

3. Ago: Matched as wolds or "youngs in terms of the median age for chronics (33) and soute schirophrenics (33) in the state of

of

ho Sozo

5. Education-occupation: Classed as high or low, using a medification of the Hollingshead-Redlich Scale.

Each experimental-control pair is not only matched on the above items,

but also on the following.

- 6. Rating of degree of psycho-social disturbance made on basis of modified Imborsky Health-Sickness Scale.
- 7. Matching agos, with discrepancy of no more than mine years within the general classification of "old" or "young".

The number of the pair to receive therapy is selected by the toss of a coin.

# Oviboria for Selection of Hospital Population

- 1. Dispensia of schizophrenia without complications such as brain damage or mental defect.
- 2. No more than 50 treatments of EST and/or LST prior to selection.
- 3. No psychosurgery.
- I: Normal intelligence (80) confirmed by project administration of Weshsler Adult Intelligence Scale.
- 5. Ago between 15 and 59.

1

#### Recruitment of Populations

Hospital: Every patient who meets the above criteria is admitted to the project regardless of ward. In order to identify all the patients who meet the criteria a distillation of all hespital records has been made.

Mormals: High educational-occupational normals were recruited from a local church couples' club.

low educational-occupational normals selected from a general hospital personnel list of low income employees.

Another group representing the agricultural element evident in the hospital population is coming through references from rural social work agents.

#### Tests: Initial and at Six Months Intervals

Experimentals and controls receive the same bettery of tests which

#### corsists of:

Horschach, HMPI, TAT, Q Sort (a series of eighty cards each containing a self-referent statement which are placed according to a specified distribution from those statements least like the individual to those most like him), WAIS, The Streop Interference Test, F Scale, (or Fascist scale as it is also known, has been useful in distinguishing between people who respond to therapy and those who do not), Truex Anxiety Scale, Handwriting sample.

This battery is administered as soon as a subject is admitted to the project, and at six month intervals.

#### Tests: Iritial and at Three Months Intervals

In addition to the above there are other measures which are given at shorter intervals.

Sampling Interview: Both experimentals and controls are given an half hour recorded interview conducted by a psychiatrist who is not one of the project therapists and who has no other contact with the publicate. From this data the following material will be available.

- 1. Instruments developed for the therepeutic interviews will be applicable to the sample interviews.
- 2. For experimental subjects, comparisons are possible between their behavior with two different interviewers.
- 3. All subjects can be compared in their interaction with one spendard interviewer.

Witterbord Echavior Rating Scala: Applicable to hospital population only

Miliem Scale: Applicable only to experimentals and is filled out by the therapist.

97-10

Relationship Inventory: Developed by Barrett-Lennard. Administered to therapy patients and their therapists in order to measure the therapeutic relationship. Also administered to controls who are asked to fill it out in regard to "the person who has meant the most to you in your trouble."

The testing schedule is maintained whether the patients are in the bespital, transferred or discharged.

## Part II. Progress Already Made

#### Selection of Natched Populations

Hospital: 32 of the 48 cells in the design are to be filled by hospitalized individuals. 31 of these here been filled.

In three instances thus far, the individual refused to be tested, refused to be seen in therapy, or refused to have interviews recorded. Thus major blocks of data were unobtainable. In these instances alternative individuals were selected and placed in the design.

However all possible data is being collected—tests, therapy notes, etc.—from the original selectess, so that the degree of bias (if any) involved in the use of these alternates can be estimated. Thus 34 individuals have been selected in filling the 31 cells.

Normal: Of the 16 normals to be selected 5 have been selected and 8 others are in process of being selected from an available group of 10.

Progress has been handleapped by lack of funds and lack of psychometrist time.

## Administration of Toshs and Ascarca

Initial: The initial battery has been administered to the experimentals and controls administed to the study. Since it has not been possible to administer every test to every individual and since experimental in process; the number of tests given various somewhat

#### from test to test as follows.

Rorschach				35
MPI				35
TAT				31
Q Sorts	1		٠.	37
WAIS				30
Shroop				34
F Scale				38
Trusic Anx	iety S	cale		31
Handeriti	ಸ್ವ			27
Sampling	Labery	isi		38

#### Three Months Tests and Measures

The first three menth period has already been completed for a major of individuals, and from this source the following tests are available. (These are in addition to the initial tests.)

Sampling Katerview	27
Wittenborn	50
Milieu Scale	. 8
Relationship Inventory	
(Therapist)	3.0
Relationship Inventory	
(Exportmentals &	
Controls)	1.3

#### Six Kouths Battory

The six month battery is being administered to 9 ex eximentals and 6 controls. The following have been completed.

Rorschach			5
MARI	:		12
XAZ			TO
Q Sort .			10
WAUS			9
georgs			1.5
F Scale			11
Truce Aux	isty S	calo	30
Haccherita			7
Sampling		rlow	1.6

# Thomasy

Fifteen of the experimentals have been engaged in therapy, but of the 15, 13 have been uillied to have all of their therapy interviews recorded, and no already have his tope recorded interviews

from this group. In addition there are a few dictated accounts of interviews hold in the isolation room or under other circumstances where the receptor failed or recordings were not possible.

97-10

#### Additional Dath

Complete records of patients' medication and the number and relationship of visitors has been collected to date and is being maintained.

From the survey of patients' records we now have complete data on all patients in the hospital concerning age, diagnosis, senation therapy in excess of 50, location in state, and file number.

Complete enciological data is about to be compiled on the patients in the project.

#### Transcriptions

Work has began on transcribing interviews.

#### Part III. Current Evaluation of Project

#### The Barriars to Therapy

One of the greatest difficulties we have encountered is one which had been partially foreseen, namely the absence of motivation or conscious desire for help.

When individuals are selected by objective criteria of the sort we have used, it means that many of them feel no need for therapy, and are not regarded by hospital staff as good bots for therapy. When in addition many of these individuals are of relatively low socio-educational status, where according to Hollingehood and Redlich, therapy is not a part of their expectation, the difficulties are multiplied.

We realised at the outset that this was as severe a test of psychotherapy as could be devised. Our experience to date merely causes us to undersoone that statement.

97-2

# The Bergiera to Elgorous Dosign

It has often been maintained that the type of Cata collected in this project and the type of recording, stratification and control procedures attempted in it are impossible in a hospitalized setting.

The difficulties are said to place such limits upon experimental rigor as to make the results scientifically questionable.

The difficulties we have encountered in this project certainly show that most of the published discussions of the difficulty of such research are very nearly accurate.

Most difficulties concern errangements between people. For example, one persistent difficulty lies in finding, and remaining in contact with, specific individuals. It has often taken many hours of effort, expended over a period of a week or more, before a given patient actually spends one hour with a psychometrist. Often many attempts must be made before one test is successfult, administered. Sometimes many weeks of such efforts are required before an individual completes a test battery. Unforeseen events inverfere with the patient's availability. Drugs, transfer, discharge, or charge in his psychological condition sometimes invalidate the results of many weeks of effort.

The amount of time and work to be expended for a given research result is so magnified that it is often difficult to distinguish a standabili from poinfully also progress. Only a devoted staff can endure this.

If the energous time expenditure is once accepted, the basic question is: does this very alow progress add up to a sufficiently rigorous research to allow estentific conclusions? Or does even the slewly accommissed data suffer from limitations which throw doubt on its value? In the present stage of the project we can begin to enever this

91-2

question. We have come for enough to be able to distinguish sheer difficulty and time loss from inherent limitations placed on scientific rigor.

97-10

#### Barriers to Data Analysis

One of our greatest barriers has been lack of funds. Although there is a great deal of data accumulated already we have been unable to make even a small start on its analysis due to lack of funds and personnel. This problem is becoming more acute as the test protocols, recordings of sampling interviews and of therapy interviews, and other measurement data continue to pile up.

## The Assured Aspects of the Research

From the progress already made it appears that the following are definitely possible:

- a) A population selected according to a stratified design of variables, age, sex, social class, and longth of hospitalization.
- b) Experimental-control pairs matched on these variables and on an interview rating scale of the degree of disturbance.
- c) A periodic test battery consisting of the Rerschach, MMPI, TAT and several other measures.
- d) Periodic recorded sampling interviews of all experimentals and controls with one standard interviewer.
- e) Recordings of almost all thorapy hours.
- f) Comparative analysis of the process of therapy in schizophrenics and normals, in the many ways already planned in this study, and in any new ways which may be devised.

# The Pecalbilitics Leherent in the Date

The great range of the data we are collecting is important both for testing our our hypotheses and for the testing of hypotheses by others when the data is published or otherwise mede available. Hany significant investigations become possible.

The stratifying variables age, sex, chronicity, describe the second control level—can be studied in relation to the individual's acceptance of therapy, process changes in therapy, outcome of therapy.

97-10

The various measures—of the client personality, of the client's behavior, of the therapeutic relationship, of the process changes in therapy—can be studied in their many interpolationships.

The relationship of reasures applied to the sampling intervious to measures applied to the therapeutic interviews opens a wide field of investigation. A first study in this area will be to compare, in a series of patients, the first interviews held by the therapist with the first interviews held by the sampling interviewer.

The relationship of various psychometric instruments to indices of process in therapy, and to degree of movement in therapy, can be studied.

In short, it already appears clear that the design can be carried through, approximately as planned, with a satisfactory degree of rigor. The groups can be located, the individuals can be matched, the tests can be administered, therapy can be offered, recordings can be made, in most increase. Thus we will be able to test not only the major hypotheses set forth in the beginning of this report, but a wealth of additional hypotheses which the data makes possible.

# licture of the Findings

It now seems clear that the findings of the research will be of the order suggested by the following statements.

It is (or is not) possible for therepists to establish the same conditions of therapy with consophranics as with somals. The process of therapy involves (or does not involve) the same characteristic changes in schizophranics as in normals. The conditions of effective therapy and the process of effective therapy in schizophranics and in normals is (or is not) the same so the conditions of therapy and the process of therapy as previously investigated in neurotic individuals.

The process of therapy involves changes a, b, c, etc, in all groups, but not changes x, y, s, etc.
There is (or is not) a positive correlation between the existence of the conditions of therapy in a relationship and the degree of nevement on the process continua.
There is a positive correlation between the conditions of therapy and process changes a, b, c, etc, but no such correlation with process changes x, y, s, etc.
The conditions of therapy are (or are not) equally associated with process changes in individuals desiring therapy and those not desiring it, with individuals of higher and lower socio-educational status, with males and females, with markedly disturbed and less disturbed schizophrenics.
Condition a in the relationship is more positively correlated with

97-10

#### Part IV. New Projects

process change in the client, then are conditions b, c, or do

It was stated in the original proposal that as we worked, now projects having to do with therapy with schizophrenics would doubtless be developed. One such is under way and will be described very briefly.

In thinking about new ways of dealing with the problem of motivation, we devised a way of making therapy available, and are trying this out on one ward. In this ward there are 2h chronic psychotic patients, mental defectives and organic cases having been transferred.

Mino therapists have set up a schedule making themselves available, usually for two hours per week, on the word. A room has been reserved for their war. This means that some therapist is available each day Sunday thru Friday. On any given day two to five hours of therapist time is thus available. A patient may come in for a short or longer contact, or the therapist may go out on the ward to offer contact. All interviews however, are voluntary. However held at the request of the therapist.

been come contest with 23 of the Cauta on the word. There have been the large test and the contest with 23 of the Cauta on the word. There have been 100 recorded inservicus, some brief, some a full hour. As

911-2

might be expected a large number of the intervious are with a small number of individuals, nearly one third with one meas.

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There is already clinical evidence that some of these chronic state hospital patients are already showing therapeutic movement. We seem to be dealing, with some effectiveness, with the problem of making therapy psychologically available to "back ward" patients.



eptomber 30, 1959

C

Prolesed please find the rebook in the arount of the 1775. On which represents the assent held of the grant being rede to your University for the study

is the emitted careaction of his

incredy.

Asalment Transurer

550.

ce: Dr.

Pear Ir. 35 P. Mar. C

The accountings arrived a few days ago. Many thanks.

August 3, 1959



in the arount of va.750.00 for the study proposed by

in the arount of va.750.00 for the study proposed by

a used is encreal for (4.375.00 lides request the proposed of the first half of the grant. The second payment will be forthcosing on or about October 1st.

The same requirements that applied to the previous grant to your interesty are applicable.

- 1. I terribal report is to be substitted after the completion of the phase of research covered by this grant.
- territal accounting of funds expended in obtaining, processing and recording data shall be provided for our records.
- 3. Full cont purchased with these fends shall be conveyed to the University to the lieu of any increased overhead rates.
- 4. My technical valors or papers which grow out of the civily consorted under this grant shall contain the following notices while a stroy was amported in part by a grant from the

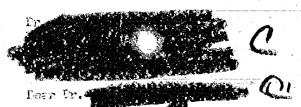
current to above conditions, it is required that the funds be excessed cuircly for the research designated and that no profits accrue to any includinal.

The found of Directors and the estoutific advisors to the John to be advisors to the John to be advisor to the upon us for any we distinguish to make the policy to provide.

And shad Avecanor

August 3, 1959

(<u>)</u>



ing a much earned rest for a few days after a stremuous course at the

I telephoned his when your letter of July 29th arrived. He is sorry shout the dolay and unfortunately has been unable to get the authorization for a larger arount at this time.

I are forwarding a check for (4,375.00 to the University which represents one-half of the grant. The ascend payment will be rade on or about October let.

Best personal regards.

Sincerely,

Assistant Treasurer

Inc.

July 3, 1959

97-14



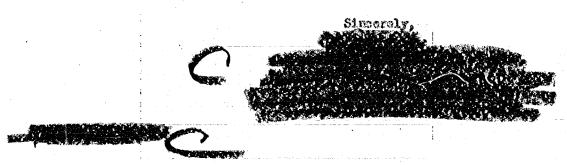
I appreciate very much indeed your latter of Juke 30. It is most helpful to me to know that we will be officially assurped of the great of \$8,750. The delay in deciding whether it might be a larger our will not create any difficulty here but uncertainty as to whether the lesser amount could be counted upon has been troublesoms.

We will count on receiving the check for this emount in late July as indicated in your letter. Knowing that it is cowing, I can berrow money from different sources to meet the necessary payroll items for July.

I appreciate very much your efforts to expedite this matter, and I am, again, very grateful to the society for the grant which comes at a most opportune and crucial moment so far as the research is concerned.

I have talked with and and know his enthusians for the conference on physiological measurement. I am glad to know that it assessed very valuable to you too. I read your apparendes on this with interest.

Very best regards.



June 30, 1939



I am in a rather heatic period, we are still attempting to obtain the larger amount. It appears as though I should be able to give you a yes or no next week but please accept this letter as confirmation of my telephone conversation that the lesser amount of \$8,750 was approved and will be transmitted in one payment (If the larger amount is not approved) in late July.

I am still enthusiastic about the success of our first meeting on physiological measurements and am continuing administrative efforts in preparation of our next meeting.

Sincorely yours,

Executive Secretary

# RECEIPT

KA DE

Receipt is hereby an enowledged of the following:

Cashler's Check

in the amount of \$8,750.00, drawn on

A 15,1959

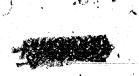


Cost Account ___

0525-1109-4902

Object Class

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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25 August 1959

PERMITER FOR: CETTE, PIENNED MYLLION

VIA

: 988/Rudget Officer

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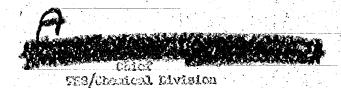
Allebast (525-1009-4902

1. Invoice No. 1 is attached covering the above subproject.
Proposat should be used as follows:

Caphter's Check in the commt of 13.750.00, dram

2. Plance forward the check to Obtef, \$75/Shemical Division through 255/Sudget Officer by Successor, 8 Suppositor 1959.

3. This is a final invoice. However, alone it is evilephied that edditional fonds will be collected for this project, the files should not be elected.



Attachrenis: Involvo & Certifications

Moterindon Ords & 2. - Addresses (_2. - 100/200 0505 1109 4912





For services

\$8,750.00



(1) It is hereby certified that this is Invoice No. 1 epplying to Sub-project No. 97 of MURITA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a deteiled agenda or the payments and receipts is on file in TSS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Cifer, 188/Chemical Division

Date:

(2) It is hereby certified that this invoice applies to Subproject No. 97 of MANTA which was duly approved, and that the project is being carried out in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memoranda.

Research Director

Date:



6 August 1959

PERSONALISM NORT CONTROLLIS

ATTESTICS!

: Firence Division

CULLUI :

: PAULIM, Subject 97

Under the authority granted in the Femoradum dated

13 April 1953 from the DCI to the ED/A, and the extension of
this authority in subsequent concremis, Subproject 97 has been
approved and (d,750.00 of the over-ell Project EdSATA finds
have been obligated to cover the subproject's expenses and
should be charged to Allotsent 0525-1039-1902.



APPROVED FOR OFLICATION OF PUBLIC:

Resignation livector

Detai

Pistribution:

Cris & L = 1994/Green

1 - 198/PASB

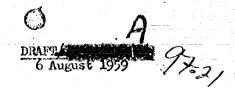
2 - TES/CD

TCS/CD (6 Aug.59)

TO: TSS/OC

1. Date of Obligation: Support of Support of Work in Support of S





MEMORANDUM FOR: THE RECORD

SUBJECT

: MKULTRA, Subproject 97

1. It is requested that Subproject 97 be approved in order to supplement the research program of Dr. University

in accordance with the attached

proposal.

2. Long term support for this study has been provided by
the The present proposal is
intended to supplement the project and provide a mechanism for evaluating certain techniques of influencing human behavior that may have
Agency significance. This support will make it possible to have free
access to the project and, when applicable, use the facility for consultation and support.

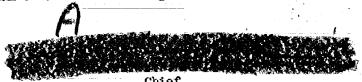
for security and cover purposes and the University in will supply the with copies of the records of disbursements related to the operation of the project at its termination. Title to permanent equipment purchased under this project will be retained by the University in lieu of overhead charges. Any unused funds will be returned to the Society upon termination of the grant.





4. The total cost of this project for a period of six months is estimated not to exceed \$8,750.00. Charges should be made against Allotment 0525-1009-4902.

5. Prof. holds a covert Agency clearance and is witting of sponsorship, all others are unwitting.



Chief TSS/Chemical Division

APPROVED FOR OBLIGATION OF FUNDS:

THE RESIDENCE OF A	)
Research Director	

Date: 8/11/59

Attached: Proposal & Budget

Distribution: Original Only



#### A Research Investigation

In afted for the Project Group



#### General Eurbose

The memoral aim of this research project is to make an intensive study of the process of chance in personality and behavior as it occurs in schizophrenic and normal individuals during a period of psychotherapy. Several therapists will each undertake psychotherapy with a trio of clients simultaneously. One member of the trio will be a chronic schizophrenic, another a more acute schizophrenic and the third, a person of better than average adjustment from the community. The tests and research instruments administered to this group of clients, and the recorded client—therapist interviews, will be the primary material for analysis and comparison.

The research is based on two assumptions for which there is empirical support: (1) That the conditions which facilitate therapeutic change are measurable in the relationship between therapist and client or patient; (2) That the process of psychotherapy is, in some of its aspects, an orderly and measurable process.

The central hypotheses are as follows.

- (1) It is hypothesized that the greater the decree to which the conditions of therapy exist in the relationship the greater will be the evidences of therapeutic process of movement in the client. (The conditions are those hypothesized by as necessary and sufficient for therapeutic change. These hypotheses have received some support from recent research.)
- (2) It is hypothesized that, given equivalent conditions of therapy, the indices of process or movement will be the same in the chronic schizophrenic, the wore acute schizophrenic, and the well adjusted person.
- (3) It is hypothesized that the process of therapy will occur to a significantly greater degree in the group of individuals to whom therapy has been offered then in a control group paired and matched to the experimental group, in which such individual therapy has not been offered.

Background of the Study

The work of this investigation will build upon several streams of previous teseatch. There are primarily; studies of psychotherapy with schizophrenics;

studies of psychotherapy with clinic clients; studies of the essential conditions of therapy; and work elucidating the process of therapy. Each of these strands will be commented upon very briefly.

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Althourn a considerable amount of research has been done on schizophrenia, reviewers concur in the opinion that almost no conclusive studies have been made (2, 2a, 5, 31). Basic questions relating to the psychological and organic tactors involved in the origin, development and treatment of schizophrenia have not vet been answered. Since the bulk of research in this problem area has been conducted from an organic point of view, psychological investigations are especially lacking. Psychological publications on schizophrenia, and particularly the psychotherapy of schizophrenia, are mostly case reports, observations and theoretical formulations. Only five studies have been found which attempt to investigate psychotherapy with schizophrenies experimentally, using controls, pre and post-testing and statistical techniques (3, 14, 27, 29, 30). Three of these five have investigated certain gross aspects of the therapeutic relationship as correlated with outcome. The other two make a beginning in investigating certain phases of outcome. The present project pushes beyond these in its study of more crucial and subtle aspects of the relationship, and in its investigation of the process of change, rather than focusing on the more gross aspects of outcome.

As to non-hospitalized individuals, a very considerable amount of research has been done to measure the outcomes of psychotherapy in maladjusted and disturbed individuals. (24) The senior investigator has been much involved in this work. Some of the most useful studies have been studies of individual cases (9, 17, 18, 20, 21), both successful and unsuccessful in their outcomes. In these studies, using methods developed by the populations for study consist of large numbers of responses at one point in time which can be correlated with large numbers of responses at a later point. By taking such measures before, during and after psychotherapy, and at a later followup point, we have been able to make valuable empirical studies of the process of change in one individual, using correlational techniques, factor analysis, and other appropriate statistical procedures. This study will utilize many of these same research procedures, and some new ones, in work with hospitalized psychotic patients, and well—adjusted normal individuals.

Two recent theoretical developments have stimulated the formation of tools which will be useful in this investigation. The first of these is a theory of the necessary and sufficient conditions for therapeutic change (22). This has been tested out on clients coming to a clinic (1, 8). The findings tend to support the theory, and instruments have been developed for measuring subtle relationship conditions such as quality of empathy, degree of positive regard, degree of penuineness in the therapist.

A second theoretical development has been a theory of the process of psychotherapy (25). An operational the has been based on this theory (25) and there is beginning evidence that the Scale has some reliability and validity (28).



Pullaing on these foundations of previous work the present study aims to test the following coperal proposition. It hypothesizes that to the degree that the theoretically defined conditions for therapy exist in the relationship, one will find indices of movement or process in the individual client, whether that client is schizophrenic or normal. This hypothesis is held for the neurotic client as well, but since a considerable body of research evidence exists for that group the present study will concentrate on the process of psychotherapy in two extreme groups—the hospitalized schizophrenic and the thoroughly adequate normal individual.

### THE OVER-ALL DESIGN OF THE STUDY

The research involves the following general steps. As given below, the steps are in roughly chronological order.

## Brief Description of Phases of the Research

Using definite criteria, three population groups will be selected.
 Group A will be a group of chronic schizophrenics, group B of more acute schizophrenics, group C will be normally well-actiusted individuals.

Group A is so defired as to include patients from Hospital who meet the following criteria: a hospital diagnosis of schizophrenia; hospitalized 8 months or more; living within driving distance of no prior evidence of mental defect; not lobotomized; less than 50 EST or IST; no somatic therapy in past 2 months.

Group B includes those who meet similar criteria, except that they have been hospitalized for less than 8 months.

Group C, the normal or well-adjusted group, will be chosen in the following manner. These individuals will be recruited from church and other groups. They will be asked to volunteer for research in personality. No mention will be made of the possibility of therapy. It will be explained that some will be asked to devote a short period of time, others longer periods, but that if they are asked to devote a longer period of time to the research, it is believed that they will find the experience useful and educational. It is felt that this method avoids the selective factor which would operate if people volunteered for therapy. It selects a well-adjusted group who have not previously indicated any desire for therapy.

II. Within these groups there will be matched pairs of individuals, matched for age, sex, socie-educational status and degree of psycho-social malfunctioning. One member of each such matched pair, chosen by a toss of a coin, will have individual psychotherapy made available to him. The other will serve as a control.

Careful rules have been set up for carrying out the matching of these pairs. The matching in socio-educational status is based on the scales used by Hollingshead and Redlich (10). The matching in degree of malfunctioning is based upon a modification of the Luborsky Health-Sickness Scale (16).

III. A battery of research instruments will be administered to both therapy

with them. In the case of the individuals in therapy these instruments will be administered either prior to therapy or during the initial neriod of therapy. The instruments have been selected to measure the stage of process development of the individual, and the qualities of the inlationship with the therapist.

The instruments being used include; an appraisal interview, to obtain a sampling of the personal expressiveness of each therapy and control individual; the lorsohace; the PMP1; a 0-sort of self items; five cards selected from the PA1; the stroop Interference lest; the kelationship Inventory devised by Barrett-Lennard (1) designed to measure the qualities of the therapeutic by Barrett-Lennard (0) in the case of the control individual, the relationship relationship (or in the case of the most to him); the Wittenborn Behavior Rating with the person who means the most to him); the Wittenborn Behavior Rating Scale (32), filled out by the hospital staff; and several other instruments still in experimental form.

In addition to the above instruments which will be admiristered, the recorded interviews will be available for analysis by various means. Some of the rethods which will be used are as follows: the ratine method developed by evaluate various qualities of the therapeutic relationship; the recently developed by of analysing crient attitudes toward self; the

IV. A trio of cases, one chronic schi-zophrenic, one more acute schizorhrenic, and one normal, will be chosen for each therapist. The method of selection will be such as to preclude bias, and to provide overall, a roughly representative sample of more chronic and more acute schizophrenics, and a group of normals matched with them in age, sex, and socio-educational status.

The rather involved method of stratification and matching by which this is achieved is indicated in the "Graphic Summary" on the next page which gives a picture of the 48 clients in the study and the manner in which the 24 members in the therapy group are assigned to the therapists.

If in general our findings support our hypotheses, then the stratification described in the Graphic Summary will have been largely unnecessary. But if our findings are ambiguous or negative, then the stratification will assist greatly in further analysis. We can determine whether the process of therapy occurs more markedly only in certain diagnostic groups, or primarily in a certain age group, or primarily with individuals of a certain socio-educational status, or in more or less disturbed clients, or with individuals who work with a certain therapist, etc.

Thus our rationale of selection and matching, stated very briefly, is as follows.

1. Our groups are chosen to be as representative as possible, using stratification rather than pure randomness to achieve this.



#### Controls

The Control Group	Group A	Group B more	Gropp C Normal
Groups A. A. and C (more chronic, more acute,	chronic	acute	
and nothers) are natched to age, socio-educational	HY	HYF	HYF
	HYM	HYM	HYM
status and sex. In the charts to the right, Y and O stand for	irG).	HOF	HOP
	ROM	HCM	HOM
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and low socia-educational status, M and i for	LYM	LYM	LYM
	LCr	LOC	LOF
make and remain.	LOM	LOM	LOM

#### The Therapy Group

This group is stratified in a fashion identical with the controls, and each individual is paired wit the corresponding individual in the control group. These pairs are matched not only for age, such educational status and sex, but also for degree of psycho-social disturbance. The decision as to which member of the pair receives therapy is made by flipping a coiu.

The	rapy Group			
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abronic .	acute	and the second s		
HYF	HYF	HYF		
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LYF	LYF	LYF		
LYM	LYM	LYM		
LOF	LOF	LOF		
LOM	LOM	LOM		

#### The Therapists

Each of the eight therapists carries on therapy with a diversified trio, made up of one chronic, one acute, and one normal individual. The cases with which each therapist works is indicated



- 2. Our triads will be selected in such a way as to give each therapist a variety of cases with which to work, so that if the process is similar, this will show up across individuals of differing characteristics.
- 3. hach therapy case will be matched in age, sex, and socio-educational status with a paired control individual to provide an adequate test of the thirt bypothesis that there will be a significant difference between a group which has therapy and one which does not.
- V. Six or nore therapists differing rather widely in amount of therapeutic experience and differing to some degree in approach to therapy will undertake the psychotherapy. Each therapist will work with the trio of cases selected for him, one chronic schizophrenic, one acute, and one normal individual. Interviews will be held as frequently as necessary or feasible. All interviews will be tape recorded.

The therapeutic interviews will be continued as long as desired with members of all three proups. If the patients are discharged from the hospital during the period of therapy, they will continue to be seen on an out-patient basis.

In addition to trained therapists it may be possible, during the course of the project, to utilize one or more lay persons selected for their naturally therapeutic attitudes. Such persons would be encouraged to spend an amount of time equivalent to therapy with one or more patients who would be studied in the same fashion as those in the therapy group. The aim here would be to see whether therapeutic attitudes, even without professional training, may be influential in producing personality change.

In all of the hospital therapy cases the patient will be placed in charge of one or the physicians cooperating closely with the project. This physician will have the final responsibility for the therapy and for the patient's welfare. It will be a part of his responsibility to avoid the use of EST or chamotherapy unless absolutely necessary. The purpose of this condition is to give as much of a trial as possible to the process of bsychotherapy without other treatment means being utilized.

VI. The battery of research instruments will be readministered at intervals to all therapy cases and all controls. Some measures will be rereated every 3 months, others every 6 menths. This will give repeated measurements of the degree to which the conditions of therapy exist for any given individual either in the therapy relationship of some other meaningful relationship. It will also give repeated measurements of some of the indices of the process of therapy eroup, be derived from the recorded interviews.)

Since the length of therapy is likely to be different in the schizophrenic and normal subjects, the only schedule which can be set up is that the buttery of research instruments will be repeated every 6 months after therapy is over, for a minimum total period of 15 months. Testing should be carried on for one year after therapy is completed. The matched control individual will be tested as long as the therapy case with which he is matched.



VII. The data from the research instruments and (equally importantly) the data from the recorded interviews will be analyzed to test the general hypotheses mentioned previously; that the greater the degree to which the conditions of therapy exist, the more marked will be the therapeutic movement; that the process of therapy will not be signedificantly different in the three therapy groups; that the process of therapy will occur to a significantly lesser degree in the control than in the thorapy population.

More extended comments upon the way the data will be analyzed so as to test these hypotheses is contained in the section which follows on Analysis of Process.

VIII. The findings will be prepared in article or book form for reporting to the professions of acychology and psychiatry.

The recorded interviews, test data, and other materials from the project will be carefully preserved so as to be made available to any qualified research worker who wishes to musuc further study of the material. Some of the recorded interviews have be made available for tracking purposes with psychologists and associatists.

## Analysis of Process

Since this irrestination focuses largely upon the process of therapy rather than upon its outcome, it seems worthwhile to define our use of this term, and to discuss the ways in which we expect to test hypotheses relating to process.

In the experiential flow of events in a series of therapeutic interviews, certain characteristic sequences have been noted clinically. These may be thought of as evidence of therapeutic movement or process, of the changing which is going on. Since research can never study flow itself, process becomes defined operationally as those discriminable characteristic sequences which exhibit change over relatively short periods of time. Thus the individual may become more expressive of self-related feelings now than he was a month ago, or communicate less of non-self material, and nore of self-description. Though such indicators of process are related to outcome, they come from though such indicators, and represent points in a sequential flow of events, rather than single end-points such as cure, recovery, or social adjustment, which are terms relating to outcome.

As a basis for testing our propositions regarding movement in therapy we will have various "samplings" of behavior gathered at different points in time. There will be the interview interactions between client and therapist; the interaction between the client and appraisal interviewer; the samplings of client behavior by means of objective and projective tests; the observations of his behavior. Our hypotheses are such that they predict sequential change in those samplings, in defined directions.

In order to clarify the directions, we have set up some thirty continua which define the qualities of change associated with psychotherapy or with the development of a more integrated or more optimum personality. Some of these continua have to do with: the way the individual perceives himself: his attitudes boward himself; the manner in which he experiences

timself; his league of freedom to communicate himself. Others have to do with: the member in which the individual relates to his problems; his relationship to his own teelines; his manner of experiencing; his manner of perceiving. Still others have to do with; his manner of construing experience; his manner of relating to others; his manner of problem-solving; the degree of rigidity in his behavior. In each of these continua we have operational means (sometimes crude) for determining the placement of any given sample of behavior.

To list a few of these continua and the way in which behavior samples may be located on them, may give a clearer picture of the method. The two ends of each continuum are briefly defined, and the instruments on which the measurement is based are listed.

1. Client nerceives self rigidly, in defensive fashion

Client perceives self as fluid, changing person, reasonably related to self-ideal.

U-sort (7);

 Avoids all experiences of self as initiator of choice, action, or values.
 kaskin Scale of Locus of Evaluation (19). Acceptantly experiences self as initiator of choice, action, and values.

14. reelings exhibited, but comisd as feelings. Feartul experiencing of feelings.

Acceptant experiencing of feelings and personal meanings.

Process Scale

19. Perception is stereotyped, poorly related to reality.

Jonietz Scale for analyzing Rorschach (11)

Perception is reality oriented, more tentative, more fluid.

Using these concepts of samplings of behavior and process continua, the hypotheses of the study can now be stated in operational form, in an order suited to their logical presentation.

- 1. Samplings of behavior taken from the control group at early, middle, and late points in the study will show no significant movement on the process continua.
- II. Samplings of behavior maken from the therapy group at early, middle, and late points in the study will show significant movement on the process continua and will show significantly greater movement than is found in the control group.
- III. The tindings regarding movement on the process continua will not be significantly different for Group A (chronic) Group B (acute) or Group C (normal).
- IV. Process changes from left to right on the continua for the whole group (Groups A, B, C, and controls) will be positively correlated with the degree to which the conditions of therapy (as operationally defined) are degree to which the conditions of therapy (as operationally experience.

In addition, whether the findings of the project are positive or negative, they should throw light on the nature of schizoparenia or schizophrenic behavior; should throw further light on the nature of psychotherapy and the behavior relationship; should add to our knowledge as to the process by which personality changes; should indicate whether this process is the same in the neurotic, schizophrenic and normal; should be theoretically significant in indicating the degree to which personality and behavior can change; should indicate whether well-adjusted individuals can profit from psychotherapy; may suggest the basis for large-scale therapeutic procedures with psychotic patients.

# Present Status of the Program

from the On the basis of an initial grant Research through the University & already under way. At the date of this writing-(April 15, 1959) sixteen hospitalized schizophrenics and two well-adjusted normals are tested and matched, and more than loo interviews have been held with the therapy members of the pairs. Five therapists are conducting the therapy and three other therapists are ready to begin. A project group of ten individuals is actively at work on the various phases of the study--selection and matching of individuals, testing, appraisal interviews, therapy. ... Dr. serves as the coordinator of this group, and he and Dr the major investigative responsibilities. The project has the approval of the Research Committee of the Research Committee of Asspital of the Director of the Division of Mental Hygiene, I.

generous cooperation of these man and affiliation. generous cooperation of these men and of the staff at has helped to make the project possible.

# The Development of the Program

It is no doubt evident that the study described above is simply another step in a continuing program of investigation of many aspects of psychotherapy with many types of individuals. Out of this study will come leads for further work. While it cannot be predicted with certainty what directions the continuing program will take, two possibilities, already under consideration, will indicate some of the current thinking.

Depending on the findings with the first block of 48 individuals, a second block of similar basic design may be inaugurated, selecting the new block in such a way as to settle issues raised in the initial study.

Another quite different possibility will almost certainly be carried out in one form or another. This will be to make therapy available, on as simple a basis as possible, during given hours on a given ward of either chronic or acute psychotics. A therapist will spend perhaps two hours we two days per veek in a ward, and will see for brief interviews (probably 20 minutes) each patient who wishes to see him. All interviews will be recorded, and will be available for various types of analysis. This will extend the range of types of disturbed individuals seen, will investigate the extent to which therapy will be sought if casily available, and may set a pattern which could be followed by hospital psychiatrists and psychologists whospital psychiatrists and psychologists

The reason for mentioning these two future possibilities is to indicate that the basic plan involves not simply one project but a continuing investigation of the possibilities and limitations of psychotherapy with individuals with varying degrees of disturbance, and the nature of the process of personality change in psychotherapy.

97-21

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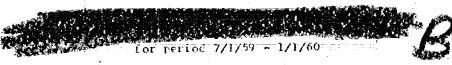


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Budget requested from .



17-21

3

Sudget for carrying on program at optimal level for 6 months (see tequest, previous page)

Support available from the University of Research Committee for this 6 months perio

...

Funds requested for optimal program

\$16,189

....5,000

\$21,189

Budget for carrying on program at minimal level for 6 months, until optimal funds available

Suprort available from the University of Research Committee for this 6 months pe

Funds requested for minimal program

\$13,750

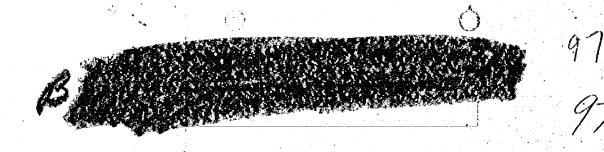
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	Proposed Budget	Requested	from Other
	Personnel .	A CONTRACTOR	Source
	Principal Investigator,	0	<b>8</b> \$5000
_	(part time)  Project Associate research coordinator,	\$6000	2000
	Consultant, Ph.D. (part time) Therapists (part time)	o	2500 8500
Marie Caller	Ph.D.		•
	, Fh.b. M. D.		
	M. D.	: i	•
-	M. S.		•
	Project Associate (full time, data analysis)	7500 '	
	Project Assistant (one full time or two half t	imelendo	
	(psychometrist) Administrative Assistant (selection, matching,	5500	
•	intake of patients, scheduling appointme	ents)	
	Records Secretary (half time)	1800	
	3 Research Assistants (part time)	6000	
	Hourly help (clerical tasks)	2000	
	Social Security and Retirement	2303 \$37103	\$37103
	termanent Equipment		
	Tape recorders and microphones	600	•
	Files and cabinets	200	
	Typewriters	325	
	Consumable supplies		
	Recording tapes	2000	
	Folders, Cards, Office supplies	250	
	Psychological tests	100	
			,
	Travel		
	For staff to de followup testing	300	
	Other Expenses		
	Payments to control subjects for testing time Sound-dampening of offices for recording	500 1000 \$5275	\$ 5275
	Subtotal		\$42378
	Overhead (15%)		6357 \$48735
	Second year		44000
	Third year	• ,	44060
	Fourth year		40000 \$176,735
	Total Request	•	ALM CALL CO.





April 24, 1959

MEMORANDUM TO: The Directors

SUBJECT: Project Projectal - Cr.

Attached is a proposal by Dr. for the Initiation of his observations on the process of personality change during psycho-therapy. Its focus is upon selling branics with a control composed of named individuals.

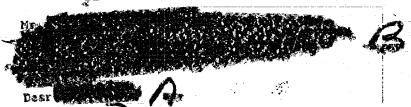
He has proposed an artifact and a minimal program both of which rhould be considered. In conversation with him, however, I developed the feeling that the minimal program would need his needs and would encourage concentration on this aspect of the proposal.

A Executive Secretory

Marian 17

fact 3

April 22, 1959



I am attaching a description of the research progress in psychotherapy with schizophranics and normals which a group of us have are carrying on with initial support from the University of Research Committee.

I would like to ask if this profits could be considered for temperary expect by the Beerd of the half while we are endeaveries to obtain substantial and continuing support from the latter to this can you will find attached to this latter.

- a. A description of the program and its research design.
- b. The budget request which we are planning to enbalt to
- c. A double budget request to the transition of menths period beginning July 1, 1959. This request is stated in Terms of an eptimal level of support, and also in terms of a minimal level of support which would encode us to continue until we can obtain more substantial backing.

If in your judgement this is on appropriate request to suimit to the Board. I would be happy to have you send copies of this material (and this letter) to the members of the Board for their consideration and evaluation.



4 August 1959

MEMORALDUM FOR: THE RECORD

SUBJECT.

MOULTRA

The amount of \$339.72 remaining in this project will be accounted for by the University in their final accounting of Subproject 97.

TSD/Research Branch



### INVOICE CENT LIST

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#### CERTIFICATION

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paid to The final report typing expenses.

Since this payment was made, the funding mechanism has been terminated. We are therefore unable to obtain a detailed account from the transfer of these funds have been spent by MANEARA # 98 in the completion of his research and in accordance with the grant approval.

A copy of the cancelled check is on file in TSD/BF.

daya/azar

AFPROVED:

Sidily Corplies C/Ted

November 17, 1966

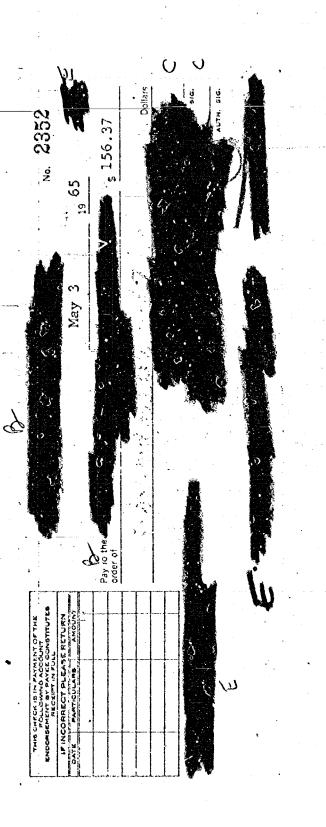
Memorandum for: Chief, TSD/BF

Subject: Dr. Research Grant

1. In May 1965, the remaining balance of Dr. s grant, that had previously been administered by the of \$156.37 was sent to the at Dr. s request. This sum was to be held by them to cover typing costs on his project when it was completed.

- 2. Attached is a copy of the covering letter and  $\beta$  the check that was sent to
- entity as of June-1966 and, therefore, cannot request further accountings.
- 4. If further information is desired, we will be happy to furnish it.

It is hereby certified that \$156.37 was correctly paid to



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Line or Section

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- on this line the amount to be accounted for which shall be the sum of amounts shown in and 3. Enter
- the lack of a receipt. Each amount listed in this section shall be supported by a voucher consisting of either the If the number of entries exceeds the available space they may be consolidated as one entry in section 5 and supported by a listing of the individual entries on a separate sheet. receipt obtained from the payee or in lieu thereof a certification explaining 'n
- Enter on this line the amount of any refunds of advances by the advancee indicating whether by cash, check, or money order. vi
- When accountings for advances are obtained, list as expenses Advances made to thind parties which remain outstanding at the end of the accounting period shall be consolidated and the total entered as a single amount on this line supported by a Final credit will not be given for disbursements which are or refunds of cash, as appropriate advances to be accounted for. listing on a separate sheet.

ŀ.

Enter on this line the amount of cash on hand, or if the amount of the disbursements the amount advanced the balance due the advancee shall be shown in parenthesis, i.e. and treated as a minus amount in arriving at the "Total Accounted For", line 9.

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Reflect on this line the "Total Accounted For" which must agree with the amount shown on "Total To Account For". o

16 November 1966

HEMORANDUM FOR : Chief, TSD/BAB

ATTENTION

SUDJECT

Research great

1. Were grant status report for the period April/June 1965 reflects disbursement of \$156.37 to Dr

2. It is requested that an accounting be obtained from Dr. for this grant.



Distribution:
Original & 1 - Addressee

Alkhetin 95

20 October 1965

INCORARDUM FOR

Certification and Ligison Division,

Covert Claims Dranch

SUBJECT

MKULIRA Subproject 93

1. This project was approved, under the authority granted in the memorandum dated 13 April 1993 from the DCI to the DD/A (VD/S). The project was approved on 11 August 1999 in the expent of \$9,735.00.

2. Review of internal TID records indicate that only one funding (\$9.735.00) has been made to for this project. Further that this passed to and received an accounting from the grantee in the enount of \$9,973.63. This accounting which was recorded on your voucher Ho. \$45831, reflects unused grant funds in the execut of \$156.37.

3. From a perusel of the syrical of Youchers which touch on the many IMMERA subprojects it appears that the entry made on your voucher No. 352331 is a duplication of other entries affecting this account.

h. As of 30 September 1965 the 760.0 account Schaidiary Ledger reflects an outstanding balance for subproject 93 of \$4,927.03. This amount is over stated and should be subjusted to reflect the correct outstanding balance of \$156.37 as stated on the grantees last accounting.

Cinter, TSD/SS

Distribution: Original & 1 - Addressee

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# INSTRUCTIONS

- If advances nave been made to third parties, enter the total of such advances outstanding at the beginning of the accounting period of other than U.S. Dollars were on hand, received, or disbursed during the accounting period, all pertinent data, i.e., rate, method of acquisition, etc., must be shown. If funds, in the form on line la. d
- In every case, If more space is required to explain receipts, prepare receipt form, number and attach hereto. completely identify the source of receipts. ai
- The voucher may be When a receipt is not obtained, prepare a certificate and attach as a voucher. When space on form is not sufficient to list all vouchers, prepare a listing on a separate sheet and enter the total under item 3. If advances to third parties are cutstanding at the close of the accounting period, attach an itemized list and enter the total on line 3a. Attach a voucher for each expenditure and assign a number thereto in numerical sequence, the receipt obtained from the payee. ന്
- When accounting not be given for disbursements which are advances to be accounted for. cash, as appropriate. for advances are obtained, list as expenditures or refund of Final credit will . .
- Total receipts entered on the line "Total to Account For" must agree with the total disbursements entered on the line following "Total Accounted For." เง๋

September 12, 1963

Dear

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00

Enclosed please find the accounting for trom hich shows a 0 balance. This should close that old one.

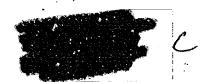
* .

I have written to  $\xi$  for an accounting of the last 2 years by the \$30,000 grant to  $\xi$ 

Enclosed is an accounting on which I have made up since I had all his records and made the payments for him. He may use the balance up in some small expenditures which he has not yet requested reimbursement for so please don't close this one out.

Enclosed also is a copy of a letter from which you can put in his file. He is still spending our grant money and won't account until it is all gone.

Best personal regards.



Ż.

# September 12, 1963

Grant to Dr. 1959 in the amount of \$9,735.00 Expenditures; Equipment 284,60 Research Assistants 1,566.50 Principal Investigator Fees 7,350.00 Fees for library access, Supplies and Books 377.53 Total Expended to date 9,578.63 156.37 Balance in account

The above expenditures were made by the Fund, only direct payments.

therefore, controlled the finances and kept the records of payments. I certify that these are true expenditures from Dr.

I certify that appoint or materials have been satisfactorily possived as I the expenditures were incurred on official desiress.

Date: Jan 15 1964

A

September 18, 1959

escopared for the recognic

SUBJECT:

Froject - Financial Arrangements

This necognider will confirm the verbal discussion between W.

and Dr. Pregarding finucial arrangements agreed upon
at the present time.

- on the date that are detifies us. Assemble that are detifies us. Assemble to the basis of \$5,000.00 a year on half time basis. This will be paid in monthly installments and is subject to the withholding taxes and social escentive as a regular especies of the because a member of the because a member of the social section of the s
- 2. Fayrent will be rade promptly of any vouch ra substitted C by Ir concerns incurred for his project.
- 3. Dr. Mill investigate suitable equipment for copy work in libraries and will notify the better that time it will be decided whether will purchase this equipment for ir. Mill purchase the equipment and loan better to lr. Co

Other than the shove conditions, will wait until backes further plans after the first of the year before making other financial payments.



 $\bigcirc$ 

No. 295

Cost Account __ 0525 · 108 · 1802

Object Class _

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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26 August 1959

MENORSHERM FOR: CITEP, FIRECE DIVISION

VIA

: 132/Audget Officer

EUBISCT

: Kantani, Emproject 98, Invoice No. 1 Allotaeut 0725-1009-1982

1. Invoice No. 1 is attached covering the above subproject. Payment should be used as follows:

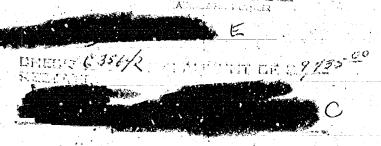
Capition's Check in the resount of \$9,735.00 drawn on yapable to

- 2. Please forward the check to Chief, TES/Chemical Mivision through TES/Sulfet Officer by thesis, 8 September 1989.
- 3. This is a firel invoice. Econver, since it is anticipated that additional finds will be obligated for this project, the files should not be closed.

Tes/Chemical Division

Attenment Levelor & Corbinications

Distribution: Orig & 2 - Addresses | 2 - 138/160 1 COTTON MATERIALS AND AMARAMA ORIGINAL MATERIALS OSSISSIONS - 14902





26 August 1959

REPORTED A ROS. CHIEF, PHANCE DIVISION

VIA

: 203/Ardjet Officer

**SUBJECT** 

: 178151A, Subproject 90, Invoice No. 1 Allougant 0525-1007-1603

1. Involce No. 1 is attached covering the above subproject. Payment chould be used as follows:

Caphler's Check in the escent.of \$9.735.00 Grova on

2. Please forward the cheek to Order, WS/Chemical Mivision through 123/2020et Officer by Include, 8 Ecytember 1959.

3. This is a firel invoice. However, since it is enticipated that editional funds will be obligated for this project, the files chould not be closed.

Chesteal Division

Attachment Invoice à Cortifications

Matribution:

Orig & 2 - Addressed

1 - 273/3453

2-uss/cd

TSS/CD

26 Aug 59)



For cervices

\$9,735.00

B

CERTIFICATIONS

(1) It is hereby certified that this is Invoice to. 1 applying to Eubproject to. 53 of INULERA, that performed is estimatery, that services are being accomplished in accordance with mitual agreements, that a deticled agends of the payments and receipts is on file in TWS/CD, that this bill is just and correct and that payment thereof has not yet been made.

Chief, 135/Chesical Mv1slon

Date

(2) It is hereby cortified that this invoice applies to Subproject No. 97 of MAHRA which was duly approved, and that the project is being carried cut in accordance with the memorandum of 13 April 1953 from the BOI to the PD/A, and the extension of this authority in subsequent removands.

Reserved director

Potes

# RECEIPT

Receipt is hereby acknowledged of the following:

Official Check No. G35642 in the amount of \$9,735.00, drawn on payable to

Date: Sept 15,1959

6 August 1959

MEMORANDICH FOR: COSTIROLLER

ACCEPTION

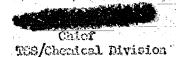
· Finance Division

TULLEUS

: IMMITTA, Subproject 98

Under the authority granted in the Memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension of
this authority in subsequent memoranda, Subproject 93 has been
approved and \$9,735.00 of the over-all Project MADIATA funds
have been obligated to cover the subproject's expenses and
should be charged to Allotment 0585-1009-1902.



APPROVED FOR OBLIGATION OF FURES:

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Distribution

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2 - TSS/CD

TSS/CD (6 August 1959)







MEMORANDUM FOR: THE

SUBJECT

MKUITRA, Subproject 98

1. The purpose of Subproject 98 is to support Dr.

research work in mass conversion as outlined
in the attached proposal. Material possessed by some of

projects (e.g.

and the data at will be inte-

grated into one document tying together evaluations of change of attitude, personality and behavior.

- 2. This project will be funded through

  for security and cover purposes

  and the accountings for funds expended in it shall conform to the

  established procedures of that organization. It is not anticipated

  that any permanent equipment will be required for the project, but

  should the occasion arise, it will become the property of the University

  in lieu of higher overhead charges.
- 3. The total cost of this project for a period of two years is estimated to be \$9,735.00 as indicated in the attached proposal. Charges should be made against Allotment 0525-1009-4902.

Downgraded to: by authority of: 187475 cate: June 1977



4. No cleared or witting persons are concerned with the

conduct of this project.



TSS/Chemical Division

APPROVED FOR OBLICATION OF FUNDS:



Date: 8)11/59

Attached: Proposal

Distribution: Original only

Downgraded to: by authority of: 187475 date: June 1977

E2 IMPOET; CL BY 187475

co 98-15

# - PROPOSAL FOR RESEARCH ON SOME ASPECTS OF MASS CONVERSION

whether conversion on fundamental marters of ideology and morality can be achieved on a massive scale constitutes an important theoretical problem. Its practical import, moreover, is brought home when one considers its direct bearing on some essmingly siveres phenomena, such as transformations achieved in "therapeutic" groups, the "brainwaching" of incrican POWs as Korea, the appeal of modern mass evangelism, the enthusiasm aroused by some revolutionary mass movements, etc. But the collective aspects of mass conversion, it seems are not easily studied by the conventional experimental designs or stat tical manipulation, which are often held up as the ideal in social research.

Concrete instances of apparent mass conversion can nevertheless be studied scientifically, if one approaches them indirectly by drawing on available findings of parallel phenomena. Many psychological and sociological studies having closely to standard methods of investigation contain findings whose relevance to the problem of "conversion" have rarely been considered systematically. It is proposed then, first, to extract some of the already available findings and, second, to apply them to case materials already collected. Apart from this effort towards synthesis on the basis of reports of mass phenomena, no staps sined at independent validation of propositions des proposed.

### Working Assumptions

To be fruitful this investigation rust begin with an adequate definition of conversion and of the phenomena to be subsumed under this generic type.

As a working definition governing the research, the following is proposed: a conversion is a fundamental charge (i.e. an about-face) concerning basic noral, religious, or political nutters which leads after the pressures which have induced it are reasoned.

This definition should allow one to relatively conversions attitude change, on the one hand, and personality change, on the other. Furthernors, the requirement that it be relatively personent allows one to distinguish between conversion and many temperary outburets of hystoria, etc. which have constinue been taken as the escape of a conversion experience. A review of the relevant literature should help to refine the definition and perhaps permit also a distinction among coveral subtypes.

A second working assumption is to be made: mass conversion is a collective affair in assuch as those influenced also influence one another. It is not simply a series of parallel changes that take place in a plurality of individuals under similar pressures. On the contrary, snowball-like effects are postulated.



### Major Iccass

The investigation shall deal with three distinct, though logically related, issues. Each of them can be put as a question:

(1) Who is susceptible ?

(2) Under what conditions are changes effected !

(3) What is the nature of the change ?

As a prelimity to any attempt at synthesis, the literature must be reviewed for any cluss concerning these three questions.

conversion rests, as James has held, upon the existence of a submerged side of the "divided" self which the experience or crisis berely brings to the fore. Can a person be converted in a direction not in line with predispositions, which may perhaps not be acknowledged by the person! There are also questions concerning the make-up of the susceptible personality. According to come, conversion is a reaction against authoritarian pressures experienced as alien; the convert robels. Other scholars have held to the opposite view, namely that the lack of strong commitment is what makes for susceptibility.

Rs (2) the conditions of conversion. An examination of the verious kinds of pressures applied is prerequisite for an analysis of the situation in which new consituents are effected. Pressure, as used here, includes more than consciously planaed manipulation to effect a change, i.e. the advance preparation, warm-up, and gimmickry which precede the appeal. To be considered also are the alternatives open to the individual, the impact of yablic images and the kind of support they appear to provide, and the effect of an act being defined by others as a conversion. The best that one can aim at in this regard is a "natural history" of the phenomenal. Theoretically it should be possible to spell out the necessary ask sufficient conditions that impel or that limit change in any given direction. Here is also where case materials will be expecially neefful.

Ro (3) the ego-old question of whether a personent change is achieved. It weems advisable to reformulate this question by inquirity as to what repidial changes remain once the pressures toward this new consistent are resoured or eased. Does a personal reorganization of beliefs require sustained group supports. Or does the initialise anthusiasm and group enthusiasm experience a natural let-does onds the initial escitament and the accompanying pressures wear offs. Of course, these are not the only alternatives. Many unsaticipated reactions (designed to lesson conflict between ideologies abandoned and the new ones accepted) may leave a permanent residue.

### Plen of Study

Step 1: Analysts of what has been typed as conversion in the past:

- (a) A specific, usually a religiously-typod, experience which signifies inner commitment to a cause. The recognition of such an experience as conversion involves "ascription" of a new role by others. But the distinction between cryatallization of latent dispositions and as about-face is obscured in this conceptualization.
- (b) Defection from one religious, political, or national affiliation to another. Actually this need not be a new consisteent instauch as the change may be and as a matter of opportunism and relates only to interests which are peripheral.
- (c) A change of outlook, whether sudden or dramatic or gradual, , on a matter central to the personality. This kind of conversion appears assentially a matter of "resocialistion." Danic values and highly patterned forms of behavior are affected.

Studies of "conversion" are to be evaluated in the light of these distinctions.

Stop 2. Evaluation of analytical cases of conversion, using the definition "o" above as a guide injectsotion of materials. This will mean the inclusion of materials which have often been emitted in discussions of conversion. Relevant embedding in the main purpose of and historical materials are to be reviewed. Instain purpose of this review is to extract hypotheses and questions concerning the three questions: succeptibility to conversion, the events that provoked it, and the nature of the change.

Stop 3. A review of techniques found effective in bringing about a basic change in social role. Relevant data are to be evaluated with regard to two questions: the personality types on whom they are most effective and the permanence of the changes produced.

The following techniques would appear to be most relevant have:

- (a) hypnosis and suggestion
- (b) therapy, the sustained mobilization of affect
- (e) "esscription." the vignification of change of status as a result of initiation correction, a recific experiences, atc. which legitimate the acceptance of a new role in the eyes of others.
- (d) porcuration, the curreptibility to retional argument by appeals to interests and dispositions in a person to some degree conscious of being the target of such appeals
- (e) enforced isolation, individual confinement, and all techniques whereby perception and information can be made homogeneous and monopolitical, minimizing any compating influences
- (f) stress, spection, and the threat of spress puntahment of or which took to thence the reserve attracture.

()

Step b. Analysis of conversion in a group context. The emphasis is to be on the collective influences which operate to define the roles of individuals vis-a-vis one another and give rise to new group identities. Below are some subject areas with examples:

- (a) Group therapy. Classical group therapy; AA and the Society of Reformed Drunkards in the 1840s; New York City Youth Poard activities.
- (b) Recruitment into the active cell or the nucleus of the select. Political and religious sects and other "natural" microccsms.
- (c) Group influences during forced detainment. Prisoners of war, concentration camp, and the Zwangagomeinschaft.
- (d) Offiges in social environment due to geographical movement.

  The "resocialization" of the immigrant or migrant in response to a voluntary change in his cultural environment with ithout necessary prior motivation to abandon his old commitments.
- (c) Changes in response to organized campaigns and pageantmy in which mass emotions are mobilized around new symbols. Revivalism (especially Billy Graham Crusade), political spectacles, etc.
- (f) Change during a period of political instability when class structure and style of life are fundamentally affected. Changes in life conditions which affect the total society.

## Step 5. Synthosis

The diverse materials covered and the generalisations to be derived are to focus on the three basic problems outlined for investigation. To repeat, the study should parmit some clarification, for example, of the rather crude hypothesis that some kind of inner discord functions conversion always. A second hypothesis, also in rather broad form, holds that the criticial situation in which pressure is applied must always entail a narrowing of alternatives and the promise of conflict resolution. Such a proposition peeds, above all, clarification. Finally, it has been contended that the only guarantee for a conversion's permanence are accompanying supportive changes in the converts immediate accial environment. Just what the nature of such support is also might be clarified.

Another problem to be touched upon concerns the "interchangebility" of susceptibles. Are the various kinds of political, social, religious commitments really equivalent? Again this survey should enable us to pinpoint more precisely areas of investigation in need of more intensive study.

### Time Schedule and Conta

Ireliminary work is to commence in the summer of 1959. Unfortunately there appears practically no chance that either Br.

or I can get any kind of leave or reduced teaching load during the latter half of 1959. During this period, a research assistant (with an equivalent of a masters' degree) could get started with bibliographical work and abstracting of literature. During the next espectars, either one of us (or both) will seek a half-time reduction in teaching load to speed along the Applicat.

A two-year period is envisioned as accessary to complete this analysis.

Support of self (or Dr to get reduction of teaching load at \$5500 per annum) 3 semesters of half-time

\$4875

Research assistant for one year at half-time, \$5000 per annum

\$2,500

Travel to consult sources and inspect data or consult with investigators

\$ 500

Miscellatoous Research Expenses
Library privileges \$ 225
Supplies \$ 150
Purchase of materials,
reports, etc. \$ 100

\$ 475

Typing of nanuscript and drafts

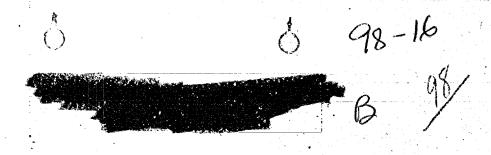
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10 per cent for unexpected contingencies

<u>885</u>



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Vay 19, 1959

MEMORANOUN TO: The Directors

"UDJECT: Project Projectal, Cologory 8 - By Dr

The enclosed proposed was solicited in order to take advantage of a personal talent and interest on the part of the Principal Investigator. An attempt will be under to into some data personal by the conting in the hands of some of the proposed by the conting in the hands of some of the conting in the hands of all the conting of all the conting and behavior.

Vitile the 'rescarch' Involved in this project is largely of a literary majora, it is fait that an attempt to conceptualize these there there are in a broader context will be useful for programming and planning for the society in the lature. The only congenity work of which we are aware at the proper time is being conducted at the factor of the property of the states this study programmes.

Executive Secretary

Enci 3

# SEGRET

### INVOICE CHICK LIST

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Project: MKULTRA, Subproject 99

Date Initiated: September 1959.

Date Expires: Continuing

Funds-current year: \$9,000.00

Purpose: To provide consultative, preparitive and analytical services in the field of biologically active substances.

Single crystals of some key materials have been prepared and the crystal structures determined to provide data for theoretical evaluation of structure-activity relationships obtained from other projects.

(When Filled In)

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Line	Secti

Enter on line 1 the amount of cash on hand at the beginning of the period , i

Enter on line 2 the amount of outstanding advances made to third parties, brought forward from the previous accounting period. oi.

Enter in this, section the amount of each receipt during the accounting period showing pertinent

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data, i.e., method or source of acquisition and applicable rate of exchange, if indigenous currency. If more space is required to explain receipts, prepare receipt form, number and attach hereto. In every case, completely identify the source of receipts.

Enter on this line the amount to be accounted for which shall be the sum of amounts shown in 1, 2, and 3.

receipt obtained from the payee or in lieu thereof a certification explaining the lack of a receipt. Each amount listed in this section shall be supported by a voucher consisting of either the

If the number of entries exceeds the available space they may be consolidated as one entry

Enter on this line the amount of any refunds of advances in section 5 and supported by a listing of the

by cash, check, or money order. v

Advances made to third parties which remain outstanding at the end of the accounting period shall be consolidated and the total entered as a single amount on this line supported by a

or refunds of cash, as appropriate

advances to be accounted for.

listing on a separate sheet.

Enter on this line the amount of cash on hand, or if the amount of the disbursements the amount advanced the balance due the advancee shall be shown in parenthesis, i.e. and treated as a minus amount in arriving at the "Total Accounted For", line 9.

exceeds

When accountings for advances are obtained, list as expenses

Final credit will not be given for disbursements which are

by the advancee indicating whether

individual entries on a separate sheet.

Reflect on this line the "Total Accounted For" which must agree with the amount shown on line  $\mu$ , "Total To Account For".

GRO -168 O45

### CERTIFICATION

This is to certify that I have received the physical studies as required by IKULURA, Subproject 99 approval. As the receipt of these entisfactorily completed abulies complitute the only accounting it is requested that IKULURA Subproject 99 be closed.

I forther certify that to the best of my knowledge and belief the studies were in accordance with the purposes authorized by the subproject approval.

A Chick Scientist

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Cost Account _2/25 - 1391 - 3912

Object Class

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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Date: 1 September 1961

DEMORANCE FOR: THE COUTROLLER

ATTENTION

: Finance Division

SUBJECT

: EXMINA, Subproject 99
Authorization No. 3

Under the authority granted in the mamorandum dated 13 April 1953

from the DCI to the DD/A, and the extension of this authority in subsequent memorands, Subproject has been approved, and 50,084.00

of the over-all Project MAULITAA funds have been obligated to cover the subproject's expanses and should be charged to cost center 2125-1303-3002.

Chief TSD/Research Branch

APPROVED FOR OBLIGATION OF FUNDS:

CERTIFY THAT FUNDS ARE AVAILABLE:

OBLIGATION REPORTED No. 109

CHAPGE TO ALLOTHENT No. 3/035. 1340. 3401

Research Director

AUTHORIZING OFFICER

Dates

Distribution:
Original & 2 - Addressee

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17 November 1961

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Allotsont 2125-1390-3902

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2. Places derived the check to Chief, TED/Research Breach through TEP/Reduct Officer as seen as possible.

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TSD/R3 (17 November 1961

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1 September 1961

MEMORANDUM FOR: CHIEF, FINANCE DIVISION

VIA

: TSD/Eudget Officer

SUDJECT

: MMULTRA, Subproject 99. Invoice No. 5 Allstment No. 2125-1390-3902

1. Invoice No. 5 covering above project is attached. Payment should be made as follows:

Cashier's Check for \$3.04.00 payable to

Cashier's Check for \$3.04.00 payable to

2. Please forward the checketo Chief, TSD/Research Branch through TSD/Budget Officer, no later than Il September 1961.

409

Chief TSD/Research Branch

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Attachments: Inycica & Certification

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No. 254/

Cost Account _0535. 1858-4102

Object Class ___

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
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6 June 1960

MEMORANDUM FOR: THE COMPTHOLLESS

ATTENTION

1 Finance Division

SUBJECT

MKULTAA, Subproject 99 Authorization No. 2

Under the authority granted in the Memorandam dated 13 April 1953 from the DCI to the DO/A, and the extension of this authority in subsequent memorando. Subproject 99 has been approved, and \$9,000. of the over-all Project MAULTRA funds have been obligated to cover this subproject's expenses and should be charged to Allotment 0525-1503-4502.



TSD/Chemical Breach

APPROVED FOR OBLIGATION OF PURDS:

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19 August 1960

125 TORANGE FOR: CHIEF, PINANCE DIVISION

VIA

: TSD/Budget Officer

SUBJECT!

: MEULINA, Subproject 99, Invoice No. 4 Allowent 6929-1009-4902

1. Invoice No. 4 is attached covering the above subproject. Other invoices will follow. Tayment should be sade as follows:

Cashier's check in the assent of \$600.00 down on a 3 payable to Dr.

2. Please forward the check to Chief, fCD/Research Brench through FED/Budget Officer by Friday, 26 August 1960.

Chief
SSD/Rosearch Branch

Attachments: Invoice & Certifications

Distribution:
Orig & E - Addressee
1 - TSD/CC
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17 Juna 1960

ESCHORATION FOR: CHIEF, FIRMES DIVISION

VIA

: TSD/Dudget Officer

SUBJECT

: EQUIARA, Rubproject 99, Invotes No. 3 Allotaent 0929-1009-1902

1. Invoice No. 3 is attached covering the above subproject. Other invoices will follow. Payment should be made as follows:

dealler's check in the amount of \$7.718.00 drawn on a payable to

2. Please forward the check to Chief, ToD/Research Branch through ThD/Research Officer by 24 June 1950.

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Attachments: Invoice & Certifications

Distribution: Orin & 2 - Addresses CHECKS AND THE AMOUNT OF STAR





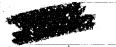
99-2

No. 456

Object Class

Date	Remarks and References	Obligations Incurred	Obligations Liquidated	Unliquidated Balance
8 SEP 1959	Dirone ",	5000.00		5000:00
16 FEB	Birone ",		1,350.00	3750.00
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99-2



28 August 1959

MEMORARDIM FOR: THE COMPTROLLER

ATTESTION : Finance Division

SUBJECT : MKHLARA, Subproject 99

Under the authority granted in the Manorandum dated

13 April 1953 from the ICI to the DD/A, and the extension

of this authority in subsequent memoranda, Subproject 99 has

been approved, and \$5,000 of the over-all Project MAULTEA funds

have been obligated to cover this subproject's expenses and

should be charged to Allotment 0525-1009-4902.



APPROVED FOR OBLIGATION OF FUNDS:

X	CRICATORES TO TO AND AVAILABLE AND CRICATORES TO THE TOTAL AND	
Acserch Director	CHARLET CON 100 0525-1008-440	Z
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Date

Distribution: Orig & 2 - Addresses

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# 11 February 1960

EDITORIO POR CEDEP, PRIME DIVISION

VIA

: The/Sugget Officer

SUBJECT

: Magran, Edgrofest 9), Invoice Ko. 1 --Allotent 6529-1889-1982

1. Invoice Me. 1 is estached covering the whove cubproject. Other invoices will follow. Payment should be made as follows:

Cashier's cleak in the anount of 11,270,00 clara on a poyable to Dr.

2. Finasa forward the check to Chief, TES/Chemical Division through Ses/Sulged Ciffeer by Thursday, 25 February 1560.

Tas/Chanteal Division

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Pictribution: Orig & 2 - Addresse

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0505- 1019-1812

AUGUSTINE CHER

RECEIVED MAR THE AMOUNT OF \$4230 CO



80 May 1960

inducation for cider, finalize division

VIA

: TEO/Dadget Officer

SUBJECT

Minuma, Subproject 99, Invoice No. 2 Allotsent 0525-1003-4902

1. Invoice No. 2 is attached covering the above subproject. Other invoices will follow. Forment should be made as follows:

Cachter's check in the ascume of \$550.00 drawn on a payeble to Dr

2. Please forward the check to Chief, TeD/Chemical Breach through TeD/Budget Officer by 3 June 1960.

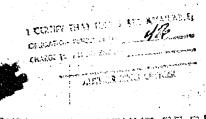
TSD/Chemical Branch

Attaqueents: Invoice & Certifications

Distribution:

Orig & 2 - Addresses

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# 0 99~

Date 23 July 1962

Branch PB Category	(1-a)
Project Title Flyrical Studion	Item Classification Unclassified
Project Cryptciiche	Crypto Classification None
Branch Project No. 7:-76	Project Engineer
Contract No. MRULTRA \$33	Task No. None
Type of Contract R&D	Date Initiated September 1961
Cost_\$9.934.00	Completion Date September 1962

Purpose: An exploratory enally concerned with the medulation of light intensity in single crystals by the reversal of orientation of optically active domains in certain ferroelectric crystals. Practical implications include possible new materials and techniques for modulation of light intensity and optical chaiters. There is also some support of structural studies of organic materials which have shown comiconductor activity.

Status: The structures of two organic intermolecular complexes have been determined. Crystalic graphic data on others have been obtained. Optical studies represent graduate student project work which is in progress.



99-2 MKULTIA

#### RECEIPT

Receipt is hereby acknowledged for Treasurer's Check in the amount of \$1,450,00, drawn on the

December 6, 1961, payable to

(Name)

(Date)

C

Consulting record for

for research on organic

semiconductors, September 1960 through October 1961:

3 days per month, for 13 months, at \$ 50.00 per day: \$-1,450.00



I have empirical and approved the submitted empired light a.

A

Triffic food sivision

Vator 1/11/6/



INVOICE

17 November 1961

\$1,450.00

For Sarviere

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### CERTIFICATIONS

(1) It is hardly comided that this is invoice 6 applying to linb-project 110. 99 of MKULTRA, that performance is sometactory, that extraces are being accomplished in accordance with mutual agreements, that a detailed agends of the payments and reculpts is on the interior, that a detailed agends of the payments and that payment that is TSD/RT, that this bill be just and correct and that payment that into act yet been made.

Chief. Tan/Research Branch

Date:

(1) It is become condited that this invoice applies to Subproject 99 of Whill The word was duly approved, and that the project is being easiled out to exceedence with the memorendum of 11 April 1965 from the office of the 1974, and the extension of this authority in subsequent momentums.

Research Mrastor

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17 Hoverber 1961

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**EUDJECT** 

: MUMERA, Emberoject 9), Tavoica No. 6: Allowert 2009-1500-2502

1. Invoice to. 6 is attached covering the above subproject. Other invoices vill follow. Payment should be used as follows:

Coshingly check in the execut of \$1,450.00 drawn on a

2. Planse forward the elect to Chief, 180/Asserch Branch through 1850/And of Officer as seen as possible.

Chlai Tro/instaich branch

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Distribution

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SD (17 November 1961)

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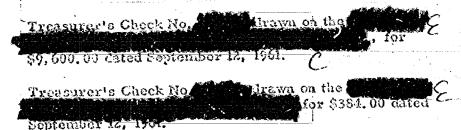
October 2, 1961



Gentlemen:

We are pleased to be able to transmit to you the following

funds:



These funds represent a contribution for the use of your directors in carrying out the very worthwhile research goals of your organization.

Yours truly.

Attachments (2)



1 September 1961

MEMORANDUM FOR: THE RECORD

SUBJECT : Project MKULTRA, Subproject 99

1. The purpose of Subproject 99 is to provide continued support for the work and services of Dr. at a definite bearing on are related to certain physical studies which have a definite bearing on various biological and physical problems of interest to the Agency.

2. The project will support studies on the optical rotatory power of solid and liquid crystals, for a period of six months (1 October 1961 through 31 March 1962). Possible practical applications of this work could be practical methods for modulation of light intensity by electrical fields, and the development of simple types of optical shutters. The materials to be studied will, to a large extent, also be of biological interest. The support will be in the form of post-doctoral fellowships for three men who will work under the direction of Dr. In addition, the project will provide for the continued services of Dr. which will include services as a consultant, preparation of materials in suitable physical forms, and the measurement of various physical properties. These relate to physical studies which are required to develop effective materials which will influence the human nervous system.



cover and cut-out for the optical rotatory power-studies. The cost of this program for six months will be \$9,600.00, to which must be added a 4% service charge for the cut-out (\$384.00), making a total of \$9,984.00. Charges should be made against Allotment No. 2125-1390-3902. In addition for other services, payment will be made from time to time on the basis Funds for this have been previously of statements submitted by Dr. allotted, and the time is hereby extended for a period of one year.

4. No permanent equipment will be acquired. Accounting for funds will conform with the usual provided through the practices of the

5. The facilities have been inspected and are considered adequate. has been given security approval. His co-workers are unwitting of Agency interest.

> Chief TSD/Research Branch

APPROVED FOR OBLIGATION .

OF FUNDS:

Research Director

Date;

Attached: Proposal

Distribution: Original Only





1 September 1961

MEMORANDUM FOR: CLIEF, FINANCE DIVISION

VIA

: TSO/Dudget Officer

SUBJECT

: MKULTRA, Subpreject 99, Invoice No. 5
Alletment No. 2125-1390-3902

1. Invoice No. 5 covering above project is attached. Payment should be made as follows:

Cachier's Chack for \$5,670rth payable to
Graves on a

Cachier's Chack for \$384,00 payable to
Cachier's Chack for \$384,00 payable to

3. Please forward the electric Chief. TSD/Research Branch through TSD/Endger Officer, no inter than Il September 1981.

A

Chini TSD/Recoarch Branch

Distribution: Origh 2 + Addresses

Attaclaments: Exclad & Cartifications p Jahrul



INVOICE

For Services

\$9,984,00

B

#### CERTIFICATIONS

(1) It is hereby certified that this is invoice 5 applying to Sub-project No. 99 of MKULTRA, that performance is natisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TSD/RB, that this bill is just and correct and that payment thereof has not yet been made.

Chief, YSD/Research Branch

Detei

(2) It is hereby certified that this invoice applies to Subproject 99 of MKULTRA which was duly approved, and that the project is being carried cut in accordance with the memorandum of 13 April 1953 from the DCI to the DD/A, and the extension of this authority in subsequent memorands.

Research Director

Date:



Date: 1 optomoor 1/61

MEMORARDIM FOR: THE COMPTROLLER

ATTENTION

: Finance Division

SUBJECT

: MEWLITEA, Subproject

Authoriteation No. 3

Under the authority granted in the memorandum dated 13 April 1953

From the DCI to the DD/A, and the extension of this authority in subsequent memorands, Subproject has been approved, and of the over-all Project ENUMERA funds have been obligated to cover the subproject's expenses and should be charged to cost center in the subproject's expenses and should be charged to cost center in the subproject's expenses and should be charged to cost center in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject in the subproject is expenses and should be charged to cost center in the subproject in the subproject is expenses and should be charged to cost center in the subproject in

Chief TSD/Research Branch

APPROVED FOR CELICATION OF FUNDS:

Research Director

Date:

Distribution:

Original & 2 - Addressee



# RECEIPT

Receipt is hereby acknowledged for Cashier's Check

in the amount of \$600.00, drawn on

dated August 31, 1960, payable to



19 August 1960

remonders for ceter, present division

VIA

: VER/BURDET Officer

SECTION .

: MANESA, Subproject 99, Devotes No. 4 Allowert 0003-1009-4508

1. Invoice to. 4 is streeted covering the above subproject. Other invoices will relies. Persent cloud be aske as follows:

Caption's check in the recent of \$600.00 dream on a repeable to Dr.

3. Planes formula the check to Chief, 160/Assessed Branch through 180/Andget Chief by Fillog, 26 August 1969.

A CREST TEST PRESCRIPTION FRANCIS

Attacheento: Invoice & Coptilications

Distribution:

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1 - TSD/FASS

2 - TSD/KB

TSD (19 Aug. 60)

A

INVOICE

For Services

\$600.00

#### CERTIFICATIONS

(1) It is hereby certified that this is invoice th applying to Subproject No. 9) of MANIAN, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in 250/22, that this bill is just and correct and that payment thereof has not yet been made.

Chief, TSD/Research Branch

Tatel

(2) It is hereby certified that this invoice applies to Subproject No. 99 of MADATA which was duly approved, and that the project is being carried out in accordance with the removandum of 13 April 1953 from the DOI to the DD/A, and the extension of this authority in subscipent memoranda.

Research Director

Dute:



July 19, 1960

For services rendered during period 14 May 1960 to 19 July 1960: 12 days.

\$600.00

I have examined and approved the submitted

expanditures.

Tatu: 8/160.

0 99-2

# RECEIPT

Receipt is hereby acknowledged of the following:

Cashier's Check No. dated 23 June 1960, drawn on

the in the amount of \$7,718.00, payable to B.

C Date 19 July 1960.

99-2

17 June 1960

KENDEAUDIA FOR: CHIEF, FRIMUE DAVISION

VIA

: TSD/Budget Officer

SUMMOT

: MKULTUA, Subproject 99, Invoice Fo. 3 Allowent 0525-1009-1902

1. Invoice No. 3 is attached covering the above subproject. Other invoices will follow. Payment should be code on follows:

drawn on a payable to

2. Please forward the check to Chief, Tab/Research Branch through Tab/Budget Officer by 24 June 1960.

Chief
T3D/Research Branch

Attachments: Invoice & Certifications

Distribution: Cair & 2 - Addressee



INVOICE

For Services

\$7,718.00

# CERTIFICATIONS

(1) It is hereby certified that this is Invoice #3 applying to Subproject No. 99 of INVIDEA, that performence is estimicatory, that services are being accomplished in accordance with mutual agreements, that a detailed agends of the payments and receipts is on file in TOD/NO, that this bill is just and correct and that payment thereof has not yet been made.

Chief, Toll/Research Brench

Dete:

(2) It is hereby certified that this invoice upplies to Subproject No. 99 of MONARA which was duly approved, and that the project is being carried out in accordance with the approximate of 13 April 1953 from the DII to the DD/A, and the extension of this authority in subsequent removands.

Research Director

Date

2 May 1960

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For Services

R Rave examined and approved the countible expenditures.

Chler TSS/Chemical Division

Table 5/5/60

MEMORANDUM FOR: The Record

**SUBJECT** 

Continuation of Project MKULTRA, Subproject 99

of the services of Dr.

The services are related to certain physical studies which are required to develop effective materials which will influence the central nervous system. These services will include the use of Dr. as a consultant, the preparation of materials in physical forms (not commercially available) in which the desired measurements can be made, and the measurement of various physical properties.

- 2. The facilities available for this work have been inspected and are considered adequate for the proposed work. Dr. has been given security approval and has been briefed on applicable security considerations.
- 3. The estimated cost is \$9,000. for a period of one year. Charges should be made against allotment 0525-1009-4902.
- 4. No permanent equipment will be acquired. Payment will be made from time to time on the basis of statements submitted by Dr.

Chie

APPROVED FOR OBLIGATION OF FUNDS:

TSD/Chemical Branch

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Date	6/8/60	99-2	
Distribution:	Orig only	and the second s	kan kanana ana kanana ayan sa

# RECEIPT

Receipt is hereby acknowledged for Cashier's Check No.

dated June 6, 1960, drawn on

in the amount of \$850.00, payable to

D1 🥌

6 June 1950

Memojandum for: The comptroller

ATTENTION .

: Finance Division

SUBJECT

i aikulitaa, Subproject 99 Authorization No. 2

Under the authority granted in the Memorandum dated 13 April 1993 from the OCI to the DD/A, and the extension of this authority in subsequent memorande. Subproject 99 has been approved, and 69,000, of the over-all Project MKULTAA leads have been colligated to cover this subproject's expenses and should be charged to Allotment 0525-1009-1902.

Chief Tsp/Chemical Branch

Approved for obligation of Yunds:

Research	Director
liescarch	Director

Date

Listelbe don:

Orig & 2 - Addressee

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- TOMEASS

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TSD/CB/DG





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incoming part chief, figure division

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VIA

: Top/Audget Officer

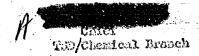
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: MEDICERA, Subordicat 99, Invoice So. 2 Allotsent 6525-1609-4502

1. Invoice No. 2 is attached covering the chove subproject. Other invoices will follow. Poyment should be made. so follows:

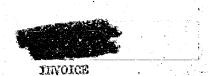
> Cashieria chack in the amount of 1990.00 depun on a paymole to Dr

2. Rease formers the check to Catef, Tan/Chemical Remark through Tan/Suiget Officer by 3 June 1980.



Attachmentat Involce & Certifications

Distribution: Orda & 2 - Addresses



For Services

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850.00

#### CERTIFICATIONS

(1) It is hereby certified that this is Invoice \$2 applying to Subproject No. 99 of MUHAMA, that performance is satisfactory, that services are teing accomplished in accordance with mutual agreements, that a detailed agains of the payments and receipts is on file in TID/CB, that this bill is just and correct and that payment thereof has not yet been made.

Chiof, TSD/Chemical Eranch

Dato!

(2) It is hereby certified that this invoice applies to Subproject No. 99 of MANAMA which was only approved, and that the project is being carried out in accordance with the measurantm of 13 April 1953 from the DUI to the LD/A, and the extension of this authority in subsequent responsible.

Research Director

Dates



# RECEIPT

Receipt is hereby acknowledge of the following:

Cashier's Check No. Acted 7 March 1960, drawn on in the amount

of \$1,250.00, payable to Dr.

Date 12 march 1960



For services rendered in period Jan. 24, 1960 to May 13, 1960:

\$850.00.



M Maya examined and approved the submitted expenditures.

A content of the submitted provided 
1/15/60



99-2

TINOICE

For Gervices

\$1,250.00

#### CHICATROCATIONS

(1) It is borely cordified that this is Invoice of applying to Embyroject No. 99 of HUMENA, that performance is satisfactory, that services are being accomplished in accordance with mutual agreements, that a detailed agenda of the payments and receipts is on file in TEM/CO, that this bill is just and correct and that payment thereof has not yet been made.

Chief, Tus/Chesical Division

Dates

(a) It to bereby cortified that this invoice applies to Subproject to. 9) of INVIAL which was duly approved, and that the project is being carried out in accordance with the amoration of 13 April 1953 from the DUL to the DUA, and the extension of this authority in subsequent recordate.

Research Director

Dute:



99-2

11 February 1960

MERCHANICAL POR CHIEF, FINNESS DIVISION

VIA

1 100/Endsot Officer

SUMMEDI'

. marka, Samojeat 99, Invoice 10. 1 Allateunt Ossy-1009-1502

1. Tovoice Fo. 1 is obtached covering the chows subproject. Other invoices will follow. Populate chould be made as follows:

Cashiorta circle in the mediat of \$1,250.00 drown on a

2. Please formed the check to Chief. Tal/Checkent Division through The/Bedget Officer by Thursday, 25 Tebruary 1950.

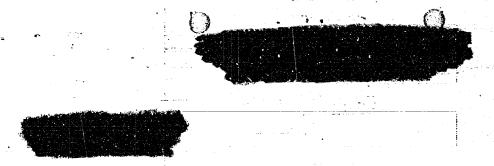
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1 - TSS/CD

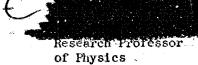


99-2

January 23, 1960

For services rendered:

\$1250.00



I have emamined and approved the submitted expenditures.

A cirter

TSS/Chemical Division

Dater

2000000



MEMORANDUM FOR: The Record

SUBJECT : Project MKULTRA, Subproject 99

- 1. The purpose of Subproject 99 is to provide for payment to

  By

  Commerically available) in which the desired measurements can be made,

  and the measurement of various physical properties.
- 2. The facilities available for this work have been inspected and they are considered adequate for the proposed work. Dr. has been given security approval and has been briefed on applicable security considerations.
- 3. The estimated cost is \$5,000 for a period of one year. Charges should be made against allotment 0525-1009-4902.
- 4. No permanent equipment will be acquired. Payment will be made from time to time on the basis of statements submitted by Dr. and will involve professional services only.

APPROVED FOR OBLIGATION OF FUNDS:

Research Director

Date 73

Distribution: Orig only.

199-11

TSS/Chemical Division



23 August 1959

MINORARDUM FOR:

THE COMPTROLLER

ATTAINTION .....

Finance Division

SUMFOT

IKULERA, Subproject 99

Under the authority granted in the Memorandum dated

13 April 1953 from the DCI to the DD/A, and the extension

of this authority in subsequent memoranda, Subproject 99 has

been approved, and \$5,000 of the over-all Project MEULTAA funds

have been obligated to cover this subproject's expenses and

should be charged to Allotsent 0525-1009-4902.

Chief Tes/Cherdeal Division

APPROVED FOR OBLIGATION OF PUROS:

Research Director

Date

Distribution:

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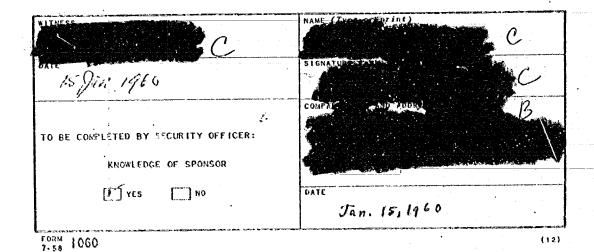
2- TSS/CD

TSS/CD/AB



SECRECY AGREEMENT

- 1. I acknowledge the fact that because of the particular fiduciary relationship between myself and the U. S. Government, I will be the recipient of information which, in itself or by the implications to be drawn therefrom, will be such that its unlawful disclosure or loose handling may adversely affect the interest, and possibly the security, of the United States. I realize that the methods of collecting, of handling, and of using this information, as well as the identity of persons involved, are often as sensitive as the substantive information itself and, therefore, must be treated by me with an equal degree of security and confidence.
- 2. I will always recognize the paramount interests of the U. S. Government in information which I or my organization may possess, compile, or acquire as a result of requests placed upon me by Government representatives pursuant to this understanding. No advantage nor gain will be sought by me as a result of the added significance or value such data may acquire due to the Government's interest in it.
- 3. I solemnly-pledge my word that I will never divulge, publish, nor reveal either by word, conduct, or by any other means such information or knowledge, as indicated above, unless specifically authorized in writing, in each case, by the U. S. Government.
- 4. Nothing in this agreement is to be taken as imposing any restriction upon the normal business practices of myself or the organization with which I am affiliated. It is understood that information normally processed by us or gathered in the regular course of business will continue to be utilized in accordance with our normal practices.
- 5. I understand that no change in my relationship with the U. S. Government will relieve me of my obligation under this oath and that the provisions of this oath will remain binding upon me even after the termination of my relationship with the United States Government.
- 6. I am aware that unauthorized disclosure of any information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, USC, Secs. 793, 794, and 798, or the transmission or revelation of such information in any manner to an unauthorized person is prohibited by law.



January 11, 1966

Dear Dr.

As a follow-up to our conversation I am attaching an outline of a proposed research project designed (a) to elucidate the physiological mechanism(s) underlying the electrodermal response, and (b) based on such information to determine procedure for maximizing the information content of recordings from this system.

Since this represents only an informal proposal, I have attached only an approximate schedule of costs. I would expect these costs, including overhead, to amount to between for one year. The project would be handled administratively through the Business Office

Approved for Rolansa

Date 27

(148)

Page II
January 11, 1965

Any official correspondence in connection with possible negotiation of a grant or contract may be addressed to

If you require clarification or modification of various aspects of this proposal, please feel free to contact me further.

Sincerely yours,

### Informal Proposal

# PHYSIOLOGICAL MECHANISMS UNDERLYING THE ELECTRODERMAL RESPONSE

Physiological Mechanisms Underlying the Electrodermal Response

#### INTRODUCTION

The manifold uses to which electrodermal measurement has been applied testify to the respect held by a large number of investigators for its potential information content.

Various measures of this exquisitely sensitive system have, in fact, been used for several decades, hopefully, as indices of "emotional" activity.

On the other hand the highly controversial state of this area, and the distrust with which it is viewed by an equal number of competent investigators, are indications of major lacunae existing in this field of knowledge. In recent years several lines of evidence have to an extent revealed the explanation for this lack of agreement; namely that the electrodermal response amplitude and base level are multi-determined by a combination of relatively independent systems which combine in varying proportions according to the nature of the behavior taking place. Among systems experimentally implicated in this response are the sweat gland secretory tubule, the sweat gland duct, an epidermal barrier layer, the corneum and cutaneous blood vessels. Within these systems there are controversies over the nature of the physiological change giving rise to the electrical change. There is, furthermore, much argument over the relation between conductance measures and passive potential measures. Are these in fact independent as recently evidenced or are they different manifestation of a common process as claimed by a group of equally responsible investigators? If they are independent,

how do they interact? Is it possible that the skin potential response is in part of vascular origin?

Besides the limitation on our capability for meaningful, quantitative conversion of electrodermal data presented by this inadequate knowledge, it also prevents valid interpretation on a psychological basis. If our inferences regarding higher level nervous (and emotional) activity of an individual are drawn from observation of his adaptive behavior, we must obviously be able to recognize the type of adaptation he is using. Cutaneous activity may biologically represent a preparation for aggressive muscular action, defense or flight or for information intake. The recent demonstration that the GSR is augmented on the side of the body involved in a muscular maneuver (33) lends further weight to its interpretation as adaptive behavior. The likely mechanisms involved in the various responses are vasomotor activity, thermal sweating, mechanical (moisturizing) sweating, water conservation (reabsorption) or sensitization of peripheral receptors. Recognition of the particular systems activated should enable qualitative identification of the gross behavior.

### STATEMENT OF THE PROBLEM

In using electrodermal activity as an indicator of central nervous system response to external stimuli, one would hope that its output can be in some manner calibrated in terms of quality as well as intensity of neural activity for use in qualitative as well as quantitative evaluation of central state. Distortions or lack

of reliability in this indicator can arise as a consequence of unacceptable technique or error in "neural calibration", that is in failure to recognize the considerations to be used in transforming from changes in conductance or potential to changes in central outflow. While our understanding of the principles of technique of measurement has already advanced to a point at which it need no longer constitute a major source of error, the same can not be said for our knowledge of the underlying physiological system or systems. Insofar as each primary suspected component (i.e. sweat gland, epidermis or vasculature) implies a different type of adaptive behavior, and insofar as they may interact in such a way as to present spurious information regarding the behavior of the individual, it is proposed that efforts shall be devoted to elucidation of the responsible systems and the means of separation. Particular attention will be paid to the potential measure which, because of its partially combined positive and negative components with their apparent stimulus response enecificity, hase a higher information than the conductance responses which are always unidirectional. In general the project will be directed toward calibration of electrodermal activity in terms of specific types and intensities of neural activity by elucidation of the various underlying mechanisms and their quantitative interrelations.

In the following discussion the entire group of reflex responses, whether they be change of resistance or conductance or a positive, negative or biphasic change in potential, will be collectively referred to as electrodermal activity.

The galvanic skin response or skin conductance response will be abbreviated SCR and skin potential response, SPR.

#### EXPERIMENTAL BACKGROUND

#### Areas of Agreement

There are several areas in which experimental evidence is currently in general agreement. Only key references are cited for each. (Many other aspects which have been experimentally demonstrated but not yet generally accepted are omitted). Areas of agreement are as follows:

- That the electrodermal reflex depends on a sympathetic nervous supply (1).
- 2. That it is cholinergic, being completely blocked by the iontophoretic introduction of atropine (2).
- 3. That the sweat gland is functionally involved, at least in part, in this reflex (3).
- 4. That there is not a simple relation between sweat production and resistance change (4).
- 5. That amplitude of the resistance response falls off with increasing frequency of the excitation current (5).
- 6. That the resistance response can be potentiated or attenuated by various mild agents to which the skin surface is exposed (6).
- 7. That skin resistance is an apparent resistance, which in large part derives from a polarization potential (7).

origin of these effects. have been able to abolish SPR but not GSR by exsanguination.

- 2. The sweat gland has long been considered as the source of electrodermal activity. Yet the nail bed noted above contains no sweat glands but produces potential responses very similar in form and occurrence to those from nearby skin. Furthermore, the output of sweat (vapor) from the skin has been shown under many circumstances to bear little relation to the level of electrodermal activity (4). It has also been possible using microelectrodes to obtain GSR's from slabs of epidermis which have been surgically and electrically isolated from adjacent sweat glands (18).
- 3. Both the positive and negative components of the SPR are abolished by atropine or hyoscyamine and are considered by many to be components of a single process (19). However, the positive component is more sensitive to ischemia (9). In the cat, found only negative responses from the sweat glands, positive only from nearby epidermis. Moreover, reflex absorption of water through the skin (probably epidermal) is associated with the positive wave of the SPR (21). There is evidence for a stimulus response specificity in the positive and negative waves in that positive responses are associated with alert goal-oriented behavior (22). The negative wave appears to be relatively non-specific. The positive and negative waves also respond differentially to temperature change (23).
- 4. The skin conductance response has been generally assumed to be a single entity (12), but much evidence supports the view that it depends on two

different components (24). While the evidence for two components under separate control is strong, the case for the epidermis as one of these is presently on shaky grounds, especially as a result of the findings on the nail bed. The most likely alternative is another type of sweat gland, presumably thermal, since the palmar and plantar sweat glands are primarily non-thermal (25).

5. The almost abandoned notion that the SCR is produced by the increased conductivity of the corneum as it becomes permeated by a conducting electrolytes (sweat) has been revived by on excellent experimental grounds. Postulation of a water barrier within the corneum allows retention of this hypothesis in the face of the observation that SCR's occur even in skin soaking in NaCl. has argued that the inability of his model to explain many of the membrane-like properties of the skin is easily circumvented by assuming that the corneum itself may have membrane-like properties which change with hydration or electrolyte content (27).

#### Alternative Models

Several models of the electrodermal effector system are suggested by the experimental data and each of these will be used as a test vehicle for interpretation of experimental results in the proposed study. The consistancy of experimental results with each of these models will be considered in an effort to arrive at the most probable system.

The actual system may be, and likely is, a composite of two or more functional systems which may be listed for convenience as follows:

### A. The Sweat Gland

- 1. The sweat gland body may undergo permeability changes which account for conductance or potential changes.
- 2. The sweat gland duct may undergo permeability changes which account for conductance change or potential change of the same or different nature as in (1).
- 3. The sweat gland duct may fill partially or completely and thereby create a channel of high conductivity. This in itself would normally cause only a conductance change, but in reducing the internal resistance of the sweat gland "generator", would result in a great contribution of sweat gland potential to total skin potential.
- 4. There is likely an active reabsorption process occurring in the sweat duct and this may be associated with characteristic potential waves.
- 5. Sweat gland secretion may function in moisturizing the corneum to protect it against abrasion during anticipated activity. It may alternatively function in thermoregulation in anticipation of a heat load. The level of this latter function would in all likelihood depend on the general state of thermostasis.

#### B. The Corneum

The corneum may act as a series resistor whose value is altered by degree of hydration occasioned by sweat glands and possibly epidermal transpiration.

### C. The Epidermis

1. The epidermis may behave as a capacitor of essentially unchanging structure in parallel with the sweat gland. Leakage of this capacitor may be

insignificant or it could account for a conductance even exceeding that of the sweat glands.

- 2. It may behave as a barrier whose permeability is altered relatively slowly by humoral mechanisms.
- 3. It may behave as a barrier whose permeability is reflexly altered.

  This alteration may
  - a) function in insensible perspiration
  - b) function in reabsorption of water secreted by the sweat glands
  - c) be a by-product of the release of a chemical mediator by nerve endings whose function is to sensitize tactile receptors (28).
- 4. It may behave as a <u>double-layered</u> barrier, the outer layer contributing to the base potential and base conductance but static in nature, the inner one also contributing but subject to reflexly induced changes in permeability and therefore responsible in part for the GSR and SPR (23).

#### D. Blood Vessels

- 1. Alteration in blood volume is known to contribute to conductivity changes, though normally to an insignificant degree. In some cases, namely when electrodermal activity is of low level and the tissue is highly vascular, this could represent a significant relative effect.
- 2. Smooth muscle activity, either arterial, arteriolar or venous constitute another source of potential. Inhibition could give rise to a different potential than contraction.

#### EXPERIMENTAL APPROACH

Attention will be given to possible resolution in the foregoing areas of controversy or uncertainty. Five primary questions may be used as the basis for formulation of research efforts:

- 1. Does the skin conductance response depend upon activity in the sweat gland alone, or does it (in addition) depend upon activity in an epidermal layer or in blood vessels.
- 2. Do the positive and negative components of the skin <u>potential</u> response depend upon activity in separate areas, e.g. sweat gland and epidermis (or blood vessel) or do they simply represent two phases of a process in a single effector organ?
- 3. Which component, epidermal or vascular most likely accounts for the skin potential responses observed in a sweat gland-free area such as the nail-bed?
- 4. What is the biological (psychological) significance of each component?

  Are they qualitatively different? Do they vary in sensitivity?
- 5. How do separate elements in the skin combine to account for a given conductance level or a given potential? To what extent are elements in parallel and in series, and to what extent does the internal resistance of one component influence the manifestation of activity in another? What is the most rational approach to the correction of observed response amplitude for differences in base level? Method

Each of the above postulated mechanisms represents a target for experimental evaluation as to its actual role in the electrodermal reflex. As

the tenability of each of these is experimentally indicated, attention will be given to the relative magnitude of contribution both to base level and response amplitude, and to the manner in which its contribution interacts with contribution of the other components. In each case skin conductance, skin potential, SCR and SPR will be simultaneously observed for quantitative test of interaction effects as well as consistancy with each proposed model. Specific experiments designed to aid in the answer to each primary question are outlined below.

- Is the sweat gland alone involved in the skin conductance response?
- a) Microelectrode experiments based on the isolated epidermal slab technique (18) will be continued in an effort to establish whether the observed SCR activity is real or is an artifact of sweat gland activity. This will primarily involve close examination of phase and wave-form relations of simultaneous recordings from the slab and nearby sweat glands.
- b) All sweat glands in a micro field will be selectively inactivated by the iontophoretic introduction of silver ion (method already established by principal investigator) and observations made of recordings from this area and from nearby intact areas.
- c) Efforts will be made to selectively reduce pick-up from nonsweat gland areas by infiltration of the upper layers of the corneum with paraffin.

  Preliminary experiments reveal that sweat glands continue to secrete after this
  procedure. The effect of this treatment on conductance and on conductance response
  will be examined.

- d) The average sweat gland (microelectrode) response amplitude and resistance level from a 0.3 cm² field will be compared with that from a simultaneously recorded macroscopic site by a sampling technique. Total sweat gland count will also be made in this delineated area. A gross electrode will then be applied to this field and the magnitude of response and resistance level compared with that calculated from the individual data. Discrepancies will be examined for indications of non-sweat activity.
- e) Experimental milária will be used to block sweat glands selectively. This method, involves stimulation of keratin formation at the sweat pore by use of high currents. Affected areas will be compared with adjacent sweating areas.
- f) Atropine has been shown to block all SCR activity but the effect is inconclusive for resolution of the present question since other effectors may also be cholinergic. Pilocarpine induces profuse sweating and may be considered to raise sweat gland output to a maximal level. Therefore any alteration in skin resistance after iontophoretic introduction of pilocarpine (30), may be considered as probably non-sudomotor. However, the complete abolition of electrodermal response would be somewhat inconclusive for the same reasons as stated for atropine.
- g) The sweat gland may be having an indirect but important effect on SCR amplitude by virtue of the induced change in corneal hydration as postulated

If he is correct, one should expect SCR amplitude to be just as large with a constant current system as with a constant voltage system even with a relatively "dry" electrolyte such as 0.1 NaCl in 90 per cent glycerol. If change in hydration is relatively minor the constant voltage system will result in diminished amplitude, owing to a significant loss of the "constant" voltage across the non-varying corneal resistor.

- 2. Do the positive and negative components of the SPR originate in separate sites? Because of unavoidable electrical leaks one can always expect contamination of signals in one area by those in the adjacent area. Results of microelectrode surveys will therefore be suggestive rather than definitive. Moreover, the positive and negative components, though slightly out of phase, are to a great extent fused and subject to partial cancellation. In fact a positive wave may occur without the combined wave ever going positive (31). Resolution of the two components is understandably difficult.
  - a) Experiments on epidermal slabs (microelectrode) previously confined to conductance measurements will be extended to potential measurements.

    Wave forms from the two areas will be examined for predominance of either polarity.
  - b) The effect of Ag inactivation of the sweat gland on microelectrode wave forms of response from various areas will be determined.
  - c) The application of an external load (shunt) will be used to determine whether the internal resistance of the positive and negative generators are different.

If the two waves are differentially attenuated when a low resistance shunt is used, this would be evidence for different internal resistances of these two components and therefore for different sites. It would be important to rule out temporal changes in the impedance of a single generator, as an alternative explanation. This would be done by comparing the magnitude of any difference in the internal resistance with the maximum variation in total resistance observed during the response. This latter can be determined by a simultaneous writeout of resistance using a 5 my, low frequency AC source (32).

- d) The report by that high current density differentially affects the positive and negative components of the SPR will be followed up by a microelectrode study. High currents will be applied selectively to sweat glands and non-sweat gland areas to determine whether the waves from these are differentially affected by this treatment.
- 3. Are the potential responses observed from the nail bed epidermal or vascular in origin?
- a) The nail will be exposed to electrolytes such as 1 M CaCl₂, known to have a marked effect on SPR amplitude on the skin. It is very unlikely that this agent is exerting any effect on blood vessels.
- b) Vascular changes of short duration will be imposed by the use of venous and arterial cuffs and the effect on SPR will be noted. Naturally occurring vascular response in the nail bed, monitored by the reflectance plethysmograph, will be compared with the simultaneously monitored SPR. The same will be done on conventional skin sites.

- c) The pharmacologic experiments by which discounted the role of vascular responses in the SCR will be extended to SPR measurements.
- d) The nail bed will be punctured to determine whether SPRs are still observable under the epidermis.
  - 4. What is the biological significance of each component found?
- a) Does the sweat gland secretion represent anticipation of a thermal load or does it serve primarily for moisturizing the skin or are both functions involved? The guiding hypothesis in this case is that both types of sweat glands function separately and according to the demands of the anticipated act. It is further hypothesized that in a well integrated organism, thermal sweating should be associated with cutaneous vasodilatation. Special attention will therefore be given to areas or to instances in which the electrodermal response is associated with dilatation as opposed to the vasoconstriction more commonly occurring. SPRs and SCRs respectively associated with these will be examined for characteristic differences. The effect of ambient thermal conditions on each will be examined.
- b) Is the positive wave of the SPR causally related to epidermal absorption or transpiration of water as previously indicated (21)? Clarification of this relationship will be obtained by observing the concomitant effects of ischemia on the positive SPR and reabsorption activity; similarly for the effects of high current density.

- c) What is the relationship of activity of specific electrodermal components to tactile sensitization? In a previous study (28) although there was a significant relation between skin conductance response and change in tactile threshold, there were many SCRs not associated with a tactile change. If there is, in fact, a peripheral sensitizing mechanism as previously postulated, it is possible that the threshold change is associated with one of the two components of the SPR. Tactile thresholds will be determined in conjunction with skin potential recordings. The separation of positive and negative potentials will be aided by the use of a newly developed electronic analyzer.
- 5. What are the principles of summation and interaction between component mechanisms and what rationale is indicated for correction of response amplitude for base-line differences?
- a) The approach to this will depend on future methods developed to obtain separate measurement of the activity of each component. Such measurements will be applied to test the validity of various physiological and circuit models of the integrated system. Among these methods, may be:
- Measurement of SPR from the finger nail and from nearby skin. The differential factor here would be sweat gland activity.
- 2) Selective block of sweat glands by Ag⁺ or experimental miliaria.
- 3) Microelectrode sampling of an entire skin field (sweat gland and non-sweat gland areas).

- 4) Simultaneous measurement of SCR and SPR from two equal areas having a different sweat gland count.
- 5) Measurement of vapor under standard conditions when the sweat glands are nonfunctioning, and when they are secreting.

  Simultaneous observation of SPR and SCR would be made.
- b) The combined analysis of SCR and SPR data with the use of external shunts to determine the respective generator impedances will be used in an effort to build a unified model.
- c) The predicted peripheral relation of response amplitude to base level under a variety of conditions will be tested. Relation to central level of activation is a separate matter. Frequently central activation is the variable sought for the indicator being base-line-corrected reflection of neural outflow. With this philosophy, it becomes clear that central variation must be avoided in this phase. Two methods are suggested:
- nerve of the cat. This investigator has already done exploratory experiments in which base level conductance of the foot pad was brought to a high level by repetitive neural stimulation, followed by standard stimuli at 30 second intervals as the base conductance gradually fell (recovered) over a thirty minute period. These experiments will be continued.
- 2) Because human skin probably does not behave exactly as the cat foot pad, similar experiments will be performed on human paraplegic

patients, using a standard electrical stimulus to the foot and recording from the opposite foot. This spinal reflex system has many of the properties described in (1).

and a standard of this nature is the use of a nerve block on the hand in the region of the ulnar nerve, with a standard electrical stimulus applied to the nerve distal to this block, using surface electrodes. Electrodermal responses will be measured from the tip of the fifth finger.

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#### Period of Work

This proposal would cover one year of effort. It is apparent that this is an inadequate period to accomplish all of the experiments described but it would be sufficient to complete over half of them. It would be hoped that continuation of support could be negotiated if appropriate, for a second year of effort.

#### Amount of Support

An approximate estimate of costs is itemized below. A fixed fee grant or contract would be most desirable but a cost-reimbursement contract on a non-profit basis would be acceptable.

#### Facilities

Among equipment on hand is a complete microelectrode set-up, a high-gain 6 channel, D. C. polygraph, free, however, only part-time, a neurophysiological set-up for nerve stimulation and recording, animal surgical equipment and diverse pieces of accessory and test equipment such as oscilloscopes, oscillators, etc. Animal sources are available

## Costs

Principal Investigator (part-time)

including FICA

Research Assistant (full-time)

Subjects

Animals

Stenographic Services

Reproduction

Expendables (Paper, Chemicals, Electronic Supplies)

Sub-total

Overhead at 20%

Total

April 26, 1966

Dear Dr.

The program to evaluate various electrical combinations for their potential for producing anesthesia has been designed and is enclosed. An effort has been made to include as many of the parameters we previously discussed and work out the details as soon as possible. After your review of the program, deletions or additions can be made if necessary.

This study does not go into the specific details of the basic principles as much as I would like to investigate at some time. I think it best to look at that phase of study after we complete this study and know the current combination that gives the best results. I would anticipate doing some microelectrode work for more specific information on the amount of current in specific brain areas at a later date.

I will complete my training program at | This will work very well with you July 1 - June 30 fiscal year. I had anticipated being committed until September 1, but have been able to arrange to start on this program July 1st instead.

One part of the budget was somewhat uncertain. This is in regard to the institutional overhead. After checking with the people at I find that the overhead charges are 20% on N. I. H. or N. S. F. type grants or 40% of salaries on other types. Since you mentioned a number of groups in Washington were interested in the program, I have assumed that all involved fit into the same bracket.

April 26, 1966

Our plans are to devote full time to this program. The only exception to this for which I would like approval is to spend 9-12 days per year to provide the necessary surgical and anesthetic procedures for the kidney transplant program at the

Electroanesthesia is used in these procedures on twin calves and the very valuable data on electroanesthesia in twins of known compatibility would be included in the reports. No grant funds from the program would be used in the kidney program.

In discussing the anesthesia program with Dr. | it was of considerable interest to note the suggested possibility of human application after completion of the animal program. I felt you would like to know of this in the event it is desirable to co-ordinate a human experimental program at a later date.

Let me know if I need to make any changes in the program enclosed. I am looking forward to getting started on our program and see if we can't find out what the potential of electroanesthesia really is.

Thank you for your continued interest.

Yours truly,

Enclosure

In the final front office approval for which we expect no problem. Also the and his secretary have security clearance so this will be no problem. Part of the items in this letter were discussed by plane after I have from you we will make

#### PROJECT PROPOSAL

Title: "Effects of Combinations of Waveforms and Frequencies of Electrical Currents Applied to the Head to Produce Anesthesia"

Investigator:

Department and Location:

Director:

Objectives and Procedures:

- I. Determination of the most effective combinations of electrical current producing anesthesia
  - A. Combinations of sine, saw tooth, square, triangle, white noise, pulse D.C. and D.C. signals will be employed in combinations to achieve this objective. Both two and three wave combinations will be employed with variable frequencies. Based on the published experience of others and my own personal experience, it is not anticipated that anesthesia will be produced by all currents. Some will produce convulsions, tonic muscle spasms, and/or respiratorycardiac distress without anesthesia. From published data, these complications have been more evident with certain waveforms and current combinations than with others. This study proposes to determine in a systematic fashion which wave-forms and frequency combinations produce acceptable anesthesia with minimal undesirable side effects. The equipment has been designed to permit investigation of over two hundred combinations of waveforms and frequencies which will be rated according to desirable and undesirable characteristics produced.
  - B. Combination waves will be applied to the head by two techniques:
    - Summation of the current before it enters the head.
       (Two electrodes-American technique)
    - 2. Summation of the current in the head. (Four and six electrode combinations with separate leads to the generators producing the combination-Russian technique).

Combinations of waveforms and frequencies which are obviously not satisfactory due to severe respiratory or circulatory distress, convulsions, cardiac difficulties or other unforeseen problems will be recorded as such, and will not be evaluated more extensively.

Combinations which show promise for anesthesia will be evaluated further as outlined in objective II.

## II. The effect of anesthetic currents on respiration, circulation and depth of anesthesia

When a combination of electrical currents appears to have potential as an anesthetic agent. the following procedures will be followed. Preanesthetic measurement of all pertinent parameters will be made (see typical experiment below). The cardiac and respiratory alterations will be monitored during and after induction. If successful, a surgical procedure will be carried out to evaluate the effectiveness of the combination of current to produce anesthesia and muscle relaxation. Since it is possible with electrical current to produce satisfactory anesthesia in portions of the body while inadequate in others, six locations will be considered for surgical procedures (simple cut down). These are head, neck, limbs, bones or skin, thoracic, urogenital, superficial abdominal, and deep abdominal. Monitoring will continue during surgical procedures. After operation, current will be shut off and the recovery behavior noted. Blood samples will be drawn before, during and after anesthesia and the recovery pattern of cardiac and respiratory changes will be followed for 24 hours. Blood pressure measurement will be made by direct cannulation of the femoral artery and this will permit monitoring of heart rate as well. Respiration will be measured by pneumograph and Lead II of the electrocardiogram will be monitored before and after application of the current.

Dogs will not receive muscle relaxants nor oxygen nor will they be intubated. These will be deliberately avoided so that muscle activity and respiratory depression may be observed, when they occur. This also allows a full response to pain during surgery if there is insufficient anesthesia.

## III. Determination of the total amperage of each combination and correlation with effectiveness in producing anesthesia

This will be done to determine the combination requiring minimal current for anesthesia. The current and voltage will be measured with a milliammeter and a true r.m.s. voltmeter. The waveforms will be monitored with an oscilliscope and the waveform combinations will be photographed from the scope to record them accurately. Measurement equipment will be attached to the anesthesia generator output.

## IV. Determination of the "shape" of the electrical field produced by the Current combination

This will be determined by connecting the recording equipment to implanted macroelectrodes and is designed to indicate the distribution of the current within the brain and its intensity. For this study, six chronic electrodes will be placed in selected locations within the brain. Dogs will then be subjected to currents of waveform and frequency combinations known to produce anesthesia. Recordings will be made using the same equipment required in Section III.

These dogs will be used only to measure the shape of the electrical field. Since these dogs can be used repeatedly, we plan to keep five dogs with chronically implanted electrodes at all times. The use of these same animals for several combinations of currents will reduce the error in measurement between animals.

These dogs will be prepared early during the period required to obtain the necessary equipment and personnel to initiate the other aspects of the project. Metallic-nylon electrodes will be implanted through small trephines in the skull during general anesthesia. The micromanipulator will be used for positioning electrodes with neurosurgical assistance.

## V. Typical Experiment: Planned technique for evaluation of each combination

- A. Waveform combination and frequency will be selected and equipment adjusted for operation.
- B. The following measurements will be made on normal animals:
  - 1. Heart rate and ECG.
  - 2. Respiratory rate.
  - 3. Rectal temper ature.
  - 4. Arterial blood gases (pCO2, pO2) and pH.
  - 5. Notation of general physical condition, activity and alertness.
- C. Animal will then be prepared for application of current.
  - 1. Preparation of electrode sites (Bitemporal or frontal-occipital).
  - 2. Cannulation of femoral artery with local anesthesia.
  - 3. Placement of electrodes (electrode will be needle or plate depending on D.C. or A.C. operation).

- D. Connect leads and apply current.
  - Record response (muscle movements, struggling, excitement, salivation, etc.).
  - 2. Monitor blood pressure, cardiac rate and respiratory rate.
  - 3. Sample arterial blood for PCO2, PO2, pH when induction is completed or abandoned.
- E. Determine depth of anesthesia by tail clamping, corneal reflexes, swallowing reflexes. If no anesthesia, abandon.
- F. If anesthesia present, proceed to cut downs at various sites.

  Monitoring will continue throughout operation. Responses to incision in various areas and manipulation will be noted.
- G. Response to removal of current from the head will be recorded and all parameters remeasured.
- H. Twelve and 24-hour post-operative observations will be made.
- L Determination of the current and voltage levels will be made after induction, during operation, and just prior to termination of current application.
- If satisfactory anesthesia obtained, shape of electrical field will be determined in dogs with chronically implanted electrodes.

The number of combinations of currents and waveforms to be evaluated and the need for numbers of animals sufficient for proper statistical analysis make it necessary to use a large number of dogs. Each dog will be used as extensively as possible and yet yield accurate results. It is anticipated that some losses by death will occur, especially since many current combinations have never before been attempted. When possible, dogs will be reused as often as practical. To obtain a definitive answer for each current we believe 4 dogs must be studied before abandoning the combination. Combinations which give promise of satisfactory anesthesia will be studied more extensively whenever indicated.

Responses noted during the entire procedure will be recorded in terms of depth of anesthesia and duration of current application.

The investigator and technicians will spend full time on the project and will have no other activities. A two-year period is considered the minimal time to complete the program. It is anticipated that two months will be required to assemble the equipment and personnel necessary for full scale operation.

# Illustration of the Method of Determining Waveform Combinations

#### Waveforms

Α.	Sine	E. Rando	m or	White	Noise
		r. D.C.			
	Square	G. D.C.	pulse	2	
C.	Triangle .	Q. D. V.	P		
D.	Saw Tooth				

# Combinations

A+A A+B	B+B B+C	C+C C+D	D+D D+E	E+E E+F E+G	F+F F+G	G+G
A+C A+D A+E	B+D B+E B+F	C+E C+F C+G	D+F D+G	E+G		
A+F A+G	₿÷G					

Combinations will be summated before and after entering head. Frequencies will also be varied. The same system will be used for determining triple waveform combinations.

## BUDGET

#### PERSONNEL SALARIES

	InvestigatorFull Time		
		chnicians (2)	
	1.	Assisting with animal procedures	
	_	Anesthesia and Surgery	
	2.	Laboratory Analysis	
	_	(Blood gases, etc.)	
	Sec	retary - part time (50%)	
		Total	\$
ANI	MAL.	<u>s</u>	
	500	dogs @ leach	\$
		ard - 5 dogs for 365 days @ .60/day	•
		500 dogs for average of 3.5 days @ .60/day	
		Total	Š
			•
EQU	IPM	ENT	
	Cor	nponents for Anesthesia Apparatus:	
	(1)	Harrison Lab. Model 865 C for D.C.	\$
	(2)	Universal Dynamics Electro-Thesis D.C.	
		pulse generator	
		Hewlett-Packard Model #3380B Sine Wave	•
	(4)	Hewlett-Packard Model 3300A/3304	
		Function generator for triangle & sawtooth	
	(5)	General Radio Model 1390-B - (a component	
		for random noise)	
	(6)	Krohn-Hite Model 310-C - Tuneable filter for	
		producing ranges of random noise	
	(7)	Interconnecting cables, leads from generators	
		to animals, connected hardware, etc.	
•		Sub Total	\$
	Rec	ording Components:	٠
	(1)	Oscilliscope - To monitor waveforms and observe	
		electrical field in head. Hewlett-Packard Model	
٠		141 A with Differential Amplifier (1403A), Time	
		base 1420 A or equivalent	\$
	(2)	Oscilliscope Camera for recording waveforms	
		for records	

(3	Milliameter - To measure the current applied to head and also in brain	\$	
(4		•	
*	true electrical power applied to the head.		
(5)	Connections, shipping	_	
	Sub Total	\$	
M	cromanipulator for positioning electrodes	\$	
E1	Electrodes  Blood Gas Analysis Equipment		
	ood Gas Analysis Equipment:		
(1)	Instrumentation Labs. Micro Analysis System recommended	\$	
(2)	Gases for Analysis Equipment	•	
Surgical Supply Charges:			
	(Includes instruments, drapes, suture, related	_	
	surgical supplies.) Charges are \$ \sqrt{set per}	•	
	day. It is planned to complete series procedures on days of surgery for more efficiency and economy.		
	We are capable of performing 12-14 surgical pro-		
	redures for the purpose of evaluation of anesthetic		
	levels in the various regions of the body/day.		
	Surgery is planned for 170 days.	\$	
	Total	\$	
MISCEL	LANEOUS		
Ph	otography	\$	
	avel		
Tu	bing, catheters, drugs	•	
•	Total	\$	
INSTITU	TIONAL OVERHEAD		
40	% of Salaries	<u>\$</u>	
·-,	. Grand Total - 1st Year	\$	

#### BUDGET - 2nd Year

# PERSONNEL SALARIES Investigator **\$** . Technicians 1. Secretarial Service - 50% of Time Total **ANIMALS** 600 dogs @ Board -Total EQUIPMENT Replacements, extra components for anesthesia equipment Electrodes Blood gas equipment, electrodes and gases Surgical Supply Charges Total MISCELLANEOUS Photography Travel Drugs, tubing, small equipment Total INSTITUTIONAL OVERHEAD 40% of Salaries

Grand Total - 2nd Year

#### INTRODUCTION

A wide range of electrical waveforms have been used on many species of animals and on man since Le Duc 1 made his attempts to produce electro-anesthesia in 1902. The most common types of current used were either direct current with DC pulses, square, triangle, sawtooth, or sine waveforms, or combinations of these. White noise was also introduced in attempts to produce better anesthesia. The principal responses detected by a number of investigators during the past few years are included. Examples of both desirable and undesirable reactions observed are included.

Fabian² and Hardy⁷⁻⁹ did extensive animal studies and then attempted human applications. They used 700 cycle per second sine wave and characteristically produced strong tonic muscle contractions. The most conspicuous cardiovascular reaction was hypertension and tachycardia. This was associated with a rise in plasma catechol amine levels. Prolonged electro-anesthesia had little effect on the blood oxygen if the animal was well ventilated. A hyperglycemic response was recorded in animals subjected to electro-anesthesia.

Geddes³, ⁴ reported on results in dogs and horses. Direct current with DC pulses was used and hypertension and poor muscle relaxation were characteristics. He observed cardiac and respiratory arrest in all cases. This was temporary in most cases if the current levels were properly adjusted. However, in his report on applications in horses, there was a 14 per cent mortality rate due to permanent respiratory arrest. Salivation and hyperthermia were also observed as undesirable side effects in dogs.

Gowing^{5, 6} reported no abnormalities in the electrocardiogram during electro-anesthesia by DC-square wave current in dogs.

Herin¹⁰ evaluated the responses and current requirements in dogs using sine, square and triangle waveforms. He concluded that sine wave applications gave the least amount of unwanted side effects. The hypertension during induction subsided as anesthesia progressed. Hematologic studies before, during and after electro-anesthesia revealed no significant differences in blood clotting time, packed cell volume, sedimentation rate, hemoglobin or differential white blood cell count.

Klemm 11, 12 used square wave currents at frequencies up to 1100 c.p.s.

A relationship between the amount of current required and the frequency of the current was observed in applications to cats.

Knutson 13-16 conducted most of his work with 700-1500 cycle per second sine wave currents in dogs and man. Hyperglycemia occurred during the passage of electrical currents. Knutson found no evidence of brain damage from the current levels used in his experiments, but cites work done by other investigators with higher voltage levels which produced hemorrhages in the brain. At the lower levels of current application, the principal danger of brain cell damage was from inadequate oxygen, due to depression of the respiration by physical interference from muscle contractions. Knutson controlled convulsions by the use of muscle relaxants or by adjustments in the current applied to the head.

Knutson found that serum potassium, calcium, chloride and sodium did not change during three hours of continuous electro-anesthesia. Blood urea nitrogen levels indicated a decrease in kidney function.

By using techniques of modern anesthesia, Knutson was able to eliminate or modify the complications of cyanosis, bradycardia, cardiac irregularities and severe muscle contractions.

Price¹⁷ reported muscle spasms, elevation in blood pressure and tachycardia as the principal disadvantages. His experience indicated that children and elderly patients tolerated electro-anesthesia especially well. The responses to electro-anesthesia could indicate potential use in patients with low blood pressure or bronchial infections, according to Price. The wave form used was sine wave at 700 cycles per second.

Powers 18, 44 reported diverse effects he observed in dogs using 700 c.p.s. since wave current. Current of 100 milliamperes for one-half hour produced increases in the hematocrit unless dogs were splenectomized. A significant increase in the myocardial contractile force was recorded using a Walton-Brodie strain gauge sutured to the right ventricle and recorded on a Model 5c Grass polygraph.

Sances 19-26 used rectangular electrical waves and made studies on conduction over cortical pathways. Evoked potentials were recorded in Macaque monkeys during electro-anesthesia. With electrical stimulation of the sciatic nerve, the evoked response recorded from the medial lemniscus was minimally affected, that recorded from the nucleus ventralis posterior was moderately reduced in amplitude, while the evoked potential recorded from the post central gyrus was abolished.

Smith³²⁻³⁶ used a number of different currents in his research. In dogs subjected to 20 milliamperes of DC and 20-30 milliamperes of square wave AC, there was a temporary but consistent change in amplitude and frequency of the EEG. The post-electro-anesthesia EEG pattern returned to normal within 30 minutes.

Histo-pathology studies revealed no neuronal changes other than agonal swelling, without areas of hemorrhage or necrosis in the eight brains evaluated.

In clinical studies on dogs, respiration was slowed, but the arterial oxygen saturation did not fall below 91 per cent. The pCO₂ levels did not rise above normal. Body temperature rises were detected, but could be reduced if the animal was not intubated and had the tongue exposed to the air.

Turbes 37-39 used a variety of currents and studied the effects on the EEG, reflexes, pain and maintance of electro-anesthesia. Slow induction was found to give a more acceptable physiological state and thus give more reliable results for all parameters evaluated. Fast inductions gave cardio-pulmonary difficulties which were fatal if not treated promptly.

Van Harreveld 40-43 using 60 cycle currents observed respiratory arrest during induction with 300 milliamperes of current. After this initial period, he reduced the current sufficient to restore respiration. No mention was made of the number of animals that had permanent respiratory arrest. Increases in blood pressure were observed. The material published by Van Harreveld indicated respiratory difficulties were present throughout his procedures.

Many of the difficulties reported with the use of electro-anesthesia can be controlled by the application of proper principles, as Knutson indicates.

Cardiac and respiratory difficulties will frequently occur if these are not observed.

The two most important principles of safe anesthesia which should be observed during electro-anesthesia are the maintenance of respiration and circulation. Most of the problems encountered are related to one or both of these systems. Maintaining proper ventilation for appropriate oxygen supply to the cells, adequate elimination of carbon dioxide and normal blood pH is essential. Equally important is the maintenance of a safe blood pressure, sufficient cardiac output, and a proper blood supply to all vital body tissues.

It is important to consider the comfort of the patient and avoid undue stress, injury and discomfort. The anesthesia should be controlled to assure adequate depth for the surgical procedures that are to be performed.

The conscientious anesthesiologist never relinquishes the immediate care of his patient until he is certain that he is no longer needed for the support of the patient's normal physiological state. He is responsible, from the administration of the preanesthetic drugs until the completion of the post-anesthetic care, for the needs of his patient, The investigator in electroanesthesia should be expected to maintain the same degree of responsibility. He must maintain a physiological state that is as near normal as possible throughout the application of the electrical currents for anesthesia.

Proper attention to the principles of anesthesiology in the calf and other animals has made it possible to produce adequate anesthesia for surgery without cardiac and respiratory arrest and related difficulties. Higher frequencies are needed to eliminate these problems and applications need to be made with a slower induction than routinely used by many investigators.

Investigations at Oak Ridge, Tennessee²⁷⁻³¹ proved it was not necessary to use techniques which interfer with the normal function of the animal. These applications of electrical anesthesia were sufficient to produce anesthesia for surgery. Later the same results were accomplished in other environments.

PURPOSE OF THE PROPOSED RESEARCH PROGRAM

Numerous investigators since 1902 have attempted to produce anesthesia with the use of electrical currents. Many types of current and methods of applying them have been tried. Some of these have been moderately successful in producing an anesthetic state. Even with successful applications, however, unwanted side-effects were usually present and resulted from the application of electrical current to the brain as a whole. Indiscriminate application of electrical currents to the head accounted for the severe unwanted actions.

It is not known if electrical currents sufficient to produce anesthesia can be directed to specific areas of the brain through external electrodes. Neither do we know if this would eliminate all unwanted side-effects. There is also a lack of sufficient evidence to distinguish between anesthesia and paralysis produced by electrical currents in animals.

The understanding of the mechanisms by which electro-anesthesia is produced could make it possible for this method of anesthesia to become clinically acceptable. Therefore, the proposed program to determine the information necessary to justify the extension of the use of electrical current for clinical anesthesia is submitted.

## OBJECTIVES OF THE PROPOSED RESEARCH PROGRAM

The objectives of this proposal are to answer three major questions.

- 1. Where does the current go when it is applied to the cranium?
- When is anesthesia present and at what depth?
- 3. What are the undesirable side effects of various currents and can they be eliminated?

# PROPOSED STUDIES TO ACHIEVE OBJECTIVES

- I. Electrical Mechanisms
  - A. Determination of the frequency response curves and the external impedance levels of cranium.
  - B. Determination of the degrees of linearity of these electrical responses.
  - C. Determination of the impedance of the tissues of the brain.
  - D. Determination of tissue voltage levels in the brain.
  - E. Determination of the distribution of total electrical current in the cranium.

- F. Determination of the convolution of dual electrical currents in the brain.
- G. Determination of the role of the cerebral spinal fluid as a conductor of electrical currents.
- H. Determination of the effects of induced brain lesions on the capability to produce electro-anesthesia.
- I. Determination of methods to focus current to specific locations in the brain.

#### II. Biological Responses

- A. Determination of the level of anesthesia.
- B. Determination of the effect of electro-anesthesia on blood gases and blood pH.
- C. Determination of the effect of electro-anesthesia on the circulatory system, including blood glucose levels.

#### METHODS

- I. Animals to be Used
  - A. Calves.
  - B. Primates.

The calf has been selected as the experimental animal in the initial studies. Primates will be used after the evaluations are complete in the calf. For this purpose, the Rheus monkey and the Chimpanzee have been selected.

In vitro studies will be done on cadaver heads of calves, primates and humans in a related sequence to the in vivo studies. والمريب والمراجع 
#### C. Justification of Animal Selection.

The most repeatable results and the most stable level of anesthesia from the use of electrical currents have been achieved during bovine applications. There are specific problems associated with each of the other species as experienced by this investigator in studies on horses, sheep, pigs, dogs, cats, rabbits, rats, goats, and monkeys. The most accurate information on the mechanisms of electroanesthesia can be obtained from animals that respond most favorable to electrical currents. Therefore, the calf was selected as the experimental animal for the first phase of . the program.

Calves are available in adequate numbers and the facilities for handling them are adequate. Calves of a 175-200 pound weight range would be used. Twenty-five calves per year would be needed.

Primates are considered essential to the program, after completion of calf studies, since the anatomical structure of the head and the reactions to electro-anesthesia more closely resembles those of the human. Thus a link between bovine and human applications is formed to more clearly define the mechanisms involved.

#### II. Currents to be Used

- A. Pulsed direct current with variable pulse duration, frequency of pulse and amplitude.
- B. Sinusoidal alternating current with variable frequency and amplitude.
- C. Dual sinusoidal with summation in the generator.
- D. Dual sinusoidal with summation in the head.
- E. Justification of Current Selections.

The review of the literature reveals that hypertension, cardiac and respiratory arrest and strong muscle contractions can occur. The cardiac and respiratory arrest can be permanent if the electrical currents are not properly applied.

I. Sinusoidal currents can be varied to produce a wide range of responses in the animal. These include electro-sleep with high-frequency-low amperage, electro-anesthesia with mid-frequency and amperage, and electro-convulsion with low-frequency-high amperage application. Thus by adjustment of the relationships between current amplitude and frequency, the differences in responses of the electro-biological parameters can be evaluated for the corresponding states of consciousness.

- wave unlike a number of other types, such as square and triangle waves which are composed of a number of sinusoidal waves at various frequencies in the harmonic mechanism. Therefore, less distortion should occur in sinusoidal applications.
- 3. Dual sinusoidal with summation in the generator produces superficial analgesia without sufficient depth in the deep tissues. It has the reverse effect of single sinusoidal, therefore the response of the mechanisms involved are changed.
- technique that opens new approaches to electroanesthesia. As the two currents are brought
  together inside the head, a number of possibilities
  exist which affects the response to current. If the
  phase angles are the same, the currents will combine in a true summation. However, variations in
  the relationship of phase angles of the applied
  currents can cause summation at locations in the
  brain and cancellations of the current in other
  areas. Thus if we can learn how to control this

mechanism to focus the current to specific locations in the brain rather than total brain stimulation, many of the unwanted side effects could possibly be eliminated.

# III. Methods to be used in each Proposed Study

A. General Statement for All Studies:

Statistical consultation will be obtained for aid in the design of experiments and in the evaluation of data generated.

- B. Specific Studies (Electrical)
  - 1. Determination of the frequency response curves and external impedance levels of the cranium. In vitro studies will be made in cadaver calf heads and in vivo studies in calves of same size. The technique to be used consists of:
    - a. Applying electrodes to the head of the calf for current application. Both bitemporal and anterior-posterior types are to be used.
    - Placement of recording electrode by sterotoxic
       adjustment into the tissues of the cranium.

Electrodes can be adjusted for depth and location in the tissues from skin levels to the dura mater. Trephine openings in the skull will be made.

- c. Connect anesthesia-current generator in series with animal head and impedance bridge for input.
- d. Connect output of impedance bridge and recording electrode in head in series to the oscilliscope.
- nated frequencies and amperage and recorded on oscilliscope. The same current is applied through the impedance bridge and it is adjusted to give same output to the scope. The impedance levels on the bridge then correspond to those of the animals head. Thus the total impedance met by the current applied through external electrodes is determined.
- f. By determining the impedance of the head and knowing the current input to the head, the current flow in the brain can be determined.
- g. By adjusting the frequencies and amplitude in an interval method, the response curves can be

determined. Five milliampere and 100 cycles per second or pulses per second intervals will be used at ranges up to 2000 cycles per second.

Above this, 500 cycles per second intervals will be used.

- 2. Determination of the degree of linearity of these electrical responses. This study is closely associated with Study A. It does not require additional measurements, but a mathamatical analysis and graphing of the responses exhibited for frequency and impedance to determine the degree of linearity of the system.
- Determination of the impedance of the tissues of the brain.
  - Rall⁵⁷, Ranch^{58, 59, 60}, and van Harreveld⁶² illustrate the variations in impedance levels in the segments of the brain and changes that take place under changing behavior patterns. Willenkin⁶⁵ found that the impedance levels in the brain stem changed in relation to the level of anesthesia from methoxyflurane. Since the brain and surrounding tissues behave like a series of parallel resistors and capicators, it is reasonable to theorize that the impedance responses will vary in relation to the frequency of current applied to the brain.

- the frequency response curve and external impedance study. The same equipment and procedures are used. The primary difference is in the tissues to be studied. This study evaluates the impedance levels at varying frequencies in the brain tissue. Areas of the brain to be studied are:
  - 1) Cerebral Cortex
  - 2) Thalmus
  - 3) Hypothalmus
  - 4) Brain Stem
  - 5) Cerebellum
- required a maximum depth to the dura for recording electrodes. In this study, the electrodes must be placed in specific locations of the brain. Electrodes will be of minimum size to prevent excess damage to the brain tissue and will have a 1 m.m. uninsulated point for recording. The insulation will be non-metallic to prevent error in results. Metallic coating produces extra capacitance values. The principal investigator has placed acute and chronic electrodes in the brain of large animals. Problems encountered will be solved by consultation with neuroanatomy and neurosurgery staff personnel.

- 4. Determination of tissue voltage levels in the brain.
  - fibers have specific voltage potentials. It is also known that the voltage changes with the state of the cells, i.e. resting, during depolarization or repolarization. 64,65 It is reasonable to predict that the induction of additional voltage of electrical currents into the brain will interfer with the normal voltage potentials of the cells, thus affecting their usual function.
  - b. Method to Complete Study.
    - 1) Equipment
      - a) Electro-anesthesia generators.
      - b) Oscilliscope with differential amplifier.
      - c) Double recording electrodes with 1 m.m. non-insulated tips 1 m.m. apart.
      - d) Electrodes controlled by sterotoxic adjustment.
    - 2) Procedures
      - a) Cadaver heads will be used to perfect techniques and then live calves.
      - b) Electrodes will be worked through trephine openings in the skull.
      - c) Readings will be made in the major segments
        of the brain at selected frequencies and
        amplitudes of input current.

- 3) Brain Areas to be Studied
  - a) Cerebral Cortex
  - b) Thalmus
  - c) Hypothalmus
  - d) Brain Stem
  - e) Cerebellum
- 5. Determination of the distribution of total electrical current in the cranium.
  - a. Object: How much of the total current applied to the head actually reaches the brain? This is an in vitro study on cadaver heads.
  - b. Procedure: Calf heads will be opened sufficiently for the brain to be aspirated. Recording electrodes will be placed in the cerebral cavity and it will be refilled with physiological saline. Electrical currents will be applied to the head in the normal manner for anesthesia and the current amplitude in the homologus solution will be calculated from the oscilliscope readings. This value substracted from the generator output should give the amount of current dissipated in the skin, muscle and bone of the head.
  - Determination of the convolution of dual electrical currents in the brain.

The observed responses of experimental Theory: a. animals under the influence of dual electrical currents indicate that the effect on the central nervous system is not the same as single wave induced currents. The responses are of a sleeplike nature rather than anesthesia if the combination is summated in the generator, but indicates deeper anesthesia if the summation is in the head. Since summation of two currents in a system does not necessarily follow a numerically adding effect, it is logical to believe that the currents applied to the head from two sources are convoluting (passing one another) in such form that the phase angles determine if they are adding or cancelling in a particular segment of the brain. Therefore, the determination of this theory would indicate the possibility of focusing current to specific locations of the brain.

#### b. Animals -

- in vitro studies in cadaver calf heads,
- 2) in vivo studies in calves.

#### c. Instrumentation -

- 1) Current Generators.
- Oscilliscope.
- 3) Recording electrodes and sterotoxic equipment.

#### d. Procedure -

- Electrodes would be surgically placed in select locations in the cerebral cortex, thalmus, hypothalmus, brain stem, and cerebellum.
- External currents for anesthesia would be applied through external electrodes.
- 3) Reading will be made on the oscilliscope.
- 4) Using known input and observed output, the convolution of current in the system (brain) will be mathematically determined.
- Determination of the role of the cerebral spinal fluid
   as a conductor of electrical currents.
  - a. Since the impedance of CSF is so little compared to the tissue of the head, there is evidence that this may be the medium through which much of the current flows.
  - b. An in vitro study is proposed in which the head and neck of calves would be used as the container for the fluids. Currents will be applied to the head in the normal fashion for electro-anesthesia. Recording electrodes will be placed in the brain and connected to an oscilliscope. After recordings

of the voltage and current to the brain, the CSF will be replaced by electrolyte solutions and H₂O. The conductance through each of these media will be determined for correlation. Thus the role of conductance through the CSF can be made.

- Determination of the effects of induced brain lesions on the capability to produce electro-anesthesia.
  - a. To provide additional evidence that specific areas in the brain are involved with the mechanism of electro-anesthesia, lesions will be produced in live animals in select areas of the thalmus, hypothalmus, and cerebral cortex and their effects on the capability to produce electro-anesthesia determined.
  - b. Lesions will be surgically produced and consultation with the staff neurosurgeons at | will be made in perfecting techniques. Current frequency and amperage requirements will be compared with those of normal brains.
  - c. The bradykinin test will be made to determine depth of anesthesia.
- Determination of the methods to focus current to specific locations in the brain.

- a. Although this study is listed last it is one of the most important studies. However, the preceeding studies must be made to make it possible.
- in the brain where stimulation to specific sites
  will produce anesthesia, thus reducing the unwanted
  side effects. The question to be answered is, "Can
  this be controlled by applying currents at selected
  phase angles from specific locations on the skull
  to allow cancellation of current in all areas of the
  brain except those that need to be affected?"
- c. In this study, the multiple inducing electrodes would be placed in specific locations enabling the phase angle to be controlled, giving the proper level of current in various areas of the brain. In the initial studies, the electrodes would be placed through the bone of the skull by surgical technique, thus eliminating the deflection of current by the bone. After determination of the proper effect by this technique, attempts to produce the same effect with electrodes outside the skull would be made,
- d. Thus determination can be made by recording from the specific locations of the brain, the amount of current present.

- C. Specific Studies (Biological)
  - 1. Determination of the level of anesthesia.
    - will be used as an index to depth of anesthesia.

      Either intra-arterial or intra-peritoneal injection of bradykininevokes a response if pain is perceived.

      There is no tissue damage by bradykinin, and the pain responses can be recorded in terms of blood pressure elevation. The test can be repeated frequently. Pain is perceived 15 seconds after injection and lasts 30-40 seconds.
    - b. By using this test at each of the frequency and amplitude levels for the four types of current to be studied, the depth of anesthesia and at what current levels it occurs can be determined.
    - other physiological changes, an outline of the signs of various levels of anesthesia can be drawn up for electro-anesthesia.
    - d. Recordings of responses will be made with a physiological recorder with blood pressure, ECG, and impedance pneumograph transducers and preamplifiers. Blood pressure measurements will

be made by direct cannulation of the external maxillary artery.

- 2. Determination of the effect of electro-anesthesia on blood gases and blood pH.
  - a. Since proper oxygen supply to the brain cells must be maintained to prevent cell damage, the effects of the various types of current on these parameters must be made.
  - b. High amplitude currents at low frequencies produce

    definite respiratory distress. It is, therefore,

    important to know at what levels there is sufficient

    disturbance of the blood gases and pH to be hazardous.
  - will be done for all four types of current at 100 cycles per second and 5 milliamperage intervals. The range will extend from no detectable respiratory distress to obvious disturbance.
  - d. Arterial samples will be collected through an implanted carotid catheter and results determined immediately after sampling. Samples will be collected at 15 minute intervals and continue until the response is stable.

- pH equipment produced by Instrumentation Labs
  of Boston, Massachusetts.
- Determination of the effect of electro-anesthesia on the circulatory system, including blood glucose levels.
  - a. Cardiac arrest can be produced by electro-anesthesia.

    It is usually not fatal if the current is reduced promptly, allowing the heart to resume function.

    Cardiac arrest is not produced if higher frequencies of current are used. Therefore, it is important to know the range of currents which will produce cardiac difficulties.
  - b. Three circulatory parameters that are known to be affected by electro-anesthesia will be studied.
    - 1) Blood Pressure.
    - 2) ECG for heart rate and amhythmics. . .
    - 3) Blood Glucose.
  - and amplitudes ranges previously indicated.
  - d. Equipment -
    - Physiological recording equipment with transducers and preamplifiers for blood pressure and ECG.

 Bausch and Lomb Spectrometer for blood glucose determination will be used.

#### ANTICIPATED PROGRESS .

In vitro studies can start two weeks after funding. It is anticipated that the first four electrical studies for the four types of current and the biological studies for two of the four types of current could be completed the first year.

PERSONNEL I. П. ш. To be named. IV. Will spend minimum of 50% time on project. ٧. Animal Assistant - Full time. VI. Technician for lab analysis - Full time. Secretary - 50% of time. ۷ű. Assistance available Neurosurgery VШ. in advisory capacity Neurophysiology IX. from these departments X. Neuroanatomy XI. Radiclogy

#### PERSONNEL SALARIES

Investigator . . . . Full time

\$

Technicians (2)

- 1. Assisting with animal procedures
- 2. Laboratory analysis

Secretary . . . part time (50%)

Engineering

(systems electronics)

Consulting (Electronics, Neurosurgery, Neuroanatomey, Neurophysiology)

\$

#### <u>ANIMALS</u>

25 calves @ \$60 each

\$

Board. # \$4,00/day for 330 days

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* Plan to reuse each animal as much as possible. Number on hand at a given time will be two thus reducing board.

#### EQUIPMENT

- Tektronix Model R293 DC pulse generator and power supply.
- Hewlett-Packard Model 3380 B Sine wave generator (can be used in both sine wave analysis and external summation analysis, one sine wave generator is already available for use in dual wave convolution studies).

- General Radio Impedance Bridge for measuring brain impedance levels, Model 1608-A
- 4. Motor drive unit for exact rate of current application in all cases
- 5. Simpson Voltmeter Model 312
- 6. Blood gas analysis equipment. Instrumentation Labs. Micro-analysis system

Gasses for caliberation of above

- 7. Bausch and Lomb Sepectrometer Model 20 for blood glucose determinations
- 8. Oscilliscope for monitoring waveform, rise time, distortion of waves, voltage levels and time intervals

The Tektronix Model 561A with needed components lists for \$1,780.00. The Hewlett-Packard Model 141A with similar components is \$2,075.00. There is one advantage of the H-P model in that information can be stored on the screen. This would enable one to record frequency responses, rise time, voltage levels, etc., on the screen at specific intervals and get direct comparisons. Thus more accuracy can be obtained. The work can be done with either. More accuracy is preferred but can be sacrificed in this case if needed for budget purposes.

- Oscilliscope camera for permanent records of readings (will work with either of the oscilliscope models listed).
- 10. Sterotoxic apparatus by Universal:

610101 "H" stand with adjustable horizontal bar

610102 Horizontal rider

610103 Carrier housing

	610104 Micrometer carrier	\$
	613001 Micrometer	
	613510 Chuck, insulated	
		\$
	Base plate and head holder will be constructed to fit needs. The equipment listed can be used in either micro or macro-electrode applications.	
11.	Electrodes, connecting cables and electrical probes	\$
	TOTAL EQUIPMENT	\$

## SURGERY CHARGES

These charges are for surgical instruments, suture, operating room charges. Since animals are to be reused the procedures will be made using aseptic techniques.

daing aseptic techniques.		$\Delta$
50 days of surgery @ . Vday	\$	ì
MISCELLANEOUS		\ !
Physiological recording instrument paper	\$	2
Photography		] i
Travel		
Tubing, catheters, drugs, chemicals		
Computor time in data analysis		i
	\$	
Institutional Overhead:		ĺ
40% of Salaries	<u>\$</u>	
Total First Year	\$	1

Reductions in equipment cost the second year should offset any increases in other items for a second year budget of \$ ! Detailed budgets for time periods after the initial year will be submitted at the requested time.

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## ELECTRICAL DISSECTION

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### IMPEDANCE CHANGES

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- 63. Robert L. Willenkin. Anesthetic Level and Electrical Resistance of the Brain Stem. Anesthesiology, 27:2, 1966, p. 231.

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September 27, 1966

Dear

Enclosed you will find 4 sample No-Snag Tags and a catalogue | They did not send the thru pins. As you can see from the enclosure, these tags can be marked by a factory process to embed the numerals.

We had a question

There are several means to re-

duce this:

- orient the tag parallel to the direction of travel
- add a triangle-shaped stiffening piece to the tag lobe
- add a wire reinforcement member
- have tags made with two pin-thru holes, or glue two tags together end to end. I have glued the tags together with neoprene cement this cement being flexible

Despite the fact that it would seem very simple to cast tags of of one's preferred shape, I feel that there is already a good bit of design value in the present models, particularly with respect to the pin-thru seal.

Please advise us if these are satisfactory, and if you would like the matter to be pursued further.

Yours truly,

September 27, 1966

#### Summary Information on

1. There are a cat owned by

the standard is set by

Other breeders have, and are, trying to introduce a variation on the standard, and the effect of this change on certain properties is open to question.

- 2. are difficult to breed, apparently the females do not conceive readily, and usually have only one or two kittens per litter.
- 3. There are very in the country probably at the most. Of these, I would estimate that are show stock.
- 4. The going price for show stock is from \$150.00 and up.
- 5. \breeders are apparently more prevalent, and they offer true \quad \and variations on the theme. Again, \quad \quad \text{whether} \quad \text{characteristics vary is unknown to me.}

The price for an area (is around \$30.00. They travel well, and if one were interested in immediate supply, this would be the preferred route until a domestic breeder could be established.

6. Dealers who have acquired a reputation for quality stock:

	-2-
7.	Dealers of unknown reputation, but with
••	
•	
. 8.	Persons contacted by me:
, <b>0.</b>	
	a.
	- Authority on most show breeds.
	- Located in
	- Is going to send me a book on abyssians.
•	b. going to send me a list of W. Coast breeders.
	c. to send me pictures of cats.
9.	Known available show quality
٠.	
• .	
	Other names - uncontacted:
10.	Other names - uncontacted;
,	
imi	In summary, we will gladly pursue any aspect of the problem. For nediate supply, I recommend:
	a. Acquiring "as pets".
	b. Acquiring copies of magazines for listings
	of suppliers, or contacting

c. Establishing a supplier, here, but having to wait for at least one year or more.

There may, in fact, be other suppliers in the country.

The owner/breeder/fanciers are very interested and inquisitive about the caller's experience and motives for acquiring this breed.

We will try to get a copy of <u>Cat Magazine</u> and <u>All Pets Magazine</u>. In the meantime, please contact me if you need more specifics.

Post Script: Will you please do me a great favor and send, if you have a particle on

is doing so much for me (like arranging for me to before buying one), that I would like to return the favor.

January 10, 1967

Dear Neal:

Enclosed is a short Progress Report of our work to date pursuant to

Very truly yours,

THIRD PROGRESS REPORT

January 5, 1967

Contract No.

# SUMMARY OF ACTIVITY FOR THE QUARTER ENDING December 31, 1966

Contract efforts during this period have been in three areas; literature monitoring, a continuation of efforts to produce an improved piezoelectric generator design, and planning for animal research studies. The results of activity in these areas are summarized separately below.

#### A. Literature Review

Many articles of peripheral relevance to this study have been scanned. The sources utilized during this period are largely composed of the Biomedical Engineering Journals and publications of NASA and NIH. became a subscriber to the During this quarter services of the Knowledge Availability Systems Center of the University of Pittsburgh. The KASC searches STAR and IAA indexes and provides with documents relevant to our interests. Searching under several descriptors appropriate to this contract began with 1963 documents and is now up to date. Descriptions of recent work of three research groups mentioned in our last formal report are contained in Proceedings of the Annual Conference on Engineering in Medicine and Biology, 1966. The report of P.J. Racine and H.L. Massie addressed the problem of determining the chemical activity present in the Konikoff-Reynolds Galvanic Electrode System. Data from several metal types in in vitro experiments are discussed, oxidation of electrode metal to its ion and reduction of free oxygen were suggested as principal reactions. Wen H. Ko described a prototype "piezoelectric energy converter for electronic implants." Professor Ko concurs with our analysis of the characteristics of ceramic bimorphs that resonant operation promises higher efficiency. His device, which was not implanted, utilized inertial coupling and the proposed energy source was the mechanical energy of heart motion. Pending contrary data, the mass and gravity limitations of such coupling discussed under Random Motion in our previous report still apply. His voltage doubler rectifier circuit should be useful. The paper by C.C. Enger and M. Klain, "A Three Gram Self-Powered Pacemaker Implanted on the Surface of the Left Ventricle," discusses recent work on solving the body fluid leakage problems of the Enger-John H. Kennedy device.

### B. Piezoelectric Generator Design

The main problem to be overcome by a successful generator design is coupling the available form of host mechanical energy into the piezoelectric element. Fluid seals, overall efficiency, breakage, size and weight are some of the aspects of this problem. In our previous report we offered some suggestions apropos parts of this problem, among them a striker system which was similar to the operation of a music box. The intended performance characteristic was for input mechanical energy to be captured in the piezoelectric element which would subsequently oscillate freely until the energy was all converted into heat (mechanical losses) and electricity. Another method of achieving this characteristic has occurred to us which has the advantage of requiring no sliding off the end of the element thus eliminating a possible wear point. The essence of this new method is to attach a small piece of steel to the piezoelectric element and use a magnet to deform the element. When the magnet's holding force is exceeded, the element is released and allowed to vibrate freely. It appears that a package similar to those used by Dr. Kennedy but incorporating this technique could be constructed quite simply. As has been previously discussed, resonant operation should provide significantly more electrical output than does "direct" drive. . .

### C. Research Experimentation

Arrangements have been made with an experienced animal researcher to conduct a few measurements of the source resistance and power yield characteristics from implant electrode EMG signals.

# II. PLANS FOR THE PERIOD JANUARY 1 THROUGH FEBRUARY 28, 1967

Work in the three above areas will continue and a final report summarizing both new data and previous reports will be prepared.

February 8, 1967

Dear

Enclosed is a short Progress Report of our work to date pursuant to

Very truly yours.

Repet Distribut

270

. FOURTH PROGRESS REPORT

February 8, 1967

Contract No.

# PROGRESS REPORT - 1 January to 31 January 1967

### I. PIEZOELECTRIC CRYSTALS

Several PZT 5-B series connected ceramic bimorphs have been obtained from Clevite. A test rig was built to allow electrical and mechanical measurements on these ceramic crystals. The test rig allows a thin rectangular crystal to be mounted cantilever fashion; i.e., clamped at one end with the rest of the element suspended in air. A stop was machined to allow the free far end of the crystal to be depressed only .020". For the 1.7" by .7" crystal which has been subjected to test this amount of deformation represents a strain of about 2 x 10-4 which is 20% of the expected fracture strain and sufficient to produce a peak voltage transient of 15 volts. The experimentation with this crystal has been concerned with establishing the transient or ringing characteristics. Electrical voltage output is monitored on an oscilloscope and the crystal is set in (decaying) oscillation by depressing the end to the stop with a piece of plastic and then sliding the plastic off the end of the crystal. Oscillation at 150 cps occurs with an approximately exponential amplitude decay at a time constant of 80 milliseconds (with a 10 meg electrical load). This time constant can be interpreted as equivalent to saying that the system has a Q of 39 with an electrical open circuit. As the resistance connected to crystal is decreased the Q is lowered and the oscillation dies out faster. A lumped constant electromechanical model of the crystal was used to develop expressions for total system Q and total electrical power delivered to the load resistor as functions of external load resistance. The optimum resistance was thus calculated and when a resistor of this value is connected to the test crystal, Q and voltage decrease to values within the experimental error ( pprox 5% ) of the calculated values. According to our calculations the maximum efficiency of energy

Dr.

Attached is a proposal for a Research Contract, Physiological Mechanisms Underlying the Electrodermal Response and their Behavioral Significance, which will allow continuation and extension of work performed under our original Contract

| The designated principal investigator would again be Dr.
| It is requested that this contract, if approved, become effective June 1, 1967.

Sincerely yours,

March 20, 1967

Approved for Release Date 27 FEB 1813

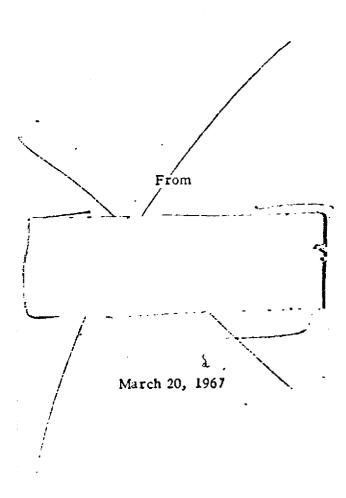
151

# Proposal

# Physiological Mechanisms

# Underlying the Electrodermal Response

# and their Behavioral Significance



#### Period of Work

This proposal would cover one year of effort.

#### Facilities

In addition to equipment originally available, there is now an additional 4-channel D.C. polygraph purchased under the current contract, and a 2-channel magnetic tape recorder with FM components for recording of biological signals.

## Amount of Support

An estimate of costs is attached. Contractual financial arrangements are proposed as exist under the current contract with the exception that indirect costs be calculated at the negotiated rate of 30 percent.

#### Reports

It is proposed that scheduling of progress reports be continued on the same, basis as described in Contract

Principal Investigator

### Cost Estimate

Principal Investigator (part-time)

Research Assistant (full-time)

Electronics Technician (half-time)

Subjects

Stenographic Services

Reproduction Services

Expendable Supplies (Paper, chemicals, electronic components, etc.)

Solid state special purpose computer components

Impedance Bridge

Magnetic Recording Tape

Travel (2:coordination trips-@

Sub-Total

Overhead at 30% (Negotiated Rate)

Total

#### PHYSIOLOGICAL MECHANISMS UNDERLYING THE

#### ELECTRODERMAL RESPONSE AND THEIR BEHAVIORAL SIGNIFICANCE

#### I. INTRODUCTION

Reference is made to the description of background and statement of proposed work described under current contract in June 1966. Further reference is made to an interim Progress Report dated February 15, 1967, which describes progress to January 31, 1967. The original contract was aimed at a systematic investigation of the basic physiological mechanisms responsible for electrodermal reflex events in the hopes that the understanding of their nature would aid behavioral interpretation and afford a rational basis for effective data treatment. Attention was to be given to the relative involvement (or lack of involvement) of vasomotor, sudomotor and epidermal activity in this reflex, to the special characteristics of the response which might be associated with each component, to the principles governing the addition of component activities, and to the specific classes of stimuli which evoke activity in the respective components. Efforts were to be made to identify the nature of the biological adaptation signified by the activity of each component in efforts to recognize their psychological significance.

The initial phases of this work (as described in the February 15, 1967, interim progress report) consisted of experiments as follows:

- (a) Comparison of microelectrode recordings from sweat pores and areas between sweat pores. These have since been extended to comparison of surface recordings with those at the deepest level of the stratum corneum.
- (b) Comparison of recordings from the corneum in different states of hydration.
- (c) Recordings from cat foot-pad under varying patterns of stimulation of the sympathetic nerve supply.
- (d) Recordings of potential responses from the nail plate which is allegedly free of sweat glands.
- (e) Study of the effect of surface electrolytes on the specific components of the skin potential response.
- (f) Production of local electrodermal responses by mechanical stimulation (calibrated stretch) and alteration of this response by chemical agents, ischemia, temperature change, and combination with activity of central origin.

- (g) Examination of the effects on skin potential response of vascular changes produced by engorgement (venous cuff), arterial occlusion, or exsanguination by a directed massage.
- (h) Comparison of electrodermal behavior as measured by constant voltage vs constant current systems.

The results of these experiments together with those already reported in the literature were utilized in the development of a new hypothesis describing the peripheral processes involved in the electrodermal response. This model, described in the interim report, ascribes conductance changes having a slow recovery rate and negative potential waves, also of slow recovery rate, to the rise of sweat in the ducts. The fast recovering conductance waves and the positive potential waves are attributed to behavior of a neurally controlled membrane readily accessible to surface solution, and involved in the rapid reabsorption of water from the skin surface. An analysis of the manner in which these components combine was used to explain the complex wave forms obtained under actual recording conditions.

From this model it was concluded that the half-time of the recovery process of the skin conductance response should be a meaningful index of the amount of fast-recovering (membrane) component in the response. A series of behavioral experiments was analyzed with the use of this index to determine whether it distinguished different behavioral states, for example, alerting for a task as opposed to execution of the task, and relaxing as opposed to task performance. The measure successfully distinguished between these conditions even in cases where conventional amplitude comparison failed to do so.

#### II. PROPOSED INVESTIGATIONS

#### A. Continuation of Physiological Investigation

Although considerable progress has been made in clarifying the nature of peripheral mechanisms, several important questions remain to be resolved. These will receive continued investigation in terms of experiments described in the current contract. Among these are:

1. Does the nail bed in fact represent a sweat-gland free area and, if so, may vascular processes explain the nail potential responses of central origin and the local positive potential responses obtained by mechanical displacement? This will be investigated by simultaneous recordings of skin potentials and reflectance plethysmographic changes from the nail plate. Efforts will also be made to alter the potential responses with electrolytes applied to the nail plate, to test for a surface membrane effect.

- 2. Do local potential responses (produced mechanically) depend upon a surface membrane alone, or may a vascular component be involved? The effect of surface agents and exanguination experiments point to a surface membrane as the responsible element but surface reflectance monitoring undertaken since the last interim report demonstrates marked similarity between the form of the local potential response and that of the change of surface optical opacity following the mechanical stimulus even in the exsanguinated extremity. The attack on this problem will consist of attempts to selectively extinguish either the local potential response (e.g., with surface anaesthetics) or the vasomotor accompaniment, e.g., by using electrical or vibratory stimuli to produce the local response.
- 3. Is the activity of the sweat gland observable at the surface only as a secondary effect of the rise of sweat in the ducts, or are there electrical changes at the secretory membrane which contribute to the surface potential response? Yand his co-workers have shown that intra-ductal electrodes in the cat sweat gland do not indicate responses when they are inserted deeper than the level of the germinating layer. Recent experiments under the present contract indicate that the human sweat gland behaves differently in that responses may be recorded at deeper levels. It remains to be decided whether these are due to pickup from nearby structures or in fact originate in the sweat gland.
- 4. In addition to the three critical questions stated above, numerous lines of approach to the clarification of mechanisms, described in the original proposal, remain to be undertaken. Special attention will be given to the combination of high frequency impedance measurement with potential and D.C. resistance measurement, and to the effects of pre-exposure to various current densities upon the positive and negative waves and upon sweat gland and epidermal responses.

#### B. Development of the Recovery Half-Time Index

Because of the high success with which the t/2 recovery index distinguishes qualitatively different behavioral states, a key effort in the continuing program will be directed toward rendering this measure maximally effective. This investigation shall be concerned with:

- 1. The development of a method for automatic on-line presentation of the recovery limb index.
- 2. The determination as to whether some fraction of the recovery time other than 50%, e.g., one third recovery to base line, is a more sensitive measure. Various fractions of the recovery time are readily selected by the automatic circuitry now planned for this operation.

- 3. The determination of the extent of the amplitude range in which this measure maintains its independence of amplitude.
- 4. The relationship of changes in the recovery index to various peripheral physiological processes as determined by independent measures such as vapor production, A.C. vs D.C. impedance, etc.
- 5. The classes of stimuli which tend to produce shortening or lengthening of the recovery index.
- 6. The lability of this measure during short term alteration of stimulus conditions.
  - C. Application of Electrodermal Measures as Indices of Bio-Psychological Adaptability

The interpretation of electrodermal activity as a biologically useful adaptation implies that its occurrence in response to an arousing situation may indicate effective behavior. There are, however, two additional requirements which must be evidenced by the behavior sample before this conclusion can be reached, namely that the type of adaptation be appropriate to the demands of the situation both qualitatively and quantitatively. The first implies, for example, that a defensive response to a situation which appropriately calls for maximum information intake is ineffective behavior. The second implies that autonomic activation should be graded in proportion to the situational demand, and most important, that the activation should rapidly diminish as soon as the demands of the situation are reduced. In other words the effective individual, in the interests of biological economy, would not remain continuously activated, but should be able to shift rapidly to the resting state while maintaining a system of sentries for defense purposes. He should then be capable, upon being alerted by his sentries (i.e., his receptive screen) to shift gears rapidly to the activated state. The dissection of the electrodermal response into qualitatively different adaptive reflexes should allow evaluation of the qualitative appropriateness of the elicited activation. The recovery index should allow observation of shifts in arousal even when the amplitude of the background activity fails to differentiate functional states.

The appraisal of an individual's adaptability to environmental demands will be determined by exposing him to a sequence of rest conditions alternated at unannounced times with tasks or stresses of varying demands (qualitatively and quantitatively). An index of adaptability will be constructed from the rapidity of activation and (especially) relaxation and the degree to which it is qualitatively appropriate to the task in terms of three categories of behavior, defense, aggressive task orientation, or information intake. This adaptability index will be validated against personal histories (job or military), clinical judgement of behavior, and performance on a battery of tasks aimed at assessing this ability.

was selected

for this follow-on action because of the excellent performance of the principal investigator, Dr.

during the initial contract period.

August 30, 1973

Dear:

Here is the first draft of the Statements of Work and Cost. My secretary put this on stationary because I forgot to mention to her that I was dictating for another party.

would like to pitch to pwhen he visits late in September. That might be worthwhile if you have a rather complete understanding of how he will address the scaling problem I mentioned and have an opportunity to dry run his presentation. Perhaps such a careful exposure would be good for the project's viability.

See you soon. Stay well and happy.

Sincerely,

249)

#### PHASE I

# ESTIMATING THE EFFECTIVENESS OF ELECTRIC FISH IN DETECTING FOREIGN OBJECTS AT A DISTANCE

Perform psychophysiological experiments kinds of electric fish in restricted water so as to estimate their ability to identify the existence of foreign objects in this water taking into account electrical discontinuities imposed by the boundaries of that water and the foreign objects placed within it. Specifically, consider the natural fish as a signal generator and receptor and then use of auxiliary signals which replicate the fishes signals and other signals of specific interest. Compute the expected behavior of such fish in open ocean or fresh waters given typical boundary conditions with respect to depth, topology, inogeneity of the water, temperature, and so forth. Summarize these findings in terms of the prospective ability of these fish to identify foreign objects in a harbor or other natural body of water of interest...foreign objects such as small submarines, torpedoes, scuba divers skin divers, and so forth.

More explicitly, determine the sensory capability of individual electric fish in terms of their ability to sense the existence of foreign objects as a function of range, fundamental area, volumetric displacement, differential discontinuity, and so forth. In this regard, use a tank of

water adjusted to the temperature and electrolytic conditions of presumed operational conditions. Retain a fish near one point and insert in the water various objects, discerning the different behavior of the fish as these objects are inserted concurrently monitoring the electrical field within the water. From these results, calculate the estimated behavior of such a fish in detecting an object in an infinite water domain and large scale waters with various boundary conditions.

PHASE II

DETERMINING THE METHODS USED BY ELECTRIC FISH FOR RANGING AND LOCATION

Perform detailed experiments wherein the particular characteristics of electric fish are related to their abilities with respect to ranging and location. Particular attention will be focused upon the use of phased arrays of receptors, the fish's ability to determine incremental time lags in the signal, the estimated spectral properties of the signal, to modify the transmitted signal as a reflection of knowledge gained from previous receptions, and so forth. Interpret these findings in terms of specific schematics and data analysis required to synthesize models of the fish's capability, models which when reified would provide signal advantage over the state of the art with respect to such a target as described above.

#### PHASE III

DESIGN OF EQUIPMENT SYSTEMS SUITABLE FOR REPLICATING ELECTRIC FISH IN TERMS OF TARGETING FOREIGN OBJECTS

Design, fabricate and test experimental apparatus suitable for replicating the above referenced models. Perform experiments with this apparatus so as to improve its ability in various regards. Make a specific comparison of this capability to that of an electric fish and estimate the utility of such an apparatus in terms of operational situations.

STATEMENT OF COST

6 months PHASE II - \$

PHASE III - \$

25 September 1968

MEMORANDUM FOR:

SUBJECT :: Meeting with Dr.

1. As I mentioned to you earlier this week I had conversations at Mr. /request with Dr. ... | concerning animal training. In going over my notes from the trip, I found some things I didn't mention to you; therefore, I'll summarize my meeting with him in this memo.

- 2. As you will recall, has done guided animal work on donkeys and rats. He said that in doing his literature search on the project, he came across work done in Sweden in World War II in which seals were trained to attach explosives to submarines. He recalled that the harness for the seal had been one of the main problem areas. Further, he said dogs had been trained in World War I to go to tanks for a food reward.
- 3. In his own work with donkeys and rats, he found the following using electrical stimulation of the brain:
  - a) negative reinforcement in all cases caused panic reaction and was not useful
  - b) an intermediate level brain stimulation was the only useful one (you could overdo the pleasure reaction)
  - c) with rats the attention span was so short (less than 1 sec.), that you needed to give immediate reinforcement (less than 1 sec.). By doing this you could train the rat in less than 10 minutes.

SUBJECT: Meeting with Dr.

- d) for guidance he needed a "logical and" in the circuitry, i.e., the animal must have the right heading and have forward motion
- e) a maximum response rate at 60-100 eps for the donkey
- f) the animal gives the response you ask for and not necessarily what you want or expect, thus your questions to it must be framed very carefully.
- 4. While preparing to get into the animal work, Dr.

  spent 2 weeks with

  He realizes you must take with a grain of salt, but while he was at the was convinced of the following:
  - a) had found pleasure centers in the brain and could stimulate them by electrical shock

5. I'm sure you would find Dr. very stimulating. The next time he is in town, I hope that you can find time to have some discussions with him.

MEMORANDUM 8 June 1970

TO:

,一个人,我们是一个人,我们是一个人,我们是一个人,我们们一个人,我们是一个人,我们是一个人,我们们是一个人,我们们是一个人,我们们是一个人,我们们是一个人,我们

Dr.

FROM:

SUBJECT:

Preliminary Proposal: "Non-Lethal Personnel

Behavioral Control"

Four copies of a proposal, "Non-Lethal Personnel Behavioral Control," dated 15 May 1970, are submitted for your consideration. We would like to emphasize that the exploratory nature of the work proposed makes it important that the task descriptions and manpower allocations outlined in our proposal be considered flexible within the framework of funding and manpower available. Some degree of flexibility is necessary to avoid wasting effort on techniques that prove to be impractical and to permit follow-through on promising approaches to non-lethal personnel behavioral control.

NON-LETHAL PERSONNEL BEHAVIORAL CONTROL

0

15 May 1970

REVIEW DRAFT

REVIEW DRAFT

# NON-LETHAL PERSONNEL BEHAVIORAL CONTROL

evaluation, advice and guidance to support development of behavioral control systems being fabricated and tested by other concerns and/or to recommend the development or abandonment of plans to undertake research and development concerned with potential behavioral control systems. This service is to be rendered during the contract period of 1 July 1970 to 30 June 1971, subject to modification if the contract objectives would be better served by a change in the contract time period. A proposed budget for the contract is detailed in Table I of this proposal.

#### TASKS

already hold clearances t the SECRET level or higher.

I. Evaluation of On-Going Projects

Evaluation of status, progress and potential of on-going projects being

#### REVIEW DRAFT

conducted by other organizations. These projects are aimed at developing such approaches as intense light and adhesive materials as behavioral control systems.

30% of research effort
Informal and formal Progress Reports due: intermittently, when
requested or indicated.

II. Evaluation of the Scientific Literature in "Soft Impact" Projectiles Evaluation of the currently available literature and recent research efforts in order to determine the feasibility of developing a "soft impact" projectile as a part of a behavioral control system.

20% of research effort

Progress Report due: 28 February 1971.

III. Evaluation of Potential Behavioral Control Techniques

Evaluation of diverse approaches, such as electrical shock, infra-sound, nets,

as potential methods of temporary incapacitation.

30% of research effort Progress Report due: 30 June 1971.

# IV. Supporting Laboratory Studies

Exploratory laboratory studies involving experimental animals will be conducted, as appropriate, in support of Tasks I - IV if data from such studies are necessary to supplement information from other sources in order to arrive at an evaluation of a potential behavior control system.

20% of research effort

Reports due: upon completion of studies.

# ADDITIONAL ACTIVITIES

Briefings and support functions such as security, communications, personnel management, travel (especially in the early phases of operation)

#### REVIEW DRAFT

0

and administrative activities will be necessary. Such activities are estimated to require about 20% of available professional manpower. The remaining 80% of professional manpower will be apportioned to the four tasks as indicated above.

# TABLE I. BUDGET ESTIMATE

for

| Proposal Dated 15 May 1970

Description	Man Years	Amou	Amount	
Salaries*:			-	
Dr. Dr. Dr. Associate Staff Members Technical Staff Members	0.10 0.10 0.30 0.50 0.50	<b>\$</b>		
·		_	ı	

# Supplies:

Office supplies, communications, books, library services, laboratory supplies, experimental animals including maintenance

(0

# Services - Consultants:

Appropriate hours at

Specialists, 40

# Travel:

Fringe Benefits at 12% of salaries (rounded):

Overhead at 43% of salaries (rounded):

*Includes leave benefits and bonus compensation.

MEMORANDUM 30 April 1971

TO:

FROM:

Document Control Custodian

SUBJECT: Receipt for classified materials

The attached document on Visual Incapacitation Systems Analysis and Implementation of Visual Impairment Systems Analysis is being returned as it is a duplicate of material previously received.

We received a shipment of classified material on 20 April 1971 (Registry No. 459785). Since we could find no receipt with this material we compiled the following list to act as receipt.

- 1.) CONFIDENTIAL Memo dated 10 March 1971: Program Plan for Systems Analysis of Light-Induced Visual Impairment, 3 pp. with attachments (Attms. I. 2 pp., II. 1 p., and III. 1 p.).
  - 2.) CONFIDENTIAL Copy of initial, interim action program, 1 p.
- 3.) SECRET Personnel Incapacitation notes (1. Objective, 2. Progress,3. Program Plan), 5 pp.
- 4.) SECRET Personnel Incapacitation Program (I. Introduction, II. Program Plan), 22 pp. Addendum 2 pp.
- 5.) SECRET Memo: Personnel Incapacitation dated 18 September 1969, 40 pp.

18 May 1971

#### MEMORANDUM FOR THE RECORD

SUBJECT: Trip Report,

Non-Lethal Personnel Incapacitation,

Drs.

- l. There was a delay in full scale initiation of this work by because of other uncompleted Agency assignments. Inasmuch as future requirements for continuation of effort in this area is uncertain, the temporary delay was in no way detrimental to the completion of a hardware system. | will request a no-cost extension to compensate for the decreased expenditure rate during the first three months of the contract.
- 2. The purpose of the meeting was to reach agreement on the future structure of the program. Although outstandingly competent in the broad medical and allied sciences field, assigned personnel were relatively naive in the general area of personnel incapacitation. Such a situation is not unreasonable since most of the prior work in this area has been accomplished by engineering and ordnance experts with occasional consultation from the biological |personnel have sciences. During the past several months had an opportunity to saturate themselves with the pertinent incapacitation literature. The present visit was an appropriate time to determine the efficient use of funds and direction of effort. The an outline of Project Officer had previously forwarded possible program direction and they in turn had prepared a suggested program in terms of their particular capability. The results of the meeting resulted in a consensus of opinion which was mutually agreeatle. Without detailed elaboration, the agreed upon general principles included:
  - (a) The general flavor would remain as outlined in the original proposal, i.e., the | effort in the total program would be primarily concerned with the biomedical aspects of long-range programs, as opposed to major participation in QRC-type projects.

MEMORANDUM

29 October 1971

TO:

FROM:

Dept. of

SUBJECT: Transmittal of Report

The first section of our systems approach, dealing with electric shock, is enclosed. As we agreed, our emphasis has been on the medical and physiological aspects of electric current as an incapacitating technique, rather than on hardware, delivery systems, and operational aspects of the techniques.

We would appreciate your comments as to the emphasis, coverage and organization of this material, keeping in mind that full, in-depth coverage of any single "system" would represent a major research effort in itself.

attm: Cys 1-4 of report

192)

24 March 1972

MEMORANDUM FOR THE RECORD

SUBJECT: Trip Report -.

1. The group will undertake preliminary evaluation of Kirlian electrophotography of organic materials in an attempt to verify some of the Russian claims for this technique. Within the limits of the remaining contract funds, investigations will be undertaken concerning: (a) discrimination of plant material treated with organophosphorus compounds; (b) differential Kirlian signatures between a variety of plant life; (c) changes in signature as a function of health or disease of the plant; (d) investigation of the "holography phenomena" in which a photograph of the entire object is registered on the film when portions of the object are absent; and (e) film signatures of human hands or other body parts under normal conditions and when treated with local anesthesia or restricted blood supply.

2. Mr. has agreed to cooperate with in permitting utilization of his apparatus in this work. Mr. is not witting of Agency sponsorship.

3. The has constructed a working prototype model of the Kirlian apparatus which was demonstrated in the course of my visit. The electrophotographs showed the Kirlian effect with a quality almost equal to those produced by the equipment. In addition,

planted bean and raddish seeds several weeks ago which are being grown under artificial light in the laboratory. Half of the plants will be treated with an organophosphorus pesticide compound (varying concentration and time of exposure) and compared with a control group of plants to determine if there are significant differences in the Kirlian signature.

(208)

I can write a formal trip report if you wish but it would simply be a rehash of the material in this report. Although, the Quarterly Report and plans are written as if the material was to be presented to me in that fashion during my recent visits. As a matter of fact they had a maze of alternatives and what appears in this report is the result of our conversations. General corrects: Replacement of benifit: Dr | was one of the original investigators of | when he was in Portland and has used it in the laboratory: I'm not surprized that they could only come up with two new concepts—a great many competent people have considered the problem: The systems analysis will be similar to that which we prepared for the visual system— they should provide a worthwhile frame of reference when attempting to respond to fire fighting requirements or in undertaking a systematic research program in any one of the areas: I have requested the no-cost extension.

) We should have a trip report - STARO of Grand The State of State of the State of

5 February 1973

MEMORANDUM FOR:

SUBJECT:

#### INTRODUCTION

The following observations and opinions pertain to:

- a. the concept of field effect monitoring
- b. the equipment delivered by the
- c. suggestions for further research

#### STATEMENT OF THE TECHNIQUE

A short antenna (e.g., 18" of wire mounted vertically in the air above an insulating support) will take on an electrical potential which will vary in response to the time variation of the electrical field in its vicinity. In particular,

| cause cyclic variation of the potential on the antenna which correlates to the
| Consider the instantaneous potential on the antenna to be a scalar, uniform over the surface of the antenna (its length is very much smaller than the wave length of the signal, e.g., 60 Hz has a wave length of 3100 miles).

The amplitude of the signal is a function of the magnitude of the the tantenna distance, the relative the degree of static charge of the signal frequency range extends from DC to less than 100 Hertz.

#### LIMITATIONS OF THE TECHNIQUE

A major problem with using such an antenna to intercept is its sensitivity to extreneous signal sources. It would be useful to select one out of a set of potential sources by means of some appropriate combination of shielding or enhanced directivity of the antenna.

Antenna theory suggests that directivity cannot be enhanced by means of antenna configuration for all practical purposes because the antenna size and the spacing between elements of an antenna array will always be vanishingly small compared with a wavelength. The wave length of  $100~{\rm H}_{\rm Z}$  wave is:

$$\frac{c}{f} = \frac{c}{f} = \frac{3x10^8 \text{ m/sec}}{10^2 \text{ sec}^{-1}} = 3000 \text{km}$$

Therefore, shielding or shaping of the field must be used to advantage if possible.

Another present limitation of the technique is the lack of know-ledge required for reliable interpretation of the signals acquired. Information should be reliable given an adequate signal-to-noise ratic, but waveform analysis for detection and evaluation would require considerable additional research. (This comment is made prior to receipt of the Final Report.)

Finally, since the antenna sits in the near field of the source, signals received will fall off as the cube of the distance. If the signal is tangential at 1 meter, the signal will be 18 db down at 2 meters, and 28 db down at 3 meters.

Signal-to-noise ratio is critical whenever data recording is done on a machine of finite dynamic range. (The TEAC recorder supplied has a dynamic range of about 35 db.)

# THE PROTOTYPE EQUIPMENT

The equipment received from the was briefly evaluated. The unit performed much as expected, and was able to provide outputs clearly showing a a distances up to about 1 meter. The signal quality rapidly deteriorates with increasing range, as expected.

The unit has a rather poor battery life, rated at three hours in the instruction manual.

The operating time could be approximately tripled by installing larger battery parks in the unused spaces of the case. A suggestion: if battery life is a serious consideration, and the unit undergoes design revisions, replace the circuitry with micropower components. Newly available operational amplifiers can run on as low as 1.75 volts, drawing a few hundred microwatts. The present equipment, exclusive of the recorder, requires about 1.9 watts. The tape recorder draws about 2.4 watts.

The unit is rather inconvenient to operate since it requires battery replacement prior to each use, and a carfeul set-up of gain controls under conditions closely approximating those expected operationally. As previously noted, the signal amplitude is quite range dependent and probably varies considerably with environmental circumstances such as the lautomatic gain controls or logarithmic amplifiers should be considered in order to optimize use of the tape recorder's dynamic range.

PROPOSAL

for a

STUDY OF THE SENSITIVITY AND RESPONSE

OF WEAKLY ELECTRIC FISH

TO STATIC AND PULSED MAGNETIC FIELDS

submitted by the

## **PROPOSAL**

# STUDY OF THE SENSITIVITY AND RESPONSE OF NEAKLY ELECTRIC FISH TO STATIC AND PULSED MAGNETIC FIELDS

# [. Background.

The study of bioelectrogenesis, particularly in the various species of electric fish, has been of increasing scientific concern in recent years. This interest stems primarily from the potential usefulness of research in this area in contributing to our understanding of a number of fundamental and significant problems. By defining the electric fish's unique sensitivity to electric and magnetic fields, and how it codes and utilizes such sensory information in its detection and navigation behavior, current evidence is providing a more complete concept of such basic questions as migration and territoriality, and is leading toward the development of various bionic devices in the form of underwater sensors and power sources. In addition, knowledge of the effects of magnetic and electric fields on physiological and behavioral processes has assumed great importance in view of man's exposure to drastic changes in such stimuli during space travel.

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THE THE PROPERTY OF THE PROPER

Living things produce a changing electric field at and near the surface of their bodies; all fish, being sheathed in a conductive substance and living in a conductive medium, produce an electric field that may be detected at relatively great distances. However, there are certain fish which produce electric fields exceeding the norm by hundreds or thousands of degrees of magnitude. The electric eels of the Amazon can produce bursts in excess of 600 volts. Other electric fish, i.e., weakly electric fish, produce continuous fields measured only in millivolts, but by means of interpreting distortions in these fields are able to sense and navigate through their environment to a degree comparable to that of other species in which vision is used for these purposes. The weakly electric fish, having very poorly developed visual abilities, must depend on information acquired through their electric fields in order to survive.

The magnetic field is a form of energy to which all plants and animals are exposed. Its influence on living systems, however, is subtle and not well understood. One approach to studying the effects of magnetic fields upon behavior is through the use of an organism which produces an electric field and uses it as a detection and navigation mechanism. The electric fish is just such an organism, and a one-year study,

l of Sternarchus albifrons and S. leptorhynchus, has demonstrated the feasibility of such work. In these species, impulses are discharged from the tail and received by the head, which becomes positive in regard to the tail. This potential difference creates an electric field about the fish's body, permitting it to detect objects through distortions in the field. Several studies have shown that these fish can perceive a static (constant strength) magnetic field, but only when either the organism or the field is in motion,

therby generating a current in the fish. It was thought that the fish was responding to the current generated in itself by the magnet. However, in these experiments the magnetic field was presented as a static field, and the sensitivity of the fish to a pulsed field presented at various frequencies, praticularly the frequency at which the fish discharges its own electric field (500-1500 cps), was not investigated. Other investigators have shown drastic increase in sensitivity to applied A.C. approximating the frequency of the fish's discharge. In addition, the strength of the field was not systematically varied in terms of the gauss level in the fish's proximity. Therefore, there are considerable gaps in our knowledge of the degree of sensitivity of the fish to magnetic fields at various frequencies and strengths.

# Completed and Proposed Research.

In order to more clearly define the weakly electric fish's sensitivity and responses to different types of magnetic fields, a study was undertaken on June 1, 1969, in which several individuals of S. albifrons and S. leptorhynchus were obtained, life-support techniques developed, and test and recording equipment purchased and constructed. The fish were tested in a Y maze, T maze, and restraining chamber, and oscilloscope recordings were made of their discharge patterns over time, through variations in temperature, and in response to various drugs including levodopa in a base-line study.

Thier sensitivity to static and pulsed magnetic fields exceeding variations in the earth's magnetic fields was observed over the following ranges of values: between 1 and 10 gauss with a static field; from 0.29 to 82 gauss at 60 cps; and from 10 to 20 Ganss at frequencies of 685-1220 cps. depending on the fish's own frequency. Apparent negative results were obtained with the static field; but the subjects were clearly responsive to the pulsed field at all gauss and frequency levels. In addition, a method was devised to administer the drug levodopa to the fish in order to determine the effects of this agent on their behavior. Two specimens were tested, and the influence of the drug on their electrical and overt behavior noted. However, the data are not complete enough to draw any firm conclusions. Since this study is currently coming to a close, and the positive results which are emerging indicate that further study should provide very meaningful results, it is hoped that the work can be continued. It is proposed that the following lines of investigation be followed:

A. To determine the final absolute and terminal thresholds of the fish's perception of a static magnetic field.

B. To determine the final absolute and terminal thresholds of the fish's perception of a pulsed magnetic field by varying its frequency and strength over a wide range of values.

C. To determine the fish's sensitivity to electric current, as a basis of comparison with his perception of magnetic fields. In addition, to calculate the current generated in the fish by magnetic fields, duplicate these values with an audio signal generator, and compare the results with his performance under the other conditions.

# III. Capabilities

staff consisting of 42 full-time and 21 part-time employees and four students working for the Ph.D. degree in information science. Of this number of employees, two have M.D.'s, three have Ph.D.'s and nine have the M.A. or M.S. degree or are otherwise qualified to work at the professional level. The proposed project would be under the irection of

is a doctoral candidate in psychology and lis a graduate. biologist working for the M.S. degree in ecology.

Laboratory facilities are available

# IV. Plan of Procedure.

The work will be accomplished within six months from the effective date of the contract. Five copies of a final report will be prepared and submitted to the contracting agency.

# V. Budget - 6 Months.

. A. Personnel.

Secretary (3%)
. Total Personnel

B. Fringe benefits* (16.5% S&W)
Indirect costs (40.00 S&W provisional)

C. Consultant fees

D. Travel - local

E. Reproduction & duplication

F. Supplies and expendible equipment

G. Equipment

# Total budget

* The total salary and wage amount shown herein provides for direct labor effort in the percentages for hours expressed herein for the budget period. The fringe benefit rate is a package rate which provides for several benefits including vacation and sick leave earned

# ADDENDUM TO PROPOSAL TO SUPPLEMENT US GOVERNMENT CONTRACT

Following conversations between the sponsor and cognizant personnel of the literature of the literature of the literature of the literature of the proposed project was warrented. The revised orientation of the proposed research will be placed upon the utilization of an electric field by certain species of fresh water fish to navigate, orient and detect small objects as opposed to the original emphasis of phylogenetic comparisons of learning.

In recent years, there has been increasing interest in the sensitivity and response of various organisms to magnetic fields. This has been particularly twue in the space program, where the effects of leaving the Earth's magnetic and gravitational fields on man's behavior and physiological processes may be of great importance. The magnetic field is a form of energy like light, heat, and sound, to which all plants and animals are exposed. Its influence on living systems, however, is subtle and not well understood.

One potentially useful approach to studying the effects of magnetic fields upon behavior is through the use of an organism whichpproduces an electrical field and uses it as a detection and navigation mechanism. The electric fish <a href="Sternarchus albifrons">Sternarchus albifrons</a> is such an organism. Impulses are discharged from the fish's tail and received by its head, which becomes positive with regard to the tail. This difference creates a field about the fish's body, permitting it to detect objects through their distortion of the field. The purpose of the present study will be to determine how <a href="Sternarchus orients">Sternarchus orients</a> itself, in terms of its own field, within a magnetic field created by the experimenters, and whether this affects its ability to detect objects of varying conductivity.

In essence, the primary goal of this effort will be a study of electric fish behavior with particular reference to: (a) measurement and characterization of the electric fields produced; (b) influence of behavior and electric field by an artifically produced field which interfers with the antural field produced by the fish; and (c) the use of the fishes' electric field for navigation, orientation, object detection and discrimination.

This addendum to the original proposal will not affect the total funds, manpower and equipment required nor will it nullify

F1/c

A Summary Review of "Sleep Learning"
With Special Reference to the
Acquisition of Foreign Lenguage Skills

July 1965

#### BRIEF

## Problem

To appraise "sleep learning" as a technique for acquiring verbal skills with special reference to foreign language learning.

#### Procedure

A survey was made of a variety of sources dealing with learning during sleep. The review included the technical literature, popular books, commercial pamphlets, Eastern European materials, and communications from scientists familiar with the problem. The material was analyzed in terms of the evidence presented for or against sleep learning as a practical training technique.

#### Conclusions

1. Regardless of present day accounts of spectacular foreign language capabilities acquired during sleep , no acceptable evidence that sleep learning is an effective technique in foreign language training has been uncovered in our survey. Verbal learning, as commonly understood, does not occur during actual sleep. Although some verbal learning can occur during low levels of wakefulness, such as drowsiness or reverse, there is no acquisition of such knowledge during real sleep.

Appendix 1 gives a sample of such accounts. The items mentioned in this sample were the impetus for this paper and received special attention in our review.

- 2. The possibility of any practical results of further research in the area of verbal learning during sleep and especially foreign language learning would seem to be rather unlikely. Unless some new and promising materials or procedures in this area are evolved, we would suggest that further research, if any is contemplated, be directed toward other, less dramatic, but more feasible objectives.
- 3. The procedure of listening to and practicing with foreign language material during periods of leisure, relaxation, or simple physical routine can result in increased knowledge and skill. The possible increase in foreign language competence expected from such practices should, of course, be assessed in terms of the psychological and physiological costs.

A Summary Review of "Sleep Learning" With Special Reference to the Acquisition of Foreign Language Skills

#### Problem

The claim that knowledge can be acquired without effort is the promise of sleep learning. The purpose of the present paper is to assess this claim with particular reference to the learning of foreign languages.

## Definition of "Sleep Learning"

The term "Sleep Learning," as used in the present paper, refers to the learning, or supposed learning, of some verbal subject matter or skill during a state of natural sleep. That this is the common meaning of the term is apparent from a review of popular and commercial sources, as well as from the scientific literature, both of which are listed in the table of references on page 11.

The references mentioned indicate a general and common meaning to the term "Sleep Learning." Other similar terms are "sleep education" and "sleep teaching." The sleep learning idea is sometimes associated with hypnotism, as in "hypnopedia." Sometimes sleep learning is associated with therapy, as in "sleep therapy." These meanings and usages apparently occur on a wide basis, being found in both European and Western literatures.

The fact of widespread agreement as to the meaning of the term, however, is no necessary reason for believing that sleep learning actually occurs. In order to test whether sleep learning does take

place, some objective criterion of deciding whether a person is or is not asleep, as well as whether the person has or has not learned anything while in the sleeping state must be utilized.

Although there are technical reasons for regarding both sleep and learning as continuous phenomena such that one speaks of levels in the sleep-wakefulness continuum or of levels in the simple-to-complex learning continuum, it is also true that reliable judgments can be made as to whether a person is or is not asleep and, independently, as to whether a person has or has not learned something.

# Criterion of Sleep

Person, in a sleeping condition, enables observers to agree as to whether he is or is not asleep at any one moment: the absence of alpha wave is commonly taken to indicate loss of consciousness or onset of actual sleep; presence of delta wave indicates deep sleep. Though other indicators of sleep are also used, the alpha and delta wave friteria are in good standing. (16, 19, 20)

# Criterion of Learning

Learning, or the acquisition of knowledge, is commonly demonstrated by a variety of questioning or testing procedures. If a person did not know the answer to a question yesterday and knows it today, this is generally taken as indicating he learned the answer in the meantime. Learning is generally inferred on the basis of an increase in knowledge or an improvement in performance attributed to experience, instruction, study, or practice.

#### Purpose of Paper

This paper is concerned with the practical problem of assessing the contribution of sleep learning to the language teaching process. The major contribution to this assessment problem comes from a series of studies by Charles W. Simon and William H. Emmons. These authors systematically reviewed the sleep learning literature for the RAND Corporation some years ago. Their laboratory controlled, yet highly practical, experiments on sleep learning are widely accepted as the most authoritative and definitive work that has been done on the problem of verbal or "complex" learning during sleep. The major failing of studies which purport to demonstrate "sleep learning" is the use of an inadequate or casual method of determining when the learner was asleep.

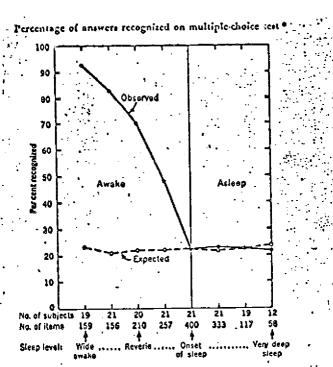
In view of this common fault, the technically sophisticated work of Simon and Emmons warrants the following detailed explication.

# The Simon and Emmons Experiments

In order to determine whether knowledge could be acquired during sleep, Simon and Emmons (13) played general information question-and-answer items one by one at five-minute intervals throughout the night to 21 people. There were 96 questions in all, and each question was played to each person in the experimental group one time. By also measuring the depth of sleep of each subject continuously during the night by means of the EEG, it was possible to determine whether a person had learned the answer to a particular item while he was

the amount learned by the experimental "sleep learning" group was provided by a matched control group of 64 people who received no intervening training on the items. It was found that the greatest learning occurred when the subject was wide awake, that less and less material was learned as the people became drowsier and drowsier, and that when the people became really asleep, all learning stopped, the level of knowledge then being no higher than the knowledge baseline of the control people who had received no training. As shown in the graph on page 7, the disappearance of all learning with the onset of actual sleep is clear-cut. The authors concluded that "the results support the hypothesis that learning of ing sleep is unlikely."

In the study just described, each person in the sleep-trained group was exposed to each question-end-answer combination once and only once. A second experiment (6) was performed to determine whether sleep learning would occur if the people had common one-syllable words played to them over and over again many times during actual sleep. By giving the people many exposures to the items, a greater opportunity was provided for sleep learning to manifest itself. The number of times the items were presented during actual sleep varied from 16 times for some people to as many as 82 times for others, the average for the group being 46 presentations. Again, no learning occurred during periods when the HEG indicated that the people were truly asleep.



*Items were presented at varying levels along the continuum between a wakir, rd. deep sleep state. The expected value was that obtained from an untrained control post comparable ability answering the same items.

* (Simon and Emmons, 1956, p. 94)

As quoted by Berelson, B. and Steiner, G.A.

Human Behavior; An Inventory of Scientific Findings,

New York, Harcourt, Brace & World, 1964, p. 179.

Probably no study of a complicated problem can arrive at conclusive proofs. In this vein, Simon and Emmons (18) state, "Perhaps the future development of new and unknown techniques will permit someone to learn complex material while he sleeps, but for the present, sleep-learning is not the simple matter that some experimenters and commercial firms, which sell equipment for this purpose, would lead us to "feve."

### Other Considerations

There is evidence that simple conditioned reflexes can be instituted during sleep in animals and, presumably, in man. (1, 7, 9) Thus, sleep learning can legitimately be defended in a technical or laboratory sense, though not in a practical or real-life sense. It would be misleading to interpret such data out of context in an attempt to provide scientific status to the popular sleep learning movement.

If learning during real sleep is impossible, and if one's entire wide-awake schedule is filled with active work or study, what about the periods in between? Could the reverse or drowsy states be used to acquire additional knowledge?

Learning during the drowsy state is certainly possible. Simon and Emmons point out that "approximately 30% of the --- material presented in the period just prior to sleep was recalled." (18)

The question is whether it is wise to use the drowsy phase for purposes of acquiring knowledge. For normal people under standard

conditions, as is typically the situation in learning a foreign language, the attempt to acquire knowledge during the drowsy state would seem inefficient and unnecessary.

Some people so skillfully manage their lives and schedule their time that they work more hours per day than the average person, yet also obtain adequate amounts of relaxation and sleep. Other things being equal, a person who works more hours per day will accomplish more in his total career than will someone who works less. The number of hours per day which students work while acquiring a foreign language ranges from very few to very many, depending upon a host of personal and situational variables.

At the present time, some schools encourage students to listen to foreign language material via tape recorder whenever they are able. Some students is, listen to foreign language recordings while shaving, or while driving to work, or while getting ready to retire for the night. Beyond some point, however, even the most steadfastly motivated students will suclumb to too much work and too much listening: they may take very obvious and direct steps to avoid the sound, such as turning the machine off, or they may simply fall asleep and ignore it. Such incidental learning has much to commend it and is frequently utilized without ill effects by students and educators.

However, none of the considerations listed above are of such importance as to impair the validity of the major conclusion reached by this review: verbal learning, as commonly understood, does not occur during actual sleep.

#### APPENDIX 1

Accounts of Foreign Language Capabilities Acquired During Sleep

# Russ Pick Up English ying Down---Asleep

1 Apail 65

In Russian experiments Perceived during sleep. Woman student marriered a lare leneme and nicht and 19, course of speceme wellsh in is thopen. To reach 50-bot 100 minutes. 28 nights

· When she high tested at found that her knowledge was equivalent to that 400 words and phrases in a achieved in the normal first-night. year course at the university.

This is reported in an article by a Russian journalist, the 1950s, says that! sleep-Villen Lustiberg, which appears in the March issue of than normal learning. the magazine New Educa-

#### DISTORTED

· Lustillerg describes experi- ut any given moment. ments in group instruction at . Lustiberg says: "The the Niev Fligher Radio-Engl- wakeful cerebral cortex reneering School After the puplis full asleep, words and terchanging points of excita-phrases are read to them in tion and inhibition; that is, it a voice which is distorted to is continually in a state of

ties of speech which are best

"sleep-learning" one At present about 30 words !

LEDNID BUZHChehenka a piniologist at the Ukrainian Klev State University it was Academy of Sciences, says it is possible to memorize up to

> Dr. Abrain Svyadoschch, who began experiments in learning tires the brain less

> Although the brain funcareas are in the same state

emphasize those characteris- partial sleen, simultaneously vigilant and relaxing."

#### SLEEP

in the same way, during sleep the capacity for work of many cells of the cerebral cortex remains. The receptive faculty of the mind can still function through these cells, although the system controlling the conscious mind is inhibited and at rest. In early experiements, D. Syndosheh successfully

taught people, aged from 19 four retained only 19.6 per to 60 years, during steep. Six-cent. The age of the persest teen absorbed 89.5 per cent did not seem to matter. Monchester Guardien of the material, but the other i

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  - * In addition to the selected references listed above, various other materials pertaining to sleep learning were assessed and correspondence with government and business bureaus, as well as with individual researchers in both the United States and Eastern Europe was initiated to insure comprehensive and up to date coverage of the sleep learning problem.

#### THE BACKSTER EFFECT

Mr. Cleve Backster has, since 1966 (1-4), presented to the lay and scientific community claims that a large variety of living materials (primarily plants, but also including hen's eggs, paramecium, amoeba, mold cultures, scrapings from the roof of a human mouth, and yeast) will produce characteristic electrical signals when connected to a polygraph machine. The signals obtained, in Mr. Backster's opinion, closely resemble the outputs seen when human beings undergo lie detector tests. That such signals are indeed produced is not surprising. What is unexpected is Mr. Backster's contention that they result from the perception capabilities of the materials.

The processes of life are such that in living systems a large variety of conditions exist which give rise to electrical charge separations with attendant electrical potentials. These potentials are interconnected by the salt containing fluids of living systems which in turn are contained in materials having diversified electrical properties. The result is an extremely complicated electrical circuit consisting of a multiplicity of parallel and series connected potentials, resistances, capacitances, and reactances. Thus, if current flow in such a system is monitored by connecting it to a psycho-integrosummeter (lie detector) one should not be surprised to see a large variety of current changes many of which will resemble typical polygraph outputs. A multitude of seemingly insignificant events can conceivably change the impedance of such a circuit through their influence on the resistance, capacitance, reactance or potential generating characteristics of the system. For example, a change in the position or strength of any nearby electrical or magnetic field can induce a voltage in a critical part of the circuit which will result in a large change in the current flow as read by the attached ammeter. Such changes can be brought about by the mere repositioning of the observer's body or motion of his limbs. Likewise, small changes in the chemical makeup of the system due to such things as adsorption of odors or water vapor can appreciably change the resistance or capacitance of the system which will change the matching characteristics

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between the readout ammeter and the circuit giving rise to impedance mismatches and a consequent change in readout. In addition, the internal environment of a living system is constantly undergoing change due to cell division, elongation, and maturation. These changes may also alter the impedance and voltage generating characteristics of the living system and result in a variety of changes in the current readout.

Figure 1 shows some voltage changes which have been induced at a distance of i meter in a human hair (stretched between two platimum electrodes and made to be semiconducting by coating it with glycerol and a liquid soap) by a vibrating barium titanate crystal. It is evident that the vibrating crystal induces a voltage in the hair preparation which is related to the first derivative of the frequency of the vibration and therefore, it is probably a reflection of the change in the electric field at the barium titanate crystal. Since the hair preparation is derived entirely from materials found in living systems and its structure is due largely to the hair (a former living material) it is reasonable to expect that this preparation has an equivalent electrical circuit which resembles, in many ways, that found in living tissues. Thus, if voltage changes can be induced in this preparation, there is reason to expect that they can also be induced in living systems.

There seems to be no reason to doubt Mr. Backster's observations of polygraph readouts from a variety of living materials. On the other hand, his explanation for these observations warrant some comments. Many of the experiments which Mr. Backster has conducted appear to lack adequate controls and almost all of his explanations or implied explanations for the results are at best impulsive. He concludes that his readouts are the result of single cell activities and, therefore, possessed by all living systems. However, his experiments are often designed to show a one to one correspondence between a polygraph readout and a specific event which is really only one example of a constantly occurring phenomenon. For example, in order to show that plants are sensitive to the death of other organisms, even at a distance, he dumps brine shrimp into boiling water and observes the polygraph responses of plants

located in another room. But if, as he purports, this experiment shows that plants are sensitive to the death of other organisms, why are the plants atuned only to the death of these particular organisms? Certainly, there are millions of microorganisms dying in the same room with the plants and undoubtedly a number of household pests such as ants, flies, and the like are also dying in various parts of the house not to mention the variety of fresh vegetables and meats being prepared in the neighborhood kitchens. Likewise, Mr. Backster has a marked tendency to look for biological explanations for his work. He always relates his polygraph patterns to psychic or physical phenomena seen in human beings; i.e., emotional stimulation, "fainting", heartbeat, nervousness, even prayer. This is a basic error which can mask and distort the possibility that the observed phenomena can be used for useful and perhaps unique purposes. It is not necessary to resort to explanations which transcend the physical laws we know now. An approach which seeks to interpret the results within the framework of known phenomena will be far more useful. Consider the possibility that the house plant, for example, acts not only as a biased electrical circuit, but also functions as a high impedance antenna. Such a system can be disturbed by changes in small electrical fields, perhaps even of the magnitude produced by brain waves and blood circulation. After all devices are available that can detect at a distance magnetic fields generated by blood circulation and brain waves (5-6). Also, the surface area of a plant is quite large and well adapted to gas exchange reactions so that trace amounts of chemicals emitted from animals can be absorbed by the plant and lead to pronounced changes in plants and their electrical circuitry. For example, plants change their metabolism and undergo leaf epinasty in response to a concentration of ethylene of as little as 0.002 microliters per liter of air (7-8). The events triggered by conscious or unconscious nervous reactions (odor emission, increase in heart rate, change in brain wave pattern, etc.) on the part of an observer, which go undetected by him, could conceivably cause changes in delicately balanced electrical circuits including those existing in living systems. Under these circumstances, the electrical readout from an instrumented plant could change in response

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to the emotional or physical state of an observer. However, the response would in no way be a case of the plant reading the individual's mind. Rather, it would be due to changes in the plants environment brought about by the observer and resulting in a change in the electrical characteristics of a delicately balanced system.

The possibility that very subtle changes in the environment alter the electrical properties of plant tissues is not unreasonable. Such changes are everyday phenomena in animal sensory organs and the structures and electrical status of plant cells have many features in common with nervous tissue. The most essential difference may actually be in the organization of the cells. In the animal, the cells are arranged to provide quick reaction times, centralized information depository and specialized information sorting together with feedback and compensatory reactions. In the plant, on the other hand, the cells are not organized in this manner and although their electrical properties may change with the environment, the phenomenon is of limited use to the plant. However, if man monitors these electrical changes, he may be able to correlate them with subtle changes in environmental factors which are of interest to him much in the same way that the receptor potentials of various nervous tissues (visual, olfactory, tactile, etc.) can be used to supply information on, for example, odor concentration, light intensity, and pressure.

It is suggested that a program be carried out to investigate the possibility that changes in the electrical properties of plants are induced by subtle changes in the environment. Methodologies which are similar to those now used to explore receptor potentials in nervous tissues could be employed and the characteristics of any signals observed correlated with such things as trace amounts of odors introduced into the environment or minute changes in electrical and magnetic fields.

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FIGURE 1. Response of Human Hair Coated with Liquid Potassium Soap and Doped with Octanol.

In each case, trace A is the response from the hair and trace B is a record of the signal driving the barium titanate transducer. The numbers indicate the frequency of the driving signal. Traces A and B were made simultaneously with a dual beam oscilloscope.

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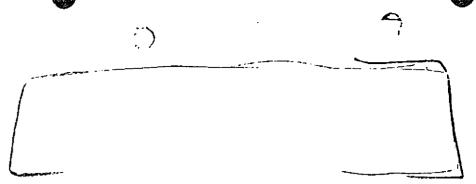
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Period Covered: June 15, 1966 to October 15, 1966

### I. Experimental

Following is a brief synopsis of activities under this contract performed during the first four months. Details will appear in the six-month report.

- 1. Animal experiments involved electrical stimulation of the plantar nerve in cats, while recording skin potential responses and conductance responses from the foot pad. Response amplitude was found to be strongly potentiated by increasing periods of rest between test series. This effect appears to be due to the state of resting hydration. It affects both potential response and conductance response and conductance response and may account for a 100 per cent difference in response amplitude.
- 2. Microelectrode studies were extended to observation of potential response from sweat gland pores and from epidermal sites along with simultaneous recordings from large sites with conventional electrodes. The epidermal sites gave primarily positive responses at the same time as the sweat pore and the gross site was producing negative responses. This finding was consistant with the hypothesis that the positive responses are of epidermal origin and reflect a different type of biological adaptation than does the sweat gland activation.
- 3. Further experiments were carried out on the nail bed to determine whether these alleged epidermal responses were in fact only artifacts of nearby skin activity due to volume conduction. Strong positive potential responses were found to be easily eliminated by puncture of the epidermis with the microelectrode used for the recording. Negative responses, if present, could not be so eliminated. The possibility that the weak negative responses are of vascular origin is being examined. This effect would confound the interpretation of negative waves from the sweat gland at normal skin sites.
- 4. Experiments to investigate the temperature effect on amplitude of the positive skin potential response have been initiated. There is a potentiation of the positive wave with increasing room temperature (these induced temperature changes are not local as in previous experiments) indicating that the epidermal component (if this is the origin of the positive wave) possibly serves a thermoregulatory function and is indicative of a covert preparation for motor activity. The negative wave, presumed to be of sweat gland origin, is not potentiated by increasing room temperature.

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This is not surprising if these sweat glands are non-thermoregulatory as claimed by Kuno and others.

5. A model, relating potential responses to conductance responses, has been developed, and is serving as a guide to the direction of experimentation and interpretation of results. This model, attributing negative waves and the long lasting component of the conductance response to sweat gland activity and positive waves and the fast-recovering component of the conductance response to epidermal activity points to methods for their separation. One method involves analysis of the recovery slope of the skin resistance response. The other entails the use of high frequency impedance measurements in conjunction with conventional D.C. measurements of skin resistance. These measurements are now under test.

### II. Research facilities and personnel

procured under this contract has been delivered and is in operation. The laboratory for the animal work and microelectrode work has been renovated and is also in operation. All personnel engaged in the research activities under this contract have been recruited and trained where necessary.

BIO-POWER

INTERIM REPORT

October 15, 1966

Contract No.

Prepared by:

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# STATEMENT OF OBJECTIVES

The object of this study is to survey past work in the area of I. body produced electrical power as reported in the literature, develop an understanding of the various methods and approaches which have been suggested as possible sources, and present this information in a useful form. This report is directed towards the general problem of providing electrical power to implanted electronic devices, such as artificial cardiac pacemakers, requiring less than 200 microwatts for an indefinite time from a completely self contained internal system.

### II. SUMMARY

A general literature review was first undertaken to both discover previous experimental work and to gather general impressions of thinking on this subject. The review indicated that there were few well documented conclusions available and that although a fresh start might be duplicative, it is needed for a systematic study. Conceivable sources were listed and each has been briefly considered from the physiological and instrumental viewpoints. In trying to evaluate potential usefulness of a source it was sometimes necessary to form conceptual designs of mechanical systems which could utilize that source. Comments on these designs are included in the discussion as contextual information because they illustrate those aspects of the systems which were considered and the design problems encountered, not because these designs are felt to be the proper solution. We concur with recent statements by investigators active in experimental work that the physiological Galvanic cell and mechanoelectric conversion are the two most promising systems, although much work is necessary before either is useful for practical purposes. Throughout this study we repeatedly encountered unanswered questions of the possible effects of biological adaptation on the total implanted system. These effects need not be entirely negative. Adaption in a direction tending to increase power output is a possibility deserving of serious attention.

### b. Muscle Potentials

With muscles the situation differs in several respects that make power pick up from this system at least conceivable. Namely, the volume of muscle is large compared with neural tissue and stimulation of a few units should not seriously disrupt normal function. The large muscle areas may allow many electrodes to be used simultaneously in order to provide a lower electrical source resistance. For example, if one pair of electrodes provides a source resistance of 500 ohm, 40 pair will provide 12 ohm. In order to utilize this low voltage ac source a miniature transformer can be used to step up the voltage before rectification. From a power standpoint it should be more efficient to use one transformer and rectifier with each pair of electrodes and sum the dc outputs. Since skeletal muscle EMG signals contain most of their power in frequencies above 100 cps, subminiature transformers ( $\frac{1}{15}$  oz,  $\frac{1}{40}$  in. can be used. Answers to important biological questions were not found in the literature. No reports describing investigation of EMG signals as power sources were discovered, although use of EMG signals for control purposes have been frequently studied. Whether or not a low enough source resistance can be achieved and maintained and what type of electrode and implantation is best are questions which will probably have to be answered by experiment. Careful technique may prevent electrodes embedded in muscles performing large movements from causing irritation and pain but this will also require study. Judging from the experience of clinical workers with implanted cardiac pacemakers, small electrodes can be tolerated but dislodgement and lead breakage may be serious problems.

### 2. Direct Current Systems

These systems are all those that produce electron flow in one direction only between the two electrodes. This is unlike the neuromuscular potential electrode system in which a capacitor would be placed in the circuit to insure that no net charge flows from one electrode to the other. In the neuromuscular system the electrical energy of interest is "Iternating current" in that charge flows from electrode A to electrode B and then, milliseconds later, returns to A. In the neuromuscular electrode system net current flow would provide no useful work and undesired reactions might accumulate products on or near the electrodes that result in "polarization" and/or electrode deterioration which interferes with the desired action. This type of electrode activity, however, can become the desired activity in direct current systems.

### a. Physiological Electrode Cell

The Galvanic cell in its simplest and classical form consists only in two different metals (or other conductors) dipping into a common ionic solution. An electric potential, characteristic of the metals, temperature, ionic species and concentration, can be measured between the non-immersed portions of the two metal electrodes. Since the fluids existing within the body are ionic solutions inter-electrode potentials can be produced by inserting two dissimilar conductors anywhere. Because of the complexity of the body fluid composition, variation in composition at different points, induced effects from the presence of foreign material, presence of many membranes with unknown properties, active processes, etc., etc., the actual chemical reactions and inter-electrode potential can not be predicted, in fact such potentials are not strictly defined. (Nims, p. 5).

We can consider that there are two general types of reaction which occur with implanted electrodes. The first, which we will call type 1, is like that in the classical Galvanic cell described above in which one or both electrode materials enters into the reaction and ... becomes irreversibly altered or lost. The second type of reaction is possible when membranes are present and the chemical environment differs at the two electrodes. In this type 2 reaction, which in its simplest form is the classical concentration cell, irreversible change to the electrode surfaces need not occur and the electrodes need not be dissimilar. The rate of the chemical reactions may be much improved by dissimilar surfaces, however, for example by catalytic action, increased effective area, inducement of local environmental change, etc. This second type of activity can be considered as a fuel cell with the physiological system main bining all the reactants and removing the end products. A special application of the type 2 system is when similar electrodes of "inert metals" or of "non-polarizable" liquid filled tubes are used in conjunction with very high impedance voltage measuring circuits which insure that the potential chemical reactions do not occur at the electrodes. This arrangement is used for investigating so called natural dc potential gradients within and on the surface of the body (4). Such measurements necessarily must draw virtually no power from the chemical energy sources responsible: for the electrode potentials, for as soon as current is drawn reactions occur and the natural concentrations change. Thus any dc current producing electrode generator scheme useful for our purposes will have inter-electrode potentials which are more or less unnatural physiologically. That is, the potential difference between electrodes of any type drawing current will be different from that measured between "non-polarizable" electrodes drawing no current, and the local chemical environment surrounding the electrodes may be grossly

different. For these reasons the type 1 system in which electrode material change occurs and the type 2 system in which it need not are considered here as two special cases of the general physiological electrode cell system.

The general case of which the type 1 and 2 systems are examples, is when dissimilar metals, which produce a potential when dipped into a common ionic solution, are placed in a nonhomogeneous environment that produces a potential between similar electrodes. This is probably a fair description of the situation prevailing in the electrode material, electrode placement combinations with which Dr. John Konikoff and others produce the best results. The Konikoff work is a significant source of experimental data and has stimulated much of the recent interest in the physiological electrode cell power source. For these reasons a brief summary of the work reported in reference 12 is included here. The reader is referred to the original paper for details.

John Konikoff and Luther Reynolds were the principal workers at the General Electric Company's Space Sciences Laboratory under a contract with NASA in 1963 - 64 to investigate the use of what is referred to here as physiological electrode cell potentials as a biologically derived power source. Many combinations of electrode materials in several anatomical locations in several species of laboratory animals were tried. Their final choice of electrode materials was "high speed steel (75% Fe, 6% Cr, 18% W, .3% V, .7% C)" and a specially prepared "platinum platinum-black" combination. The final choice of location was as follows, "... the PPb electrode was located in the abdominal cavity dorsal to the peritoneal membrane; and HSS situated subcutaneously but physically adjacent to the abdominal incision." The

longest continuous implant was 128 days, electrodes and sites were as above. The animal was a rabbit, and a constant resistive load of 10,000 ohm was applied between electrodes. After 15 days the output stabilized and thereafter remained at 24 microwatts and .5 volt. The highest power reported in short term studies was 308 microwatt. No new work from either Konikoff or Reynolds has been published since 1954. Telephone conversations with both men indicate that work is continuing, and that recent improvements in the platinum-black electrode material have increased the power output threefold for the same electrode area. Reynolds who is now at Hahnemann Medical College, Philadelphia reports that 200 microwatts has been obtained when each electrode is of 1/2 in area. This electrode power generation scheme has the advantages, according to the originators, of simple surgical procedure and no harmful tissue reaction or loss of output at least for 4 months in the one long term rabbit experiment.

According to the data in the Konikoff report and especially the recent report of Strohl et. al. (29), when "biologically inert" metals such as platinum and type 316 stainless are implanted, power levels greater than 10 uW have not been obtained and the output drops significantly below this after a few days. Strohl's comments on the inevitable growth of a fibrous membrane around implanted electrodes suggests that the electrodes become isolated from the original, dissimilar ionic environments as this membrane grows. The better power outputs and longevity have been obtained in conjunction with an electrode which actively reacts with species present in the extracellular fluids. Even when covered with (hypothetical) cells tending to maintain identical ionic concentrations around the two electrodes, a reactive electrode can continue to provide current. In evaluating an electrode cell system containing reactive electrodes important considerations are toxicity of

products and deterioration of performance with time. As Strohl notes. Faraday's first law predicts the electrode weight loss due to ionic solution when the electrode reactions are known quantitatively. For example, .91 of iron will be needed to supply 100 uA for 1 year. But at least as important are the hard to predict effects such as loss of effective surface area "catalyst poisoning", uneven surface deterioration and long term local tissue reaction. In conclusion, it appears that there is a reasonable possibility that physiological electrode cells can provide 200 uW for extended periods, but careful long term studies and an understanding of the active phenomena, which, hopefully, will provide the basis for optimizing the electrode materials, are necessary. But the simple surgery in low risk areas which has been used, the mechanics - no moving parts, the nondependence on any bodily motion, the inherent freedom from encapsulation problems, and the short term results already achieved, combine to make this a most promising system at this time.

b. Fuel Cell

been speculated on for producing relatively large quantities of electrical power for running proposed artificial hearts. These systems are usually referred to as fuel cells and usually are considered in reference to known chemical energy sources such as glucose or ATP. These systems are very appealing, largely because the proposed energy source is fairly well understood. Molecular energy yields, available concentrations and naturally occuring reactions can be stated. The development of physical systems to utilize these sources then appears to be a problem amenable to present technological capability since the available raw materials and necessary operations are known, at least

in broad outline. This is in contrast to the simpler Galvanic cell systems discussed earlier in which the present state of the art has been reached largely by trial and error without benefit of thorough understanding of the detailed processes involved. Approaching the problem from basic principles and proceeding in accordance with established theory will no doubt achieve practical success in time. The National Institutes of Health recently circulated a Request For Proposal to undertake feasibility studies of implanted biological fuel cells. When these initial studies are completed we will have a statement of the problem and outline of needed research. For the immediate future, however, the simpler a proposed system is, the greater appears its chance of success.

### B. Thermoelectric Converter

Temperature gradients within the body theoretically can be exploited as a source of electrical energy. In recent years considerable research on thermoelectric compositions for use with nuclear reactor heat sources has produced materials with thermoelectric properties much improved over those of conventional thermocouples. For example, a conventional copper-constantin couple will produce 23 microvolt per fahrenheit degree temperature difference while a material of Bismuth-Antimony-Telluride composition produces 77 microvolt/F (11,8). Simple calculations using this second figure indicate that with a 5 F temperature difference and 1 ohm resistance for every element 2500 elements connected in series will yield 200 uW at . 5 volt. A Japanese group (32) has published a report of a 150 element thermoelectric generator for use on the external body surface. Their device used the Bi-Sb-Te material and the size of the thermoelectric array appears to be about 2.5 cm x 1cm x .5cm. The data presented in their report are not

clear and well organized and therefore the following calculations based on that report may not be completely correct. A maximum voltage of about 450 millivolt (open circuit?) is reported. 'A series array of 150 elements of a material producing 77 uV/F°. will produce 450 mV at a temperature difference of 39 F°. Since some of their work was at 10°C (53°F) air temperature with evaporating alcohol on the cold junction, this temperature difference is possible. The only power output figure mentioned is 20 uW/cm. If this was obtained under conditions which produced a . 45 volt open circuit voltage and if their device contacted a skin area of 2.5 cm2 then the indicated internal resistance of their device is 2000 ohms, or roughly 13 ohm per element. If this resistance figure is realistic for thermopiles composed of elements of 2mm x 1mm x 5mm size then the 2500 element array mentioned above would produce only 1/3 of the assumed 200 uW or only 15 uW. A total resistance of 13 ohm per element appears unnecessarily high, however, according to the following calculation. The resistivity of Bi-So-Te is only  $7 \times 10^4$  ohm - cm (8). Hence an element of the above dimensions should have only 17 millohm internal resistance. Therefore the actual electrical resistance is almost entirely contributed by the contact between the thermoelement and the heat sink conductor and is largely a problem in technique. According to reference 26, contact resistivity in elements used in thermoelectric power generators may vary between 3 and 4500 microohm - cm2. The higher figure indicates a contact resistance of . 23 ohm for an area of . 02 cm and, since there are two contacts per element, a total contact resistance of .5 ohm for elements the size of those in the Japanese device. This last calculation was the basis for our original assumption of 1 ohm per element.

The conclusion we reach is that a 2500 element array operating between a temperature difference of 5 F°, with a surface area of 42 cm².

at each heat sink and a depth of .5cm will produce 200 uW at .5 volt. By comparison, 25 cm³ of medical grade mercury cells (8 Mallory RM CC - 1W) (20) has a capacity of 8 AH which, neglecting age derating, will supply 200 uW for 5 years at 1.4 to 10 volt. Since the failure of any one of 5000 contact points in the series connected array will cause system failure, and since a 5 F⁰ temperature difference between two 42 cm² areas. 5 cm apart does not naturally and reliably exist within the body, the thermocouple system is considered to be not competitive with conventional batteries for an implanted power source.

### C. Mechanoelectric Converter

In this section possible mechanical energy sources will be considered together with mechanical coupling schemes. An arbitrary criterion of 1 milliwatt net mechanical work in the coupling system was chosen as a practical minimum power level for a final electrical output of 200 microwatt. Brief consideration of actual mechanical to electrical transducers, namely, piezoelectric crystals and permanent magnet generators, is included. We make the provisional assumption in this section that if a mechanical system can be implanted which will perform 1 mW work, for example in winding a spring, for over a year, then a transducer can be designed to utilize this energy. Other than work based on electrode cell potentials all known experimental implant power generation has been with piezoelectric crystals.

#### Sources

The obvious mechanical sources are:

 Voluntary muscle, joint and limb movements

- Peristalsis (dismissable on grounds of insufficient power)
- Respiratory system rib cage motion,
   diaphragm muscle, thoracic and abdominal
   "pressure variation"
- Cardiovascular system heart motion, aorta
   and large artery pulse expansion, blood flow
- Gross body acceleration (self winding watch principle, "random motion power")

Movements associated with voluntary activity in some cases offer large quantities of mechanical power. The intermittant character of this activity means, however, that an energy storage system must be included in the design to supply power during periods of inactivity. Rechargeable batteries are the obvious storage device, especially since they are designed for and require relatively high current, short duty cycle charging. These batteries require 50 to 100% more charge current than they return, however. Therefore, any intermittant generator will have to supply 300-400 microwatt average electrical charging power if the tattery undergoes 200 microwatt constant drain. It may not be unreasonable to depend upon or require some particular voluntary movement being performed at some minimum rate for many months, but unless a particular application requires power only during a certain type of activity, it seems more straightforward to couple a motion generator to a continuous activity, such as respiration and blood flow, in which the rate and other operational norms and limits are predictable and unavoidable.

### Respiration

The first continuous motion source which we will consider is respiration. Since the object of respiratory mechanical motion is to pump air, a fluid flow system operating on the pressure volume changes found in the thoracic and abdominal cavities during the respiratory cycle is an obvious possibility. During conditions of quiet rest the variation in pressure within the human adult thorax is approximately 3mm Hg (4 cm H₂O) or .04 Nt/cm². At a breath rate of 30/min, work of 2 millijoule per breath must be done for an average mechanical power of 1 milliwatt. If we approximate the phase lag to be expected between pressure and volume by assuming no phase lag but with only one half the pressure variation (i.e. . 02 Nt/cm2), then the volume of fluid (silicon oil, gas, isotonic saline, etc.) which must be pumped each breath according to the relation PV =  $2 \times 10^3$  joule is 10 cm³. Since the volume calculated in this manner is inversely proportional to breath rate and intrathoracic pressure, the volume required in most experimental animals will be less.

An elementary non-differential system responsive to respiratory pressure variations of 3mm Hg would probably be disabled by normal atmospheric pressure variations of one or two inches of mercury. Insensitivity to ambient "dc" pressure is inherent in a differential system, however, and because the intra-abdominal respiratory pressure variation is out of phase with the intrathoracic, two bellows, one in each cavity, connected by a tube would comprise such a system. It appears that this system can provide the necessary mechanical energy without obvious size and weight objections. A simple implantation procedure with a subcuianeous tube tunnel is conceivable, although all surgical questions as well as those on materials, size, shape and irritation require extensive

design and experimentation. In summary, a respiratory fluid pumping system is recommended as deserving of further attention.

Direct mechanical coupling to respiratory motion remains as another possibility. The change in dimension of the rib cage and diaphragm are attractive. The method of coupling might be something working on the principle found in retracting tape measures. A cable is wound on a drum and a spring tends to keep the cable wound up. If the drum package is firmly attached in some convenient location and the cable held against the under side of the diaphragm or in a subcutaneous tunnel around the chest with the far end of the cable attached, then the drum would rotate back and forth during each breath. A ratchet drive to wind a second spring would allow for any "zero position" of the cable. extension with the second spring driving the actual transducer. Perhaps placing the cable inside a silicon rubber tube filled with silicon grease, the tube being of the bellows type to allow it to lengthen easily, would improve the sealing and tissue irritation situation. While quantitative data on the diaphragm has not been sought, it certainly appears that sufficient power is available from diaphragm motion and also from chest expansion. The main problems are expected to be in materials, packaging and surgical technique. Apart from material fatigue and sealing, tissue erosion and cell destruction from too great applied pressures must be avoided, for even living tissue applying pressure unnaturally (e.g. an aneurysm) can erode its way through other tissue. The experience with bone plates, wires and other prostheses which have been used for many years shows that direct mechanical attachments to internal structures can be accomplished, however.

## Cardiovascular System

The other continuous mechanical source is the cardiovascular system.

could probably be provided by the diaphragm, the force necessary to support this mass against gravity is 20 Nt, which the diaphragm could not support. The artificial heart discussants are seriously considering weights of this magnitude for long term implantation; thus we cannot a priori dismiss a random motion system as unworkable, but it does not appear to be competitive with conventional mercury batteries in power per pound.

### 2. Transducers

### 2. Piezoelectric Crystals

The mechanical energy to electrical energy transducer most often considered for use in biological power applications is the piezoelectric crystal. Manufactured crystals of lead zirconate, lead titanate (PZT) composition have far superior properties for power transduction than do natural crystals such as quartz and rochelle salt. These manufactured crystals are produced in a form known as "ceramic bimorphs". Quantitative data on the relevant characteristics of these peizoelectric ceramics have been developed as part of this study from information available from the Clevite Corporation (9, 10, 22). Data of this sort are necessary for evaluating the practicability and design requirements of this method of power generation.

### Efficiency

One of the most appealing characteristics of these transducers is an attainable conversion efficiency greater than 50%. This efficiency refers to the ratio of net mechanical energy supplied to the crystal to electrical energy supplied by the crystal under optimum conditions of mounting and matching. The simplest system for driving a crystal is to have the mechanical source directly coupled, that is, when the source (e.g. expanding aorta) moves, the crystal is deformed proportionately.

With this type of mechanical coupling a differently defined "efficiency" is significant. Net mechanical work means total work done on the crystal to deform it  $\frac{\min u}{t}$  the total work done by the crystal as it relaxes to its unstressed state,  $\int_0^\infty F(t)v(t) dt$ . Since with direct coupling the source has to be capable of supplying enough work to deform the crystal, and since as far as the transducer is concerned any work it does on the source (during the relaxation phase) is lost forever, the ratio of total work done on the crystal

$$\left[\frac{1}{2}\int_0^\infty \left| F(t)v(t) + F(t)v(t) \right| dt \right],$$

to total electrical work done by the crystal is a meaningful figure. The usual model for these crystals is:

Electrical 3 E T Cm Mechanical

The Clevite literature contains tables for calculating: Ce, an electrical capacitance; N, the transducer ratio in volts per Newton; Cm, the mechanical compliance; and M, the mass in terms of: the dimensions, L, W, T; specific crystal type, PZT-5B, PZT-5H, etc., type of connection within the bimorph, series or parallel; method of mounting and drive, e.g. cantilever mounting with driving force at the free end. With the above model the internal stored electrical energy under short circuit conditions is  $We = \frac{1}{2} CeV^2$  where V = NF with F the force in Newtons. If an external capacitance C is connected and the crystal deformed by a force F, external work will be done in charging this capacitor. It can be shown that for the greatest external work, the external capacitor must be equal in value to Ce in which case  $\frac{1}{4}$  We joules are supplied. Since in actual use a bridge rectifier would be used which allows an equal quantity of electrical work to be done as the crystal relaxes,  $\frac{1}{2}$  We is the theoretical maximum electrical energy available. The mechanical work done on the crystal in deformation is approximately  $\frac{1}{2}$  FD,

where d, the deformation, is CmF, thus Wm =  $\frac{1}{2}$  CmF². The ratio

is: 
$$\frac{\frac{1}{2} \text{ We}}{\text{Wm}} = \frac{\text{CeN}^2 \text{F}^2}{2 \text{ CmF}^2}$$
 which for a P2T - 5B parallel bimorph

cantilever is 
$$\frac{\left(2 \times 10^9 \cdot \frac{LW}{T}\right) \left(3 \frac{L}{WT}\right)^2}{\left(2\right) \left(2.8 \times 10^9 \frac{L^3}{WT^3}\right)}$$
 which reduces to

.032 or 3.2%. Of great significance is that all dimensions and the magnitude of force drop out! Also, a series connected cantilever bimorph, and an end - supported - center - driven mounting of either series or parallel connection can be shown to have the same efficiency, and the P2T - 5H material differs only slightly. Thus, while choosing dimensions, mounting, etc. will certainly effect the quantity of electrical energy produced in a direct-coupled system, this energy can never be greater than 3.2% of the mechanical work supplied (as defined above). Illustrations of the significance of these figures will be found in the discussion of previous experimental work.

### Output

It was shown above that the maximum electrical energy which can be produced in one deformation cycle is  $\frac{1}{4}$   $\operatorname{CeN}^2 F^2$ . The value of F, of course, can not exceed the force necessary to fracture the crystal. For a cantilever beam of length L and thickness T, the strain is

$$S = \frac{3T}{2L^2} D$$

where D is the distance the free end is displaced. Maximum strain before fracture is an intrinsic material parameter and one value holds (approximately) for any configuration. Mr. Carmen Germano of Clevite

has recommended  $5 \times 10^4$  (50% of the fracturing strain) as the maximum strain to apply in a real system. We can assume a maximum deflection, then, of Dmax =  $\frac{2L^2}{3T}$  5 x  $10^4$  for a cantilever mounted crystal and a maximum force of Fmax =  $\frac{Dmax}{Cm}$  (D in inches implies Cm in in/Nt). Electrical output per deflection is, therefore, for a PZT-5B parallel bimorph cantilever:

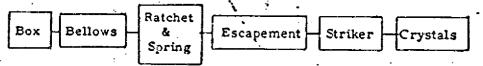
$$\frac{\text{CeN}^{2}\text{Dmax}^{2}}{4 \text{ Cm}^{2}} = \frac{\left(2 \times 10^{9} \frac{\text{LW}}{\text{T}}\right) \left(.3 \frac{\text{L}}{\text{WT}}\right)^{2} \left(\frac{1}{3} \cdot 10^{3} \cdot \frac{\text{L}^{2}}{\text{T}}\right)^{2}}{\left(4\right) \left(1.1 \times 10^{7} \cdot \frac{\text{L}^{3}}{\text{WT}^{3}}\right)}$$
= 420 LWT microjoule.

with L, W, T in inches. Since the bimorphs are only available in thicknesses close to 20 mil, the maximum output per deflection is 8.4 microjoule per square inch of area. Again, it can be shown that this figure is obtained for series as well as parallel connection, for center drive as well as cantilever.

The unit area output per deflection can be increased four times by allowing a "deflection" to be from - Dmax to + Dmax and back again, that is, by including a spring so that with no "external force" applied the crystal is deflected in the opposite direction from that which the external force produces. This variation in mounting does not effect efficiency since four times as much mechanical work is required. At the maximum strain of  $5 \times 10^4$  with a spring loaded crystal, the absolute minimum surface area necessary to produce 200 uW is  $\frac{6}{N}$  square inches, where N is the number of deflections per second, and, according to our previous definition of 3.2% efficiency, at least \$250 uW mechanical power to deform the crystal(s) is required. In order to extend the lifetime of the crystal by reducing fatigue it will probably prove

necessary to use smaller deflections than were assumed in the output calculations above. The output varies as the square of the strain however, so that at a maximum strain of 25% of the fracturing point  $\frac{24}{N}$  square inches of area are required.

If added mechanical complexity is introduced (e.g. springs, ratchets, escapements, etc.) all of the work during the active phase (e.g. systole) can be retained in the crystal transducer package. While extra moving parts will cause losses themselves, some improvement in efficiency can be expected and the mechanisms can allow other important features to be incorporated, such as a improved crystal mounting and drive with a fluid-free environment. The diagram below will illustrate the type of system we had in mind.



A box of suitable material is fitted with a flexible metal "window" of the corrugated metal bellows type seen in wall barometers, which allows both mechanical motion transmission and the possibility of maintaining a fluid barrier. The bellows' movement winds a spring through a ratchet, which prevents any loss of energy back through the bellows. The spring drives a wheel with fingers that deflect the end of a cantilever mounted crystal. The alignment is such that when the crystal is deformed a preselected distance, the finger slides off and the crystal is set in oscillation at its natural frequency. All of the work done in the original deformation thus must be dissipated within the crystal, and electrical energy is available during each cycle of oscillation. The escapement prevents the next finger from engaging the crystal until sufficient time has passed for the oscillation to damp out. Since several

finger-pushes per second are possible, a relatively small area of crystal can be used. This arrangement also provides the desirable feature of allowing input energy to accumulate in the spring until sufficient force is developed to drive a finger over the crystal in the event that the input falls below normal. If excess input energy is available the crystal is driven more often, but, since its maximum deflection is always the same, it can not be broken. E. Van Haaften of Bulova Watch has designed a system similar in some respects to the above. (18)

### b. Permanent Magnet Generators

A transducer not generally considered in discussions of implanted power is the permanent magnet generator. Because of the intrinsic weight of magnet and core materials, and because the usual mechanical input is rotational, this type of generator has little immediate appeal. However, if as has been suggested above, crystals require sealing in a total enclosure and drive through spring and gear mechanisms for optimum results then rotational input is not a relative disadvantage. If an implanted system must function for many years a p. m. generator should be satisfactory, while the fatigue lifetime of a crystal is not well understood. That weight is not an impossible obstacle is demonstrated by a generator manufactured by Rotating Components, Inc. and advertised in the 1966-67 Electrical Engineers Master catalog. This unit is 1.31" long by .95" diameter, weighs 2.5 oz . and, we calculate, can produce 100 milliwatt at 60 revolutions per second. A device especially designed for 200 uW output and low rotational speeds, therefore, should not be objectionably large, heavy or inefficient. We recommend that a p.m. generator not be dismissed until further data on the practical requirements and limitations of crystals become available. If the physiological and instrumentation problems of

obtaining mechanical work in the 10 milliwatt range can be solved, a p. m. generator may well be the better suited transducer.

#### 3. Previous Work

### Dr. John H. Kennedy

Dr. John H. Kennedy and Carl C. Enger at the Cleveland Metropolitan General Hospital have published several reports of their work with a self-powered cardiac pacemaker. (6,7) The devices constructed and implanted by this group consist partially in a piezo-electric ceramic crystal mounted beneath a flexible plastic cover. The package containing the crystal generator as well as the rectifier and pacemaker electronics is sutured to the rib cage in a position where the beating heart applies pressure through the cover to the crystal. This system has, for short periods, provided effective pacing via stimulating electrodes in several experimental trials with dogs. Since our interest is in the power generating aspects, we will concentrate our attention on the crystal.

In the most recent paper (7) the crystal dimensions reported are 3.75 x 1.87 x .05 cm and drive parameters are described as, "... the mechanical energy needed to operate the self-powered pacemaker is 200 newtons or 21.4 cm." Let us assume that what was meant is a mechanical force of 2.0 newton. Using design equations supplied by Clevite, the manufacturer of the ceramic crystals, it can be shown that for an end supported, center driven crystal of the quoted dimensions, the force necessary to produce a strain of 5 x 10⁴ (the recommended maximum) is 2.3 Nt. According to our calculations a PZT-5B crystal of the quoted dimensions deformed by a 2.3 Nt force will produce no more than 9.1 microjoule, and only 7 microjoule at 2.0 Nt. With a spring loaded crystal (and 4.0 Nt.) 28 microjoule is possible. Kennedy mentions the figure of

23 microjoule, but his reference is technically ambiguous. In order to provide a low ripple electrical source, it appears a larger capacitor than the optimum for maximum efficiency was used, however. An output voltage of 1.75 volts is mentioned. The maximum energy which can be supplied into a 1.75 volt source by a PZT-5B crystal with the above dimensions and 2.0 Nt driving force during a deformation - relaxation cycle depends on whether a series or parallel type of crystal bimorph was used. The best choice is parallel which can provide 5.4 microjoule. With a heart rate of 120/min the maximum power that could be produced is therefore 11 u W.

It is worth noting that the mechanical power necessary to deform a directly coupled crystal that provides 11 u W of electrical power is at least 340 u W. Therefore, if the transducer package can be designed to provide 20% efficiency rather than 3.2%, 68 u W could be obtained with no change in the mechanical power input. And if the displacement is increased from .2mm to .6mm, enough mechanical power is available to produce 200 u W at 20% efficiency. Even if only 10% efficiency is attainable, a deflection of 1.2mm to increase the power input does not appear unreasonable. Dr. Kennedy reports that after a one year implantation no damage to the adjacent myocardium was found. Electrical output apparently has not been maintained beyond a few days because of leakage of fluid into the package. Improvements in the crystal mounting and drive, in materials and packaging, and in surgical technique should be undertaken.

### Dr. Victor Parsonnet

Dr. Victor Parsonnet and his co-workers at the Newark, New Jersey Beth Israel Hospital have published several papers describing their experiments with ceramic bimorphs mounted on the aorta. (e.g. 18,21)

Their latest device contains two PZT-5 crystal slabs as the arms of a spring clothespin-like device which clamps onto the aorta. Each slab is  $1\frac{1}{4}$  by  $1\frac{1}{2}$  inches, an area which, according to our previous calculations for unidirectional stress, can produce 31 microjoule per deflection. This group has chosen a maximum stress of 20% of the modulus of rupture or  $\frac{2}{5}$  of the stress necessary to produce the 31 microjoule output (and a better choice from the fatigue lifetime viewpoint). At this stress about 5 microjoule can be produced per deflection or about the same output as Kennedy has achieved. As did Dr. Kennedy, Dr. Parsonnet has experienced difficulty with fluids leaking through his silicon rubber encapsulation which has limited the electrical lifetime to a few hours.

For an artery clamp of the clothespin type the mechanical work done by each expansion of the artery is roughly proportional to: systolic-diastolic pressure differential, normal variation in arterial diameter in each cycle, arterial diameter, and length of artery used. For the following set of parameters, 20 mm Hg, 2mm, 1cm, 4cm, we calculate an energy yield of 500 microjoule per beat, which is 1 milliwatt at 120 beats/minute. Aortic expansion does appear to be capable of producing the necessary quantity of mechanical work, but it remains for improved mechanical designs to meet the sealing, efficient drive, and adaptation requirements which are demanded of a successful long term system.

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RESEARCH PLAN AND SUPPORTING DATA

THE

HEART DISEASE PROGRAM

Research Plan

### Introduction and Specific Aims:

Increased proficiency in performance, decreased morbidity from illness, increased longevity and similar claims for improved health status have been proposed as benefits of regular physical exercise. In certain populations, regular gymnastics are a part of daily life from childhood to advanced age. In Russia, factory workers "break" not for coffee and a cigarette, but for calesthemics. African nomads, herders by vocation and necessity of life, with a diet comparable to that found in Western societies but who walk up to forty miles a day are reported to have negligible coronary artery and ischemic heart disease.

A decrease in physical exercise has been related to an increased incidence of coronary and ischemic heart disease. In this setting, the sedentary life, "spurt" activity has been incriminated in acute ischemic episodes. Whether directly related or whether one of several conditioning or predisposing factors, most investigators now agree that sedentary living is not conducive, through several possible mechanisms, with good cardiovascular health.

Physical exercise has been purported to be of therapeutic benefit. It has been prescribed in the treatment of obesity, in muscular and skeletal disorders, is routine in general rehabilitation from acute and chronic disease, is encouraged post-operatively to preclude pulmonary embolism and is recommended following acute myocardial infarction in the hope that inter-coronary artery anastomosis will increase. Physical medicine is part of the therapy of apoplexy from its onset to recovery. Other examples could be cited and the physicians regular admonition to patients is to exercise regularly.

The physiology of exercise has been the subject of intensive study, especially since the Second World War. The respiratory and circulatory adaptations to exercise stress has been studied: in acute mild to severe exercise stress; during supine and upright exercise; in the field and in the laboratory; in "conditioned" and "unconditioned" subjects; in various occupational groups; in age groups from childhood to old and; during and sometime after acute circulatory disorders and in various disease states, including chronic lung disease, diabetes mellitus and situations of chronic systolic and diastolic left ventricular overload. Despite this tremendous effort, there is much that remains obscure about the response to physical work. While what happens in various situations, in response to this stress, is known, how and why it happens is less clear. In many of these studies, the results are not consistent, the samples are small, the stress is variable and the results are of questionable statistical significance in extrapolation to populations or general groups.

(235)

Physical exercise has been employed as a diagnostic tool: to establish respiratory and circulatory adequacy; to determine and to quantitate physical fitness; to establish functional or serobic capacity and functional reserve for physical work and to diagnose or detect latent ischemic heart disease in age groups at high risk from covert coronary heart disease. The standard exercise tolerance test (Masters) has been clarified as to criteria (Mattingly), and quantitated in terms of degree of positivity (Robb and Marks) through anatomic and clinical correlations. While this test detects advanced coronary heart disease, it is insensitive to mild or moderate degrees that may be equally hazardous by location or other means to overt ischemic heart disease. The studies employing graded and maximal exercise stress (Bruce, Hellerstein) have offered a more sensitive method of detecting significant coronary artery disease at an early stage. Such sensitivity is essential if methods available or developed, are to be applied to prevent the overt expression of this process as clinical ischemic heart disease.

From the studies available then, it is clear that no one parameter will characterize an individual's physiologic or cardiovascular health status at a given point in time. The body milieu is dynamic and therefore, dynamic testing will best describe its response characteristics and health status. Through the application of physical exercise as a stressor, especially if sufficient stress is applied, and through the measurement of multiple response characteristics or parameters, a physiologi: portrayal of an individual can be described. Moreover, such a portrayal will remain relatively constant unless improved by physical training or deteriorated by intercurrent illness or disease. Health status can therefore be described and followed in terms of functional capacity and reserve.

Through the application of these methods to normal subjects, in quantity and through longitudinal as well as vertical observations in different age groups; through identical observations in subjects at high risk for circulatory discorders; and in pathological groups suitably matched with the normals, the natural history of both normal and disease-affected circulations can be evolved in functional terms.

This approach to circulatory study of function and health also provides an opportunity to test methods and techniques and to evaluate instrumentation for the optimum application of the stress. In a similar way, the effects of exercise stress, beneficial or detrimental, of varied types and mode of application can be evaluated to determine which will provide the maximum therapeutic effect in diseased states.

In summary, the plan of investigation is based upon the hypothesis that dynamic testing yields much more meaningful information about health status than static testing and that physical exercise can be used as a research tool to determine and quantitate cardiovascular health status; to detect latent ischemic heart disease and, as a therapeutic agent, be used to reverse the decrements in circulatory function produced by disease.

### Methods of Procedure:

### General Method:

Each subject will serve as his own control for longitudinal study. In addition, each subject will be paired with another normal subject in a different age group and with a pathological control with a specific abnormality of the circulation. This pairing or matching will be by background, amount of training or physical exercise, body surface area, lean body mass and similar parameters.

### Subject Selection:

Normal subjects will be accepted as volunteers for this program from the community available for study. "Normality" will be determined by the screening evaluation described below.

The study group, at high risk from coronary artery and ischemic heart disease, will also be determined by the screening procedure. Allocation to this group will be according to such indicators of coronary artery disease as, suggestive history or physical findings, asymptomatic positive Double Masters test ischemic ST segments I on Screening Procedure, LAD or RV1 patterns on ECG, asymptomatic aquired bundle branch block or other conduction disturbance, suspect of heart disease, elevated serum cholesterol, serum triglycerides, serum uric acid or clinical gout, a strong family history of heart disease or other circulatory disorders, diastolic hypertension, Diabetes Mellitus (clinical or latent) and obesity.

Groups of pathological controls for the above two groups will be accepted by referral from the out-patient services of

and from physicians within the Community. In addition, pathological study groups will be established in the following disease categories:

- 1. Chronic Lung Disease
- 2. Chronic Systolic Load, Left Ventricle
- 3. Chronic Diastolic Load, Left Ventricle
- 4. Cardiomyopathy:
  - a. Ischemic Heart Disease
  - b. Primary Myocardial Disease

### Study Group Size:

The normal study group should ultimately comprise 100 subjects in each decade from the second through the seventh. Each sub-group slouid consist of thirty subjects, as a minimum number for statistical significance.

### Procedure:

Three basic procedures will be followed in this study, according to the group as follows:

#### Procedure A:

This is a screening technique, adapted to the study of a large number of test subjects. It is intended to provide a baseline cardiovascular evaluation of both static and dynamic nature; to detect latent or potential circulatory disorders in "normal" volunteers; to provide subjects for the group, at high risk from ischemic heart disease and is the basic evaluation for all subjects.

#### Procedure B:

This procedure will be a more extensive evaluation of circulatory functional capacity and reserve. This procedure is an out-patient evaluation that can be accomplished in one-half day. It is intended to provide more detailed information that can be extrapolated to the group studied only by Procedure A. Information obtained in this procedure will be useful in determining any modifications toward a more meaningful screening technique.

#### Procedure C:

This procedure is an exhaustive study of cardiovascular health status. It employs all available facilities and techniques available within the Medical center. Conventional catheterization techniques and ancillary radiographic, radioisotope and other pertinent methods of circulatory study will be employed as they are pertinent to achieving the goals of this study. This procedure is an in-house, in-patient evaluation requiring three hospital days. Facilities for this evaluation are available through the

### PROTOCOL: Procedure A

- Each subject will sign an informal consent authorization for study.
- Each subject will be interviewed by a social worker and baseline socieenvironmental data obtained.
- 3. In the post-absorptive state, blood will be obtained for baseline hematology and blood chemistry (FBS, 2 Hr. post-prandial sugar, cholesterol, uric acid, total lipids, phospholipids and triglycerides).
- h. Complete history and physical examination will be recorded.
- 5. Baseline records of the following will be recorded:
  - a. Electrocardiogram

- b. Phonocardiogram
- c. Vectorcardiogram
- d. Eallistocardiogram
- 6. Standard exercise tolerance test (Double Masters)
- 7. Post-standard exercise (Double Masters) vectorcardiogram
- 8. Total body water (tritium) and calculated less body mass will be determined.
- 9. Exercise Screening:
  - a. Resting control determinations will be made of blood pressure (cuff) and heart rate (RKC).
  - b. Wherever possible, blood pressure will be obtained throughout the test procedure from an induelling arterial needle in a brachial artery. The blood pressure, in this instance, will be directly obtained together with the integral and First derivative of the pressure pulse.
  - c. Arterial oxygen content will be monitored by ear oximetry.
  - d. Where direct arterial sampling is available, arterial blood will be obtained for the direct determination of PO₂, PCO₂, P₄, Lactate and Pyruvate.
  - e. Radiocardiogram will be continuously monitored.
  - f. Expired air will be collected for three minutes in a Douglas bag for baseline oxygen consumption and RQ.
  - g. The subject will then perform exercise on the bicycle organeter as follows:

The radiocardiogram will be continuously monitored during the exercise. Records will be obtained at each minute during and following the completion of the exercise until the rate has returned to the control level.

At the completion of three minutes of the maximum amount of exercise the subject can perform, expired air will be collected in a Bouglas bug for one minute. for the determination of oxygen consumption and RQ.

Oxygen content will be continuously monitored by ear eximetry and a record made of the level at each increment of work to maximum. Where direct arterial sampling is possible, a sample will be taken during the mid-point of the bag collection for PO2, PCO2, pH. Lactate and Pyruvate.

When direct arterial pressure is obtained, records of the integral of the pressure pulse and the first derivative of pressure will be obtained at each minute during exercise and each minute following exercise until the pressure has returned to control levels.

### PROTOCOL: Procedure B.

- The subject will have completed procedure A and have been selected according to the criteria outlined above under "Selection."
- The subject will be allowed a rest period in the laboratory until blood pressure and heart rate are stable.
- 3. RKS will be attached and continuously monitored.
- 4. Cournand needles will be inserted into a convenient artery and vein; the former for arterial blood sampling and pressure monitoring; the latter for the injection of indicator substances and other test materials.
- Control recording of heart rate and pressure, pressure integral and derivative will be obtained.
- A Valsalva maneuver will then be executed and the changes in pressure and and heart rate continuously monitored and recorded.
- 7. When the subject is stable as shown by heart rate and pressure, expired air will be collected in a Douglas bag for three minutes for the determination of payeen consumption and RQ.
- 8. During the second minute of the collection of expired air; an arterial blood sample will be obtained for PO2, PCO2, pH, Lactate and Pyruvate (12 cc.)
- 9. Following arterial sampling, duplicate determinations of cardine output will be made by the indicator dilution technique.

# Part II: Exercise at 100 Watts (600 KgM/min.)

- 1. Subject will exercise on the Fleisch bicycle organiter for seven minutes.
- 2. Arterial pressure, pressure integral and first derivative and heart rate will be continuously monitored and records taken of this response at each minute during exercise and at each minute following exercise until these parameters have returned to the control levels.

At the end of the 4th minute, expired air will be collected in a Douglas bag for one - three minutes.

At the start of the fifth minute, an arterial blood sample will be : obtained for PO2, PCO2, pH, Lactate and Pyruvate.

Cardia: output will then be determined by the indicator dilution technique.

### Part III: Exercise at 200 Watts (1200 KgM/min.)

1. Part II will be repeated at this level of work.

# Part IV: Exercise at 300 Watts (1800 KgM/min.)

The criterion for continued testing at the higher work levels will be a return to near control levels of heart rate and blood pressure.

The criteria for maximal exercise stress will be an exercise level which the subject cannot sustain for more than four minutes, up to seven minutes. That is, the maximal amount of work which any given subject can carry out for a full seven minutes will be considered his maximum. Other criteria which will be used to determine that the test was maximal and that a steady state existed at the time of data aquisition are:

- Heart rate of 170 or more at the two peak levels of work; that is, at the
  peak level of exercise for seven minutes and a similar rate increase at the
  exercise level of failure.
- 2. Agreement of expiratory volume and a plateau in oxygen consumption. (Less than 500 cc. difference between two consecutive levels of work in  $VO_2$ ).
- 3. RQ and O₂ uptake/minute/H².

Wherever possible, the following data will be aquired both at rest and during each exercise period:

- 1. A-a PO2 and PCO2 gradient.
- 2. External recording of apex and base phonocardiogram with apexcardiogram.

### PROTOCOL: Procedure C

The procedures used in this portion of the study will combine exercise stress and the determination of hemodynamic response by intra-cardiac techniques. The specific procedure will depend upon the pathological problem under consideration but will be directed to the measurement of the same parameters determined in the other protocols. Angiocardiographic, radio-isotope and other indicated ancillary methods will be used as indicated to obtain the required data (eg. cornary arteriography).

#### DATA ACQUISITION:

The raw data obtained directly in analogue form during the test procedures will be obtained using a multi-channel photographic recorder and simultaneously recorded on magnetic tape in either analogue or digital form (after A-D conversion). The raw data obtained by interview (Social and environmental history, medical history) and by physical examination will be recorded by the examiner on suite able forms (check sheets), key punched and card filed or placed on magnetic tape. Free field data will be provided for. All diagnoses will comply with the International nomenclature and the diagnostic, functional and therapeutic classifications of the New York Heart Association and will be adhered to for cardiovascular classification.

A dictionary of terms has been compiled for the above purposes and for the derived physiologic parameters. Programs for the ADP of raw data to obtain the derived data is now in process.

Automatic data processing equipment is available for this work on a time available basis at the present time and other facilities can be employed, should funds be available.

The following parameters will be measured, as noted below and on the following two tables:

1. Cardio-pulmonary Index:

Age + vital capacity (100 ml.) + breath holding (sec.) + Pressure breathing (mm. Hg.)

Systolic pressure + diastolic pressure + heart rate

The normal value is 1.000; values below 0.752 suggest impairment of cardiovascular function.

- RKG analysis; (interpretation according to attached ECG code)
- Double Masters analysis; (positive, negative, equivocal) .
- 4. Analysis of phonocardiogram, with other parameters to determine q⁻¹ time, mechanical systole, ADG, VDG, etc.
- 5. Ballistocardiogram (see attached code)
- 6. Maximal exercise and exercise screening (see Tables 1, 2).

#### TABLE 1

# PARAMETERS MEASURED

F	a	r	aı	me	2	t	e	r	

Height 2. Weight 3. Body Surface Area 4. Fat free body mass Total body water 6. Pulse rate 7. Systolic pressure 8. Diastolic pressure 9. Mean Pressure 10. Integral of pressure 11. First derivative of pressure 12. First derivative duration, A-B 13. BA duration, onset to peak 14. Systolic ejection period 15. Hemoglobin 16. Arterial PO2 17. Arterial PCO2 18. Arterial pH 19. Arterial lactate (Lo, Ln) 20. Arterial pyruvate (Po, P1) 21. Respiratory rate 22. Minute volume (Vg) 23. End tidal CO2 24. Duration of Dag collection 25. Tidal volume 26. Anatomic dead space 27. Physiologic dead space 28. VE (BTPS)
29. Soxygen in VE 30. % carbon dioxide in V_E 31. % nitrogen in V_E 32. Cardiac output

# Dimension

feet, inches; meters pounds; kilograms square meters kilograms liters beats per minute non Hg. om Hg. om Hg. mm Hg./sec. (delta :/delta T) milliseconds milliseconds . milliseconds grams om Hg. mm Hg. mg. % mg. \$ breaths / minute cc. / minute percent CO2 กม่านของ minutes cc. cc. cc. / minute liters / minute

# TABLE 2

# DERIVED VARIABLES

<u>v.</u>	ariable	Dimension
1.	Oxygen capacity	cc.
2.		
· з.		cc./100 cc. :
4.		cc./minute
. 5.	• 4	cc.\minga
	Oxygen consumption index	cc./M²
7.		cc./Kg/
8.		cc.
9.		# ee ea
10.	Functional capacity; functional reserve;	
	reserve capacity (VO2 Max.)	cc.
11.	Functional reserve index	cc./M ² ·
12.	Functional reserve / F.F.B.	cc./Kg.
13.	Cardiac output	Liters / minute
14.	Cardiac index	Liters / minute / M2
15.	Cardiac output / F.F.B.	Liters / minute / F.F.B.
	Stroke volume	cc. / beat
	Stroke volume index	cc. / beat / K ²
	Stroke volume / F.F.B.	cc. / beat / Kg.
19.		cc. / 100 cc.
20.	(a-v) PO2 difference	cc.
	Effective left ventricular work	Kg.M / minute
22.		Gm. H / minute
	Minute work index Stroke work index	Kg.M / minute / K ²
	Minute work index / F.F.B.	Gm.M / minute / M2
	Stroke work index / F.F.B.	Kg.M / minute / Kg.
27.	Mean systolic ejection rate	Gm.M / minute / Kg.
28.	Total systemic resistence	cc/systolic sec. dyne cm. ⁻¹⁰
	Tension time index	dyne cm.
30.	Physiologic dead space	cc.
31.	Anatonic dead space	cc. *
32.		liters / minute
	Alveolar ventilation	liters / minute
34.	V _D / V _T ratio	T Total
35.		mp.
30.	A-a CO ₂ gradient	·
	XS lactate	mg. 🐧
38. 30	Lactate/pyruvate ratio	****
40.	Androbic metabolic rate Acrobic capacity	•••
41.	Oxygen pulse	cc.
42.		cc. VO ₂ / heart beat
43.	Oxygen pulse index Oxygen pulse index / F.F.B.	cc. VO ₂ / heart beat / K ²
43. 44.		cc. VO2 / heart beat / Kg.
44. 45.	·	kilocalories
43.	(% of energy transformed into work)	
46.	Work equivalent	% Watts, foot pounds, kg.M/min
	The state of the second	watts, root pounds, kg.m/min

# Significance of this Research

A dynamic test procedure will be applied to a community population, at risk from ischemic heart disease. Through a broad approach to the evaluation of test subsects, including consultations where indicated, a broad social and environmental perspective and the response to stress, latent ischemic heart disease will be detected. Further investigation of individual subjects so detected, will confirm the value of the screening technique and will provide information, allowing patho-physiologic correlations in the epidemiology of coronary artery and ischemic heart disease.

In addition, the natural history of "normal" physiologic function will be delineated. Results obtained in pathological groups will allow description of decrements produced by cardiovascular disease. The natural history of specific diseases of the circulatory system will be described in functional physiologic terms. Within this framework, factors will be delineated which may lead to the early detection of functionally significant abnormalities; discovery at a time when preventive measures may be most effective. Within this framework, methods may be tested for their ability to arrest, retard or reverse the functional decrements produced by disease.

## Facilities Available:

The screening procedure will require approximately 400 square feet of additional space. Procedure 8 can be carried out in the facilities

| as currently constituted. Procedure C can be accomplished in the in-patient facilities of the | in which this investigator now has allocated two full work days. Ultimately and ideally this phase of the study could best be accomplished in a facility established within the medical center, specifically for this purpose, that is, Clinical research applied to the problems of Public Health and Preventive Medivine and the Epidemiology of circulatory disease.

### SUPPORTING DATA:

# Previous Work Done in This or Related Fields:

The principal investigator first carried out research in exercise physiology in 1961-62. This involved the use of exercise in subjects with hyperthyroidism, before and after ganglionic blockade and normal subjects. The overall project was an investigation into hyper-dynamic circulatory states and included thyrotoxicosi physical exercise and aspirin. He and the co-investigators have been engaged in Clinical Medicine and Cardiology and Clinical Research in these fields for the past five years; for the past eighteen months as independent investigators.

In the past eighteen months, 750 normal subjects have been evaluated. In addition, 126 subjects with known disease of the circulation have been seen in consultation. In the former group, 637 Double Masters tests have been performed. (Report in preparation). In this group, one subject was detected with ischemic

heart disease. Also in the normal group (Procedure B), exercise stress testing has been performed in 58 subjects. Three subjects, in addition to the one found by the double Masters test, were found to have definite ischemic ST changes (see attached abstract; report in preparation), (see attached tracing).

In the pathological group, the evaluation of 78 subjects with known episodes of clinical ischemic heart disease were evaluated. The period of observation in this group averaged 8 years from the ischemic episode. The double Masters test was positive in 47% of this group and negative in 53%. Prognosis could not be made on the basis of this exercise response, and average longevity did not differ between these two groups. (report in preparation). It is concluded that this test does not elicit sufficient stress to determine functional capacity of the heart afflicted with ischemic heart disease.

The report of the first thirty subjects studies (Procedure B) is attached. This was supposedly a "normal" group.

Also these same studies have been utilized in the past eighteen months to establish laboratory norms and procedures and a preliminary functional rating for normal subjects.

# Personal Publications:

Curriculum Vitae of Investigators is attached.

## REVIEW OF PERTINENT LITERATURE

The work of Hill (1) demonstrated that there was an upper limit to the ability of the respiratory and circulatory system to deliver oxygen to the tissues during heavy work. This is the maximum oxygen consumption and in normal subjects, the major limiting factor is the status of the circulation. This fact was early put to experimental use. Its use as a test of function, its limitations, sensitivity as well as its validity were conclusively demonstrated (2,3). Oxygen consumption at maximum work has been shown to decrease with age (4,5,6), to be higher in upright than supine work (6) and to be a sensitive index of cardiovascular disease (7). For adults, it remains relatively constant unless altered by either disease or physical training.

The hemodynamics of exercise have been extensively studied (1,4,5,6,8). The entire subject has been recently reviewed (10).

The anerobic costs of mild work in health and in disease have been presented by Huckabee (11) and in normal men and trained subjects by Bruce (12).

The exercise test of Masters (13) has been clarified and modified by Mattingly (14) and placed on a pathophysiologic basis through the studies of Robb and Marks (15). This test however, detects ischemic heart disease only in its advanced stages Coronary artery disease is much more prevalent than its ischemic manifestations and a more sensitive test is needed to detect it at a time when prevention can be applied. The studies of Bruce appear to be a more sensitive method but requires wider implementation for validity to be determined (16, 17, 18).

Much of the cited work relates to small numbers of subjects and the observations are vertical in type. The entire subject of physical exercise as an epidemiologic tool to determine cardiovascular health status has been recently reviewed (19).

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# PERSONNEL:

# Personnel Available:

- 1. Physicians (2)
  - a.
  - b.
- 2. Technicians (2)
  - ٨.
  - b. Vacant
- Secretarial Staff (1)

a.

# Personnel Desired:

- Physicians (1)
- 2. Physiologist, exercise (1)
- 3. Anthropologist (1)
- 4. Interviewers (2) (Social service and Community Health trained)
- 5. Registered Nurse (1)
- 6. Technicians (2)
- 7. Secretarial Staff (4)

Brie Cally

## EQUIPMENT:

# Equipment available:#

- 1. 16 Channel Electronics for Medicine photographic recorder
- Pre-amplifiers and amplifiers (Efor M)
  - 1. 2 ea. SGM (Pressure).
  - 1 ea. LLD (Semi-log)
  - 3. 1 ea. DCA-81 (DC amplifier)
  - 4. 5 ea. Single ended push-pull single ended tape converter (14 Channel)
- 3. Consolidated Electronics Tape Transport Mechanism
- 4. Gilford densitometer and withdrawal systems.
- 5. Fleisch bicycle orgometer
- # Only major items are listed. Necessary support items are also available.

# Equipment Required:

- Pre-amplifiers:
  - 1. 1 ea. SGM
  - 1 ea. 8 Channel tape
  - 3. 1 ea. EEP-8
  - 4. 2 ea. DC Amplifiers
- 2. 1 ea. 12" Remote Monitor with stand
- 3. Quinton; Model 1860 Treadmill with programer
- 1 ea. Lanooy Orgometer
  - 1 ea. Orgometer pedaling assembly
- 5. 1 ea. Cas-gas chromatograph

MISCELLANEOUS:

The following additional points are felt to be highly desirable to this investigator, for the proper accomplishment of this program.

1. Space:

While only 400 additional square feet of space was requested above as required, the addition of 600 square feet would allow establishment of a suitable space for blood and gas analysis and space for electronic equipment and repair shop, both of which are highly desirable in view of the number of subjects projected and the consequent number of samples to be analysed; and also in view of the amount and frequency of use of complex electronic instrumentation and supporting gear.

2. Personnel:

a. The services of bio-medical statistician in the design of this study, the data acquisition and interpretation is deemed to be a virtual necessity, in view of the number of observations to be made on the projected number of subjects.

b. The full time services of an electronic technician for equipment maintainance and assistance in data acquisition is considered most desirable and advantageous to the accomplishment of the study.

3. Establishment of an Advisory and Consultation Staff:

This program will utilize moderate to severe stress in normal subjects with known circulatory disorders. So as to safeguard the rights of the test volunteers and the moral and ethical aspects of this work and also to assist as consultants in the overall management of this program, it is recommended that a Senior Advisory Board be established. The following are suggested as participants:

1. 2. 3. 4. 5. 6. 7.

8.

BUDGET:

USE OF LINC-8 FOR EEG DATA REDUCTION

1/6/67

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# USE OF LINC-8 FOR EEG DATA REDUCTION

#### Background

Interpretation of EEG Waveforms for information relating to subject state has been an area of long interest to people outside of the neurophysiological field. A dozen years ago, Norbert Wiener conducted investigations of brain records. He sought to apply to EEG interpretation, some of the statistical communication theory developed by his circle at MIT. This theory has been set forth by Y. W. Lee. In 1954 Dr. Weiner was particularly interested in "a nominal 10 cps clock pulse" which he hypothesized, formed the basic timing for serial re-ordering of the brain processing organization; he noted state differences associated with this part of the spectrum in different subjects.

Detailed specific statistical reduction techniques are laid out by Dr.
by Dr.
former attacks reduction in a classical statistical approach,
dealing with power spectral estimates, phase functions, autocovariance and cross covariance functions, transfer functions,
ccherency, etc. He uses these descriptors to determine significant factors associated with EEG responses. A large number of
variables can be treated simultaneously.

The latter attacks the problem principally from a "period analysis" standpoint. The basic waveform is clipped and zero-crossover intervals are scrutinized. Similarly, the first and second derivatives are processed for clipped periods. The investigator utilizes all three of these on the same time base to examine the spectrum for state evaluation.

The references also give summaries of other recent techniques applied to EEG analysis.

It is intended here to present the results of a modest study cartied out on a set of data furnished through the courtesy of Drs.

[for educational purposes. The subject was

recorded, in three states, on 1/4", 2 track, FM tape run at 7 1/2"/sec as follows:

(a) Drowsy 5 min. (a-2) 1 kcps tone

(b1) Alpha 5 min. (b-2)

(c1) Light sleep and Alpha (c-2) "

# Editing and Reduction

The tape was played into the A/D channels of the LINC-8 for editing, using the SCOPE-8 program. The three 5 minute samples were examined for gross characteristics. Comments were as follows:

- (a) <u>Drowsy:</u> 30-60 second amplitude (long term) modulation was noted to be present in addition to the 7-10 cps dominant component band.
- (b) Alpha: more extreme excursion; less pronounced long term modulation; pronounced short term modulation or beating.
  - (c) Light Sleep: less pronounced excursions.

The data was visually edited again and a run made to store the data. This is given in the column labelled Run I of Table I. It was attempted to recover representative samples of high, intermediate and low signal power. Block storage numbers are shown.

Next the stored data was examined for spectral content using the program FRQANA; scope camera pictures were taken for comparison in matrix form for significant differences in the various states.

Repeats of data taking was next performed in Runs II and III. Run III was sampled at a lower rate; this gives a longer sample interval.

Next, selected blocks were differentiated once and stored in locations corresponding to start point 100 ( 000 waveform sample, 100 first derivative, etc.)

It was feasible to make certain preliminary evaluations of the data at this point. These were:

- I. Signal content for discrimination between states was highest for the high points of the long term modulation.
- 2. A finer frequency resolution was (1/2 cps) more relevant than the 1 cps resolution.

Finally a set of runs were made for oscilloscope pictures to show the below format:

- l. sampled waveform
- 2. frequency analysis of (1)
- 3. first derivative of (1)
- 4. frequency analysis of (3)

# Results and Conclusions

Figures 1, 2, and 3 show three representative outputs which appeared tentatively as "typical":

- 1. Drowsy: this is sample 060, 160 of the data, taken at a high point. The waveform is shown at the top; its spectrum is immediately below shown out to 32 cps. A dominant spike shows up at 9 cps; a plateau from 8-13 cps is present. A "characteristic" hump showed up in the region 14-20 cps.
- 2. Alpha: this is sample 062, 162; a reduction of the hump at 14-20 cps was noted. A bifurcation or "forking" appeared in the alpha region at the depression at 9 cps. This would explain the beating or short term modulation.
- 3. <u>Light Sleep and Alpha:</u> this is sample 072, 172; predominance of the alpha tones is noted with a general shift in energy to the lower end of the spectrum.

For all three samples the first derivative spectrum shows up as expected; namely, the "bluing" of the spectrum by applying a derivative function.

It would appear that a parametric study of BW, frequency, accenting functions (S, S², etc.), examination of phase relation-

ships, reduction techniques, and other processing would be meaningful. This might permit the design of a real time EEG analyzer which would not require a high level of training for operation.

# REFERENCES

1. MIT Report # 181, Y. W. Lee

2.

3.

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FIGURE

FIGURE 3 LIGHT SLEEP AND ALPHA February 15, 1967

Period Covered: June 15, 1966 to January 31, 1967

#### I. Summary

Certain key experimental findings obtained during this first phase of the research have been combined with earlier observations cited in the project proposal to produce a model of best fit for the electrodermal system. It encompasses both a dual peripheral effector mechanism and a central control system. It assigns little or no function to vascular mechanisms. It has been used to develop a new method for analysis of the skin conductance response which has been highly successful in accomplishing sorting of qualitatively different behavioral states without utilizing response amplitude as such. The new method should lend itself readily to automation.

# II. Specific Experimental Findings

# A. Peripheral Mechanism

# 1. Microelectrode Observations:

pores and from areas on the palmar surface between sweat pores (epidermal sites), together with a macroscopic recording from a nearby 0.3cm² site (25 subjects). Pure positive waves, pure negative waves and biphasic waves were usually obtained from either microscopic site with equal frequency, although in a few subjects, the epidermal sites showed predominantly positive responses while the pores produced negative or biphasic waves. For the population as a whole, no pattern was detectable which allowed prediction of the particular waveform at either type of microscopic site.

One observation of interest was the frequent occisions in which the microelectrodes on the sweat pore and epidermis showed only positive waves while the macroscopic site showed pure negative waves (Fig. 1). This is attributed to the fact that the macroscopic site was covered with electrode paste and

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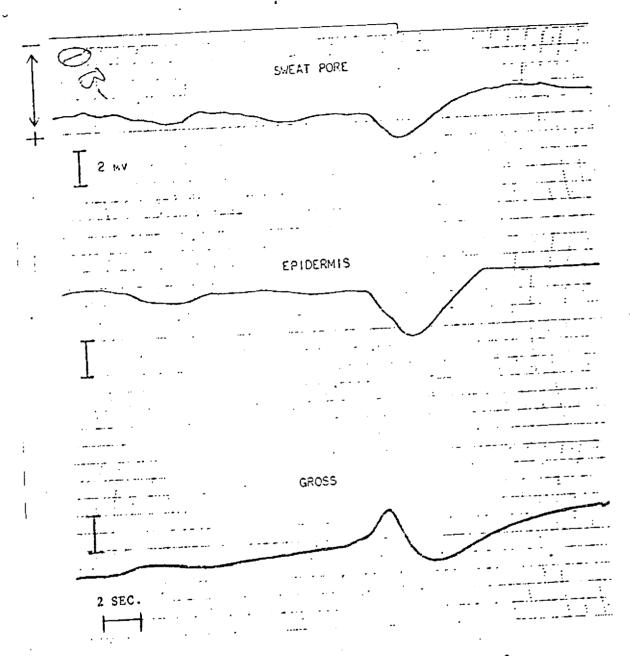


Fig. 1. Simultaneous microelectrode recordings from a sweat pore from the area between sweat pores, and from a nearby macroscopic site all on the volar surface of the finger. In this example the gross site shows a negative response, despite the positive activity in the microscopic sites. Negative is upwards.

with an electrode while the microelectrode sites were exposed to air and were considerably drier. When dry macroscopic electrodes made of woven silver cloth (to allow the site to remain dry) were used, the same effect was obtained, namely prominent positive waves at the dry site, while negative waves or negative with weak positive components occurred at the wet site (Fig. 2). This effect is consistent with the predictions of a hydration effect recently discovered at this laboratory and investigated further under the present contract. It points out that the presence of two areas in the skin with different potentials must result in internal circuit currents. The potential observed at the surface is then determined by the value of the two generators and their internal resistances. If the internal resistance (which includes the sweat duct and the horny layer, as well as any membranes involved) is reduced, the surface potential will move in the direction of that generator whose internal resistance is affected. Thus, when sweat overflows into the dry corneum, it reduces the resistance of the horny layer and brings the surface potential closer to the potential of the epidermis which is less negative than the sweat pore. This mechanism makes it imperative to work with a completely hydrated preparation if this spurious effect is not to be confused with true positive potentials, such as may be recorded with the site immersed in dilute saline.

Since the spiral duct appears to be relatively freely permeable to ions as it passes through the horny layer, the corneum acts as a volume conductor when moist and interferes with the separation of sweat gland and membrane effects by means of surface microelectrode recordings. To eliminate this effect and also the hydration effect described above, the skin is now being prepared by slicing away most of the corneum, so that the microelectrode may rest almost on the granular layer, or may be inserted directly into the exposed sweat duct at this level. About 12 exploratory experiments have been run to develop this technique and a series with a fixed experimental design has been initiated. Surprisingly, the potential at the surface pore is 10 to 20 mv more negative than the potential within the lumen of the duct at the granular or Malpighian layer. This may be indicative of a diffusion potential across the spiral duct wall. Also surprising is the observation of positive as well as negative and biphasic waves from within the exposed lumen at the deeper level. Experiments entailing simultaneous microelectrode recordings from the duct and from the granular layer are in progress. These should hopefully furnish definitive information on the origin of the different forms of potential response.

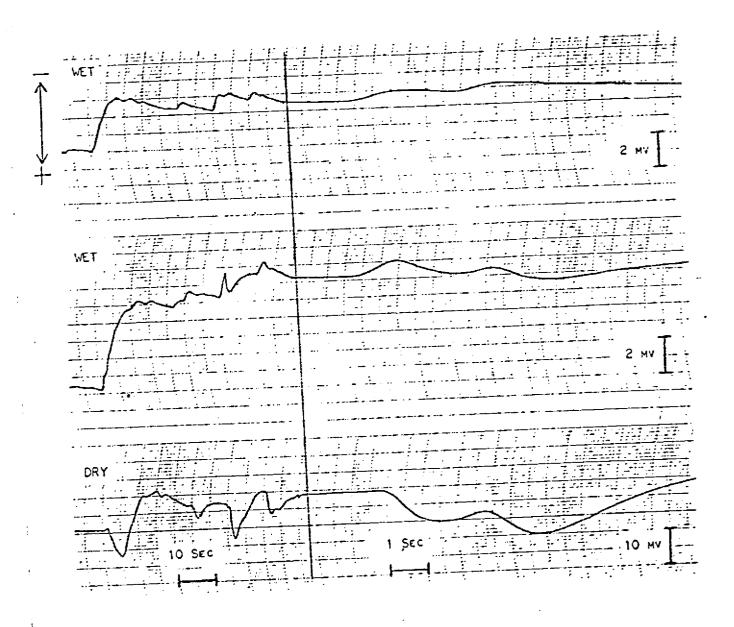


Fig. 2. Comparison of recordings from a conventional (wet) site and a similar dry site covered with porous silver cloth. Note greater positivity in the dry site.

## 2. Animal Experiments:

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A series of experiments was run on 6 cats to investigate the characteristics of conductance and potential response in the footpad as a function of the pattern of electrical stimulation of the plantar nerve. Following repetitive stimulation (e.g., 8/sec, 15 volts, 5 sec.) there is an initial augmentation of the conductance response to single shock stimuli. The amplitude of this response, tested at 30-second intervals, drops progressively to about 50 percent of its initial value over the course of 4 minutes following the repetitive volley. When it reaches this level, another repetitive volley causes an immediate doubling of the response to the standard single shock (Fig. 3). The decay then progresses as before. This phenomenon also occurs when skin potential responses are monitored. It is not due to base level effects (base level may be altered by only 5 percent during the repetitive volley and may fully recover by the time the first highly augmented response is elicited).

Another experimental finding in these experiments concerned the behavior of a second response superimposed on a preceding one. The findings of an earlier study indicated that the amplitude of a second conductance response was the same as the first, except for the steepest portion of the recovery slope of the first wave, at which point the second wave was markedly attenuated. This phenomenon was confirmed and extended to potential response measures. The behavior of the potential summation processes was almost identical to that of conductance summation. In these experiments, for an unknown reason, attenuation of the second response on the downward slope was considerably greater than in the first series.

The above findings suggested numerous follow-up experiments which could help lay the basis for the calibration of electrical changes in terms of nerve activity. However, these experiments were halted when it was fearned that the sweat glands of the cat footpad are apocrine (G. H. Wang, The Neural Control of Sweating, 1964). This has profound implications with regard to the interpretation of measurements from the cat footpad. It renders the extrapolation of such results to human measurements highly suspect. Investigators have, however, for several decades utilized the cat footpad as an experimental eccrine preparation. han investigator well ex-Consultation with; perienced in working with the cat footpad, revealed that there is considerable question as to the validity of Wang's statement. Until this matter is cleared up, however, this series of experiments is potentially irrelevant and will be suspended.

### Nail Plate Recordings:

Special efforts were made to insure that the potential res-

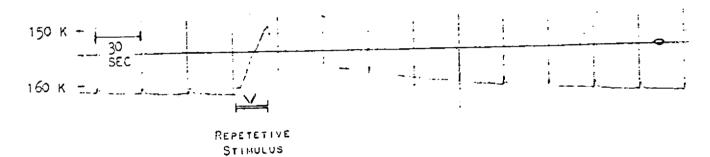


Fig. 3. Potentiation of the skin resistance response from the cat footpad following a repetitive volley (V),

ponses recorded from the nail plate, previously reported, were not artifacts of potentials generated in normal skin on the opposite or lateral sides of the finger and transmitted to the nail electrode by virtue of the volume conductor properties of the finger. A portion of the nail plate near the distal, lateral portion of the finger was cut away to expose the intact nail bed. Two simultaneous microelectrode recordings were obtained from this area. The most common recordings were pure positive SPRs. When one of the microelectrodes was pushed barely through the uppermost layer of the nail bed, the potential showed a conspicuous positive shift of the order of 15mv and potential responses were markedly attenuated at this electrode. The control electrode remained active (Fig. 4). In three of the four subjects thus examined, puncture caused attenuation of the response (to a word association test) to less than 5 percent of the control level; in two of these the response was essentially abolished. When the microelectrode was withdrawn and placed on the surface of the nail bed adjacent to the point of entry, activity reappeared. The fourth subject showed the positive shift with puncture but response amplitude, initially low, was not diminished. Although this evidence, added to the earlier indirect evidence gave compelling support to the contention that the responses did in fact originate in the surface of the nail bed, some doubt was cast on the supposition that the nail bed represents pure epidermal tissue (free of sweat glands) reported the as described by histologists. finding of sweat ducts along the distal margin of the nail which invaded the nail field (personal communication). graphs do show the spiral ducts entering the periphery of the nail bed for a distance of 1 to 2 mm. Whether these traversed the nail bed much further is uncertain; since nail recordings, except for those described above, are taken as close to the center of the nail bed as possible, it is thought unlikely that the potential recordings are contaminated by the products of sweat gland activity. However, until this factor is clearly resolved, the evidence from the nail bed must be accepted with reservations. Histological data is now being sought to settle this issue.

# 4. Alteration of SPR Waveform with Surface Solutions:

An earlier study had demonstrated that total amplitude of the electrodermal response, conductance or potential, could be altered by the exposure of the site to various solutions. A follow-up study was undertaken to determine whether the positive and negative components could be selectively altered by this procedure. The exposure of palmar sites to IM AlCl₃ was found to potentiate the positive response by an average of 750 percent (average on 7 subjects). The negative response was attenuated to 54 percent of control, but this may simply reflect the cancelling effect imposed by the increase in amplitude of the

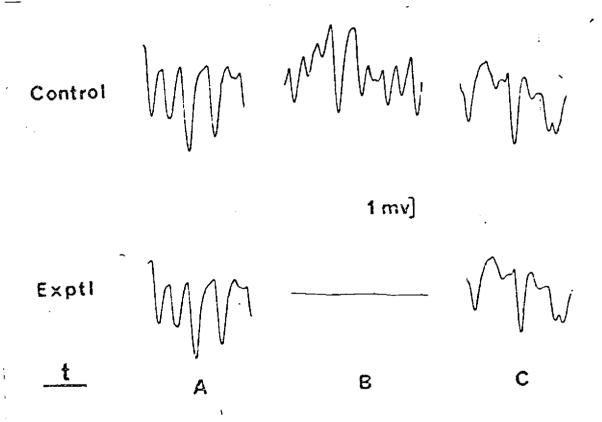


Fig. 4. Simultaneous microelectrode recordings from the nail bed showing positive responses to word associations. In the center panel, one microelectrode has been pushed through the germinating layer and responses have disappeared. To the right, this electrode has been withdrawn again and replaced on the surface near the puncture.

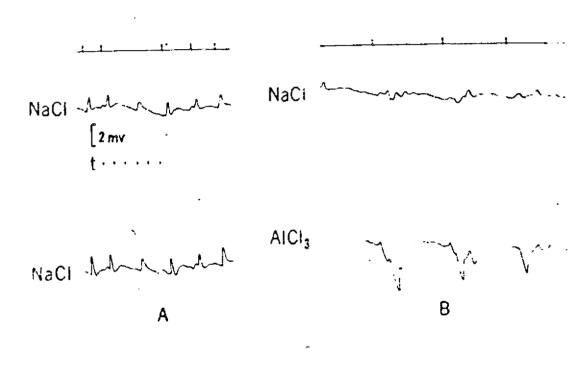


Fig. 5. Potentiation of the positive SPR wave by 1 M AlCl₃. Negative is upwards.

positive wave in the complex (Fig. 5). It is of special significance that the earlier study on the conductance response showed an average of over 600 percent increase in this measure. This suggests that the conductance response may be associated with the positive wave.

Another agent tried was 5M NaCl. This had not been tested for its effect on amplitude of conductance response, but had been shown to reduce resistance to 5 percent of control level. The effect on the potential response waveform was a conspicuous potentiation of the "c" wave, a negative overshoot which sometimes follows the positive wave. Uniphasic negative waves were unaffected (Fig. 6). Until the effect on the resistance response is determined, this effect cannot be fully interpreted. It is presently considered to reflect a lytic effect on an ionic barrier, presumably the semi-permeable membrane responsible for the positive wave. This membrane, according to earlier studies from this laboratory, must be accessible to surface agents, and behaves as an imperfectly selective cationpermeable membrane. The initial phase of the response is seen as an increase in the permeability to cations, resulting in a hyperpolarization, i.e., in a negative wave. As the breakdown of membrane resistance proceeds, the relative impermeability to chloride is apparently lost and depolarization occurs, resulting in a positive wave. As the integrity of the membrane is restored, the first effect is thought to be recovery of the relative impermeability to anions. If the recovery period is prolonged, there may be an appreciable delay before the permeability to cations is reduced to normal. During this phase, the membrane will be hyperpolarized, resulting in a second negative wave or overshoot, termed the "c" wave. A concentrated electrolyte such as 5M NaCl is thought to loosen membrane structure (to wit, the profound reduction in resistance) so that recovery is prolonged, accentuating the negative overshoot.

The above concept of the membrane process in the electrodermal response also explains the effect of AlCl3. The
absorption of the aluminum ion by the fixed negative charges
of the membrane would cause partial neutralization and incipient
loss of selective impermeability to anions. When the membrane
breakdown occurs during the response, the loss of impermeability
to anions is therefore much more marked, resulting in greater
to anions is therefore much more marked, resulting in greater
depolarization and a stronger positive wave. Although this
explanation and that for the effect of 5M NaCl are hypothetical,
explanation and that for the effect of other experimental observations and in part form the basis of the newly formed model
of electrodermal activity.

Fig. 6. Potentiation of the SPR c-wave by 5 M NaCl. Negative is upwards.

Upper trace, 0.1 M NaCl; Lower trace, 5M NaCl, 15 minutes.

5. Production of a Positive Potential Response by Local Mechanical Effect:

In 1921, Ebbecke discovered that a local decrease in skin resistance could be produced by pressure, electricity or heat and he interpreted this as the response of an epithelial cell layer. Several years later, Rein found that a positive potential response could be produced by the same means. This phenomenon subsequently drew little attention, although it was confirmed It was reported to be obtained from bу various parts of the body but not from the palms or soles, a finding which suggests that sweat glands are not involved in the process. In an effort to facilitate the investigation of the properties of the positive response in the present research, a method was devised which would produce a fairly reproducible mechanical effect. Electrical stimulation did not appear desirable because of the numerous structures which it might activate. Pressure was thought undesirable because of the possible production of electrode artifact. The mechanical method chosen consists of taping to the volar surface of the finger a small inflatable bag. The tape is applied to the lateral sides of the finger such that inflation of the bag to 180mm Hg exerts a stretch on the dorsal skin under the electrode. Inflations are made for 5 seconds at 30-second intervals and produce a square wave stretch. The response consists of a very rapid positive segment followed by a more gradually increasing segment (Fig. 7). In this recording, as in all others, two sites on separate fingers are subjected to the stretch stimulus. A third site on another unstimulated finger is used to monitor any response of reflex origin. The local responses (L) resemble the responses to word association (W) in general form and amplitude, but are not present on the non-stimulated control finger (C).

Although the response is relatively stable, it varies with the state of background activity of neural origin. In Figure 8, the enhancement of the response by negative skin potential activity is illustrated during the response to a sniff. This potentiation is typical and has been reproduced numerous times on 12 subjects.

The local potential response (LPR) has also been obtained from the volar surface of the finger, despite Ebbecke's statement to the contrary, possibly because he did not use stretch. Its amplitude, however, is less than that from the dorsal surface. No local conductance responses were obtainable from the volar surface, though they were readily obtainable from the dorsum.

The LPR can also be produced by vascular engorgement of the finger, produced by the sudden inflation of an arterial finger

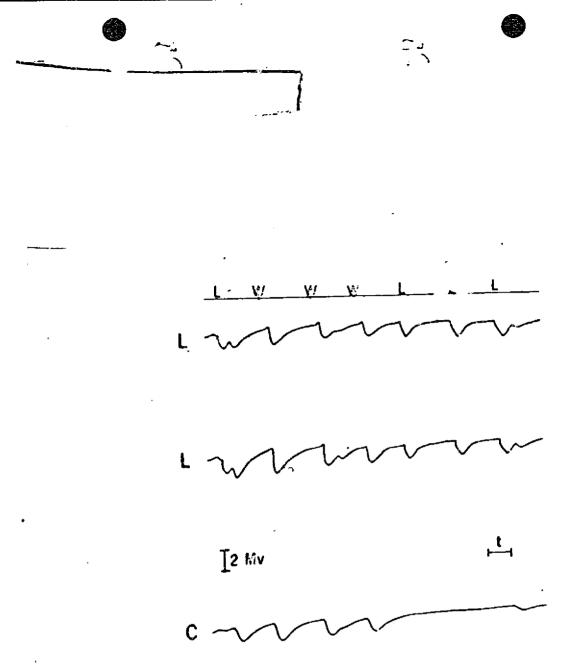


Fig. 7. Comparison of local potential response (LPR) and central SPR to a word association stimulus. Upper trace: L = local stimulus (stretch); W = word association stimulus. Traces labelled L show recording from fingers fitted with stretch device. Trace labelled C is a control finger which responds to central neural activity only.

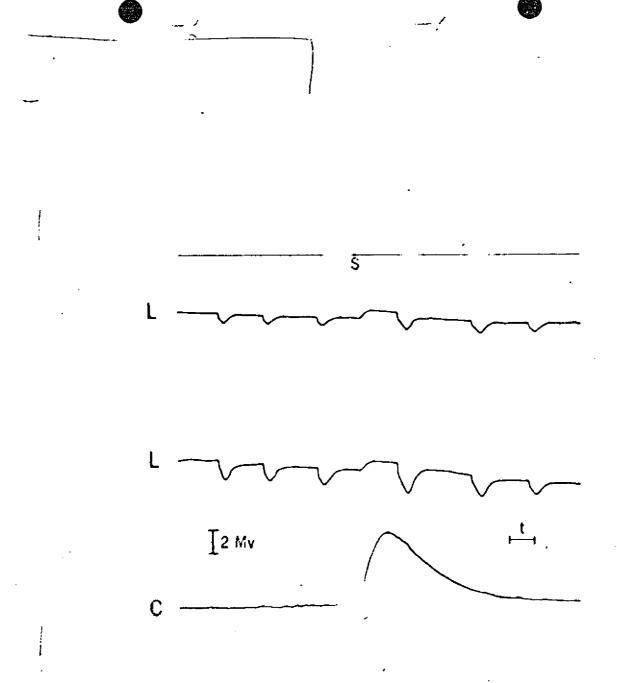


Fig. 8. Increase of LPR amplitude produced by background negative activity of neural origin. The negative activity has been produced by having the subject sniff sharply at point "S" on the upper trace.

cuff. Because of the relatively large area encompassed by the cuff and the small finger volume distal to it, the vessels of the distal portion are markedly engarged. The resulting LPR is considered to be caused by stretching of the skin by this process. If prior to cuff inflation the hand is elevated to head level to empty the veins, inflation of the cuff produces little or no LPR.

Exsanguination of the finger for 15 minutes, produced by rolling a tight rubber doughnut from tip to base of the finger, potentiates the LPR by about 20 percent (14 subjects). The positive skin potential response of central origin (SPR) is simultaneously depressed, sometimes to less than 25 percent of control. If the positive LPR and the positive SPR are reflections of the activity of the same end organ, this must indicate that hypoxia exerts its effect on the nerve endings rather than on the effector organ. Ebbecke, in fact, reported eliciting the local conductance response (LCR) from day-old cadavers.

The exsanguination data suggest that the LPR is not produced by a vascular mechanism. Added evidence is seen in the fact that the LPR like the SPR is susceptible to the effects of locally applied electrolytes such as 1N AICl₃, 1N Na₂SO₄, or 5M NaCl. An example of this effect is seen in Figure 9, in which 1N Na₂SO₄ causes reversal of the rapid portion of the response but not of the secondary slower portion. This effect is reversed when the finger is returned to 0.1 NaCl solution. The effect of 1N AICl₃ is rather variable, although clearly present. At times it attenuates the LPR; at other times it potentiates it. A solution of 5M NaCl produced a marked potentiation (e.g., 100 percent) of both phases of the response which was readily reversed by 0.1N NaCl. Work with this agent has just commenced and the inter-subject variability of this effect is as yet unknown.

The rapid and slow components of this local response are considered to originate in separate processes since they occasionally dissociate as in the case of the results of exposure to Na₂SO₄. An occasional subject will show inversion of the rapid phase, with a normal positive slow phase. Because of the rapidity of the first phase and its negligible latency, it is possible that it reflects the direct effect of stretch on the horny layer. Earlier unpublished data from this laboratory shows that a collodion membrane when transiently stretched manifests a sharp alteration in the diffusion potential established across it. The horny layer possibly behaves in a similar fashion. If this is so, however, one would have great difficulty in explaining the augmentation of this response immediately after negative

activity of central origin. Moreover, a similar pattern of fast and slow components is produced when the site is compressed rather than stretched. In this procedure a standard finger cuff is inflated over the electrode site. To test for whether the effect was due to electrode artifact, the experiment was repeated in solution with the electrode at some distance from the finger. In three subjects thus tested, the typical wave-form described for the stretch method persisted. It is therefore concluded that both the fast and slow components represent activities of two different viable membranes accessible to the surface, both sensitive to mechanical stimulation but either located at different points or having different electrochemical characteristics.

# 6. Vascular Effects and SPR:

In the first phases of the present investigation a series of experiments was undertaken to determine whether a vascular component was involved in the skin potential response. Earlier work by Darrow and by Lader and Montagu had established that vasomotor activity did not account for any appreciable portion of the skin conductance response, but these authors did not investigate the relation to potential effects. Vascular changes were induced by venous and arterial occlusion, by means of pressure cuffs. Venous engargement is known to produce a compensatory increase in venous tone. Arterial occlusion produces a reactive hyperemia involving arteriolar dilation. Local cold causes a reflex vasoconstriction. If any of these local effects are accompanied by a local potential change recordable on the skin surface, one must face the possibility that these may be present in the SFR.

Initial experiments were accomplished with venous occlusion (20 to 60 mm Hg). The cuff was placed on the arm with the reference electrode on the central side of it. The experimental site was on the volar surface of the middle segment of the finger. A site on the opposite hand was used to monitor central reflex effects incidental to the occlusive procedure. Out of a total of 69 occlusions on 7 subjects, 48 showed a negative local response of up to 3.7mv (average 1.2mv). In later experiments, however, a finger cuff was substituted for the arm cuff and the response disappeared or in some cases was positive. It was then determined, by varying the proximity of the reference electrode (outside the cuff) to the cuff, that the apparent local negative responses from the finger were in fact local positive responses from the reference site, resulting from mechanical deformation of the reference area by inflation of the cuff.

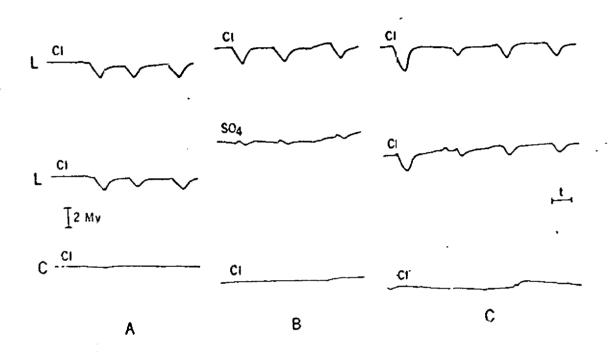


Fig. 9. Reversal of the fast LPR component produced by 1 N Na₂SO₄. The reversibility of the effect upon substituting 0.1 N NaCl for the Na₂SO₄ is shown in the third panel. A, control; B, one finger in Na₂SO₄; C, returned to NaCl.

In another series of experiments exsanguination of the finger was accomplished by the method already described. In four subjects exsanguination was terminated suddenly after 15 minutes by cutting the constricting toroid. The associated potential response was either minimal or absent. Further runs of this nature are scheduled as are simple arterial occlusions of varying durations. At present, indications are that vasomotor responses do not produce appreciable potential changes at the skin surface.

# 7. Testing of the Hypothesis:

Experiments by on the cat footpad have lead him to postulate that the electrodermal response can be explained entirely by the effects of filling the sweat ducts and hydration of the corneum, there being no necessity to consider the presence of an active membrane in explaining the electrical effects. Although at first glance an assortment of observations leads one to reject such a hypothesis, has been successful in defending it from many points of attack. To investigate the question as to whether hydration model or a membrane model can best explain the electrodermal response, the following test was performed.

Two similar active sites were exposed to constant current and constant voltage sources, each under dry and wet conditions. The dry condition would be expected, on the basis of model, to produce a larger response than the wet condition, whether a constant voltage or constant current source is used. The membrane model, because of the dead space (corneum) interposed between the electrode and the active membrane, predicts that responses should be reduced by the dry state with constant voltage but not with constant current. Comparisons were run with dry plate electrodes against a preparation in which the corneum was allowed to hydrate with electrode jelly.

Observations on three subjects were all consistent with the membrane model in that responses were considerably higher with constant current than with constant voltage in the dry state; responses in the wet state were higher than in the dry state when constant voltage was used. These results imply the existence of an inactive resistance between the surface and the site of resistance changes. Unless the hydration changes postulated by take place in the deeper layers of the corneum, his model must be regarded as inconsistent with the results of these observations.

## 8. Model of Peripheral Electrodermal Process:

The above findings have been combined with previously known

data to devise a model which best explains the total observations. It rests on several tentative conclusions drawn from available evidence, namely:

- a. Vascular effects probably play a negligible role in accounting directly for either conductance or potential responses.
- b. A negatively charged membrane accessible to surface solutions is responsible for the jet-like potential and conductance responses which recover rapidly and completely following neural discharge. This membrane is largely responsible for the positive potential response component, but can produce a short initial negative component when the membrane breakdown process is slowed. It can also produce a negative overshoot. The conductance change associated with this process is of the rapidly recovering type. This membrane is tentatively regarded as identical with that responsible for the LPR and is thought to be located in an epidermal layer rather than in the sweat gland or duct. Activity of this membrane is considered to be associated with reabsorption of moisture from the corneum.
- c. Secretion of the sweat gland is not attended by appreciable conductance or potential effects but the filling of the duct produces a reduction in resistance and a negative shift in surface potential due to reduction in generator internal resistance. The sweat diffuses laterally out of the duct into the corneum where it is absorbed at a rate indicated by the intensity of positive activity. If absorption is slow, the associated resistance and potential changes may persist, resulting in a slow rate of recovery as seen in the first waves of figure 10.
- B. A New Approach to the Analysis of the Skin Conductance Response

The manner in which the fast-recovering membrane component and the slow-recovering sweat component are thought to combine to produce various forms of potential and conductance wave forms is illustrated by the recording in figure 10 and by the schematic addition in figure 11. From figure 11 it is seen that a measure of the relative sweat and membrane activity may be obtained by inspection of the recovery limb, namely by observing the point at which the curve breaks and noting the elevation of the gentler slope above starting level. In practice, these two processes are frequently partially fused so that the overall recovery rate may serve only as a rough index of the relative sweating and absorption rates. The recovery of the fast conductance component appears to be exponential, in which case the time required for 50 percent recovery should be

a --- b c d

Fig. 10. Comparison of skin potential tracing (upper) and skin conductance tracing showing the relations of their various wave forms. The first three waves (a, b and c) are characteristic of the pure negative sweat response with minimal reabsorption. Membrane activity is indicated by the appearance of the fast components superimposed on the sweat waves at c and d in both traces.

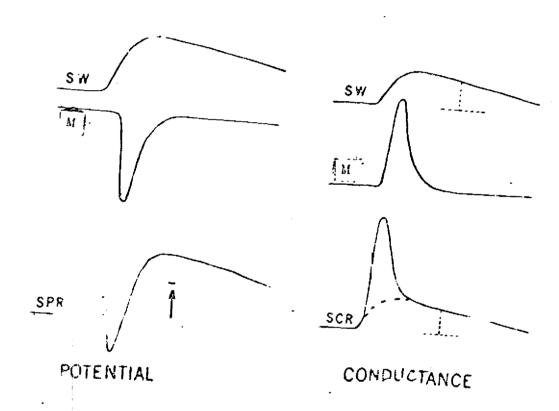


Fig. 11. Schematic presentation of the relation of the separate positive and negative potential components to conductance changes and of the manner in which they combine. S = sweat; M = membrane effect.

independent of amplitude. The recovery half-time would be prolonged in accordance with the amount of sweating in the response. Thus, recovery half-time (t/2) should, as a first approximation, constitute a useful measure of the relative membrane and sweat activity of a wave.

#### C. Behavioral Studies

# 1. Theoretical Approach:

During a comprehensive exploration of the cat-brain while recording from the foot-pad, showed that positive or negative responses could be obtained by cortical stimulation, but that only negative responses could be elicited by stimulation of the hypothalamus. The positive waves were obtained by stimulation of the premotor cortex (Brodmann Area f), an area responsible for fine motor coordination. Lesions in this area cause loss of motor inhibitory restraint and produce forced grasping. If a monkey with such a lesion (bilateral) lies on its side, the forced grasping is relaxed on the downward side, indicating that another inhibitory influence has taken over, perhaps mediated by the vestibular and cerebellar control mechanisms. Interestingly, a human subject with electrodes on each hand shows a depression of the positive SPR on the downward side when he lies on his side. This is suggestive of the relation of positive activity to fine motor coordination. It is hypothesized that the pre-motor area functions in the fine adjustment of the moisture content of the skin necessary for manipulative behavior. The positive wave, shown earlier to be associated with water-reabsorption, is seen as an indicator of this regulatory process and therefore of a set for goaldirected manipulative behavior. Electrodermal activity of hypothalamic origin on the other hand, tied as it is to the limbic system, is (in the absence of thermoregulatory demands) more indicative of an emotional response associated with palmar and plantar sweating. In the light of the mechanical resistance to abrasion afforded the skin by high levels of hydration, this is considered to be a protective maneuver. While, sweating may be produced by stimulation of the premotor  $cortex_{p}^{m}$  type of sweating is viewed as delicately regulating the moisture content of the palmar and plantar corneum and is likely to be accompanied by evidence of the reabsorption process manifested by positive activity. Non-thermoregulatory activity of hypothalamic origin is viewed as a primarily protective and would not likely be accompanied by the reabsorption process; it should therefore not show the positive component. Obviously this approach must represent a gross oversimplification of the control process, which includes inhibitory as well as facilatory influences from many other parts of the brain, including the entra-pyramidal system and limbic structures. However, it does establish a rationale for rating responses along a dimension from primarily defense reactions to primarily goaldirected preparations. Firther, it elaborates a behavioral

Table 1. Comparison of P/D and t/2 measures in differentiating the responses to the alerting and execution signals for a perceptual task and a reaction time task administered in mixed random order.

# PERCEPTUAL

Trial	Alerting	execution	% change
1	1.16	1.09	~6
2	.85	1,00	+16
3	1.00	1.00	0 .
4	.80	1.03	+29
5	1.12	1.00	<b>-11</b>
6.	1,04	.90	-13
7	1.04	1,00	<b>-4</b>
8	.88	1.00	+14
	ļ		

t/2 (s	econds)	
Alerting	Execution	% change
25	8.0	-68
9.0	4.5	<b>-</b> 50
.7.5	4.5	<b>40</b>
6.0	4.0	<b>~33</b>
5.0	4.0	<del>-</del> 20
8.0	3.0	-37
9.0	4.5	<del>-</del> 50
8.0	8.0	0

Median -2 N.S. Median -38 P < .03

# REACTION TIME

			4
	P/D	Ratio	ļ
Trial	Alerting	execution	% change
1	.94	.89	-3
2	1.00	1.00	0
3 ·	1.07	89	<del>-</del> 17
4	1.14	.97	<b>~</b> 15
5	.95	.85	-11
6	1.23	.93	-24
7	.95	.87	-8
8	1.50	1.06	<del>-</del> 39
9	1.0C	.89	-11
10	1.35	1.02	-24
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t/2 (s	seconds)	:
Alerting	Execution	% change
11.5	4.5	-61
3.0	8.0	+167
15.0	4.0	-73
8.0	4.0	~50
10.5	4.5	-37
13.0	5.0	<b>-</b> 62
6.0	3.0	-50
5.0	6.5	+30
4.5	13.5	+200
8.0	6.0	-30

Median →13 P < .01

Median -50 P < .20

Table 2. Comparison of average values of recovery half-time (t/2) for resting state and aggressive guessing game task in 12 subjects.

t/2	(seconds)
-----	-----------

Subject	Resting	Task	% Change
1 2 3 4 5 6 7 8 9 10 11	6.7 5.0 4.9 5.7 5.3 7.5 3.6 10.0 3.9 3.9 2.2 8.1	5.6 3.6 3.1 3.1 2.9 2.8 3.1 5.0 3.2 2.9 1.7 3.1	-16 -28 -33 -46 -45 -63 -14 -50 -22 -26 -23 -63

Median -30

P < .001

first three waves during the task period which matched these in politide were chosen for the comparison. Results for the 12 publicular are shown in table 2. All 12 showed the same results, namely a shortening of the recovery half-time during the task period (Fig. 12). According to the theoretical framework underlying the analytic approach, this would indicate that the moisture-regulating mechanism, supposedly activated for goal-directed manipulative behavior, was mobilized during the task which included the use of a push button signal by the subject. However, similar results were obtained even when no push button procedure was included. This suggests an extension of this motor preparation to problem-solving situations in general, even though the manipulation may be only symbolic.

#### III. Conclusions

Because of the relative simplicity and high sensitivity of the t/2 measure, it should lend itself well to automation. It is almost, but not entirely, independent of response amplitude and thus constitutes a measure of the quality of response which is relatively free of the problem of assessing overall activation level of the electrodermal system. It apparently can differentiate between behavioral shifts of relatively long duration, as well as between the rapid shifts associated with two successive brief stimuli of different qualitative meaning. Future efforts will be concerned with investigating its sensitivity to various subjective states, especially the defense reaction and to determining whether it is affected by changes in base level. At the same time efforts will be made to devise a system for automating extraction of this measure.

The pieces necessary to construct a faithful model of the peripheral electrodermal effector system are gradually falling into place. Form most promising areas for further study of this system include microelectrode experiments, observations on the locally induced response, studies on the effects of various solutions applied to the skin surface, and studies on the reabsorption process. These are presently occupying a major part of the laboratory effort and will continue to do so for an appreciable period.

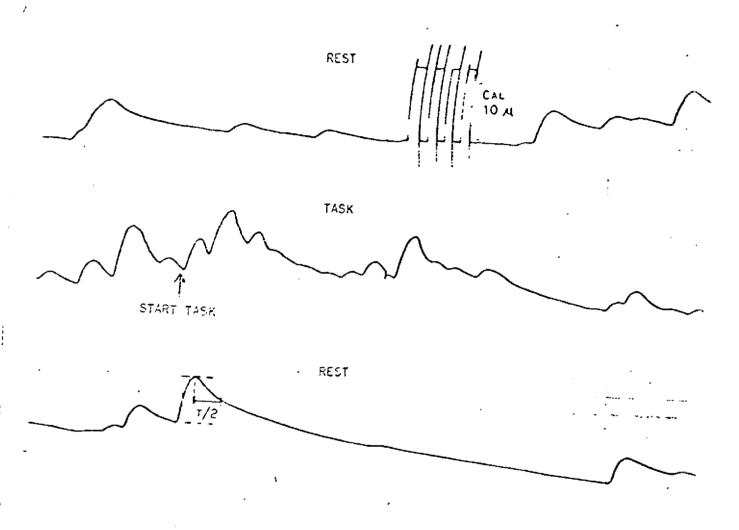


Fig. 12. Samples of conductance tracings from a subject at rest and engaged in an aggressive guessing game, showing the change in the recovery limb responsible for the shortening of the recovery half-time (t/2).

ADDITION TO TASK ORDER NO. 1

BASIC CONTRACT NO.

for

PROPOSED WORK DURING TEN MONTH PERIOD 23 April 1966 - 23 February 1967

## INTRODUCTION

Our proposed plan for research and development for the next ten months is described below in five major task areas. However, the overall objective remains identical to last year's goal: that of being able to provide the client with rapid, flexible services in engineering, electronics, animal behavior, and operations analyses. New technical and biological developments will continue to be reviewed so that we can maintain a facility for answering and anticipating needs. In order to maximize the capability for meaningful response and planning, it is proposed that the practice of periodic contacts between the Technical Monitor and Task Leaders remain in effect, and increased where possible.

The five task areas are:

- o ad hoc consulting on special problems
  - •
- animal capabilities
- o animal guidance

A DOSSIER ON PINNIPEDS (SEALS)

#### SUMBARY & CONCLUSIONS

A survey of pinnipeds (seals) was made to determine their ability to be trained. Information on their sensory abilities, physiology, and anatomy was also accumulated.

It was found that of all the kinds of pinnipeds, the sea lion (Zalophus californicus) and the common harbor sea (Phoca vitulina) were the ones most easily trained. Other types were rejected because of apparent tack of intelligence, large size, or scarcity of the species.

Data on their abilities indicate that Zalophus is superior to phoca in size, locomotion rate, strength, and ability to perform certain circus-type tricks. Phoca, on the other hand, is superior to Zalophus in terms of ability to swim immediately upon being born, eats more omniverously (and less), and can probably swim faster. Phoca is reported to do a greater number of things because he is usually kept as a house pet while Zalophus usually performs more exacting routines in the circus or zoo. Both seem equally intelligent and seem to possess equal sensory abilities.

Both are readily available at the proper time of year. Zalophus costs about \$100 (up) and Phoca \$25 (up). Maintenance costs for Zalophus are correspondingly high.

#### WHAT IS A 'SEAL'?

A 'seal' is any of the suborder <u>pinnioedia</u> of the order <u>carnivora</u>. The seal is a flesh-eating animal that presumably returned to the sea and evolved into his current physical form. Sea cows, manatees and dugongs are not seals, but rather herbiverous animals who, as the whales, may have never initially left the sea environment. There are three families of pinnipeds:

Family 1: Otariidae (The eared seals)

The fur seal (Callorhinus alascansus)
The stellar sea lion (Eumetopias stelleri)
The sea lion (Zalophus californicus)

Family 2: Odobenidae (The walruses)

The arctic walrus (Odobenus)

Family 3: Phocidae (The 'true' seals)

The common harbor seal (Phoca vitulina)
The harp seal (Phoca groenlandica)
The hooded seal (Cystophora cristata)
The sea elephant (Macrorhinus leoninus)
The grey seal (Halichoerus grypus)

Thus, a 'seal' is either the sea lion (Zalophus) that we see performing in the circus, or it is the common harbor seal (Phocida) which also is commonly called the sand seal; or the grey seal (Halichoerus) which is sometimes called the Atlantic Seal. Other

seals (harp, hooded, hair, walruses, and the like) are less common because they inhabit remote arctic waters.

The only seals commonly trained have been:

will not live in temperate climates.

- 1. The california Sea lion (Zalophus californicus)
- 2. The harbor seal (Phoca vitulina)

  The other seals are either hostile, very large, unintelligent, or

Following is a list of characteristics of the two types of seals which, for simplicity, I call Zalophus and Phoca.

Name		Length	Weight <u>Male</u>	Weight <u>Female</u>	Dentition
ZALOPHUS		10'	2,000	60 <b>0</b>	$\frac{3}{2}$ , $C\frac{1}{1}$ , $P\frac{4}{4}$ , $M\frac{1}{1}$
	. ,	:	:	٠	•
PHOCA	•	5'	50-60	50-60	$1\frac{3}{2}$ , $C\frac{1}{1}$ , $P\frac{4}{4}$ , $M\frac{1}{1}$

#### FOOD AND FEEDING

Young seals are difficult to feed. Transition from liquid to solid food is difficult and should be accomplished as early as possible. Enteritis common and usually fatal - anti-biotics helpful.

Feed seal pups 50% cows milk, 50% animal oil of any sort, add

3 tsps cod liver oil per feeding, emulsify with tragacanthus gum.

Feed via bottle or intubation (Tube cannot enter lung accidentally).

Fill animal to overflowing. Animal will burp, groan, roll over

and appear dead but is only sleeping. Add vitamin 'B' complex

(B₁ critical) to diet. May be taught to catch own food but not recommended. Adult animals will eat dog food, cat food, agricultural fish meal (fertilizer), vegetables, soups, etc. Very omniverous, Starving animal will swallow stones, occasionally when not starved; will regurgitate them voluntarily.

In the wild they eat crustacea, fish and squid.

Zoo Diet: Zalophus (600 # male): 96 pounds/week

Butterfish - 48# Mackerel - 24# Smelts - 24#

Phoca (70 # female): 28 pounds/week

Mackerel - 28#

#### **HEARING**

The auditory acuity of both Phoca and Zalophus seems to be quite acute in air. Little is known about their hearing ability in water although it is reported that they emit sounds (clicks) which might be used for proximal echo-ranging. Zalophus calls were short bursts of clicks at rates up to 50/sec with frequencies ranging from 600 to over 1,000 cy/sec. These clicks were also recorded in the 'bark' that Zalophus makes in the air. Phoca's signals (clicks) were of less intensity than Zalophus' and each of the subspecies of Phoca had a major component near 12 kcy/sec. The fact that both Phoca and Zalophus respond to the human voice indicates sensitivity in the 325 to 2500 cy/sec. range. Although active echoranging might be of minimal effectiveness it is generally agreed that all pinnipeds possess excellent passive listening capabilities.

#### LOCOMOTION (LAND)

Phoca travels poorly on land - 10% flipper action and 90% bumping on his rig cage. Fatigues easily and can go about & mile in 8 hours. Zalophus, with forward-facing flippers can hurry along for several miles at about 1-3 mph. Greater rates seem possible. Phoca has been clocked going uphill at 1.5 mph and 4-5 mph downhill for very short distances. Presumably Zalophus could carry a load faster and farther than Phoca. Mobility is determined by the nature of the surface over which the animal has to travel.

# LOCOMOTION (SEA)

Phoca can swim 15-20 mph and stay submerged 10-12 min. Zalophus can remain submerged for about 15 minutes and can swim 10 mph and possibly faster under duress. Again it seems likely that Zalophus would beat Phoca in load-carrying ability in the water, but mainly due to his greater physical size. Both have been taught to pull a small boat and retrieve objects. Both swim well in either salt or fresh water.

#### KOISIA

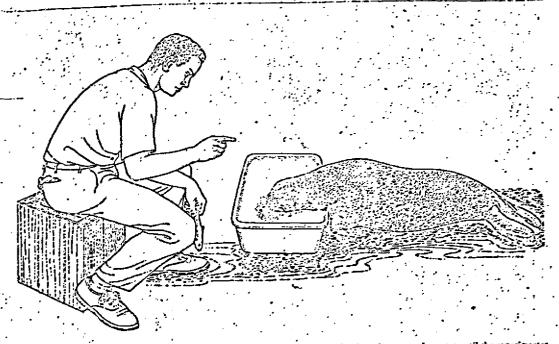
Both Phoca and Zalophus seems to have the same visual capabilities and anatomy, so the single description following will serve for both.

Cornea is flatish and serves well both in water and air.

There is the possibility that there is also some muscular adaptation which also helps vision in both water and air environments. Reportedly can see Color. Can detect hand waving handkerchief 120 yards away. Can follow trajectory through the air of a stone I" in diameter thrown 40 feet through an arc 20 feet high. Vision not necessary to survival because blind healthy seals have been captured. No ducts to remove tears to masal passages, so eyes overfow with tears that run down their cheeks and may influence vision.

nitrogen narcosis and embolism in the seal.

The Weddell seal has been tracked to about 800 feet in his quest for food. It seems likely that depths in excess of 1,000 would be neither safe or common for the seal.



VOLUNTARY DIVING eliminates any possibility that restraint affects the seal's responses. This harbor seal (Phoca vitudina) is

being trained to keep its now under water until the experimenter lowers his warning finger and instead displays the reward, a fish,

From: Scholander, P.F. The master switch of life. Scientific . American, December, 1963

#### MEMORY AND LEARNING

Both Zalophus and Phoca seem to have excellent learning ability and memory. Zalophus has been used in public demonstrating balancing, musical, and other abilities. Phoca perhaps has more written about him as an intelligent pet who can be housebroken, learn commands, and perform a few useful acts.

phoca has been reported to respond to 35 words such as basket, here, in, out, ball, sing, swim, mouth organ, stick, trumpet, plate, mackintosh, and others. He would stay in a boat, go overboard, swim forward, abeam, or aft on command. Would get the mail and carry it home. Also carried and unpacked a picnic basket. List of clever behavior long.

Has a fair time sense in that he can predict events that occur twice per week. Remembers geographical locations after a period of two years. Also remembers locations of holes in ice which implies navigational memory.

In general Zalophus and Phoca both seem to learn readily and will retain habits for a great length of time.

### SEAL TALK AND SONG

Seals seem to able to communicate and express themselves in terms sufficient to establish territorial boundries and to indicate pleasure. They can emit a bark, click, or roar and have been able to "sing" according to some experts. (See section on hearing for details on frequencies of 'clicks'). They have a large range of vocal ability. Their 'singing' has been recorded (see song below), and history is available of times when seals were called and sung to by fisherman and indeed the seals responded by approaching the singer and even falling asleep.

Ability for seals to play musical instruments indicates at least sensitivity to a great range of sounds and also a certain degree of adiance toward these sounds. However few of the sounds seals make (other than roars of rage) seem to carry much information.



Note: The 'musical ability' of pinnipeds should not be considered unusual when we take the complex but repetitious songs of birds so much for granted.

## SOME GENERAL PHYSIOLOGY & ANATOMY .

Composition of milk: (General)	. Water Fat	46.4 % 42.0 %		9.7% 0.85 %
Percent body weight:	Brain	0.63	Kidneys	0.70
(Phoca)	Eyes -	0.13	Adrenals	
	Heart	0.73	Liver	2.51
	Lungs Thyroi	1.85 d 0.008	Spleen	0.32

Bones in body - 176 plus 7 (if not fused). (Phoca)

Breeding (Zalophus)

Puberty - about 3 years of age
Breeding season - June-July
Gestation period - 348 to 365 days
Litter size - 1
Estrous appears as isolated event in
breeding season.

Composition of seal meat: Protein 19.1 % Fat 10.6 % Carbohydrates 1.4 % Water 66.0 % Other 2.9% Calories per 100 g = 183

Minerals in seal meat: Fe 11.4 mg Niacin 4.9 mg (mg / 100 g) Riboflavin 0.09 mg Thiamin 0.04 mg

Excreted Nitrogen:

(Phoca)

Ammonia- N' (2 - 7.5)

Urea - N (61-90)

Uric Acid - N (6-11)

Combined Creatine - N and Creatinine - N (9.1 - 31)

BMR (Resting) : 540

BLOOD pCO₂ mm Hg pH Temp, tension kg saturation
Phoca(Smaller number)

pCO₂ mm Hg pH Temp, tension kg saturation
37 - 38°C 28-40 mm Hg

# ANATOMY & PHYSICLOGY .... CONT.

Heart Rate (Phoca): 100/ min (10-140/ min. 95% range)

Blood Pressure: (130 - 140 mm Hg 95% range)

Body Temperature: (36.8 - 39.8 °C range among species)

Sex Ratios: Percent Male - 51% (48 - 54 % 95% range)

NOTE: The 95% range indicates that 95% of all readings fall between indicated values.

<u>Bile Acids:</u> "Beta"-Phocaecholic Acid (C₂₄H₄₀O₅)

Hydroxyl groups 3.7,23(?)

Melting point 22.2 -22.3 C

Specific Rotation + 27

#### UN-RECONDENDED PIRNIPEDS

NAME OF ANIMAL

REASON(S) WHY REJECTED

Grey Seal (Atlantic) (Halichoerus grypus) Will grow up to 8' in length, weight 2,000 pounds (male); smells terribly. normally and worse when sexually aroused. Pups need to learn to swim.

Stellar Sea Lion (Eumetopias jubata) (Eumetopias stellari) Very large (males up to 2,000 pounds, females somewhat smaller).

Does not survive well in warm climates. Alaska Fur Seal (Callorhinus alascansus) Hunted but protected. Not known for their intelligence.

The Walruses (Odobenus rosmarsu) Exceptionally large ( males 3,000 lbs, females 2,000 lbs. ) Cannot survive in temperate zones comfortably. Not very intelligent. :

Hooded Seal

Large ( male 1,000 lbs / female 900lbs). (Cystophora cristata) Sunburns readily, even in Arctic.

Haro Seal (Phoca groelandica) Another Arctic seal. Notably affectionate to humans and hence easy to slaughter -and considered to lack intelligence.

Caspian Seal Seal Elephant Lesser Seals

. All of these are relatively rare (fresh water species) or reduced in number by hunting and hence are relatively unavailable.

# RECOMME DATIONS [MISC. DO'S & CONT'S)

# To anyone wishing to train a pinniped it is recommended that:

- 1. All those who will be handling the animal should work with it from the day it is captured as a pup.
- 2. Use only females.
- 3. Get animal eating dead fish as soon as possible.
- 4. Never under any circumstances punish the animal. Use only rewards to reinforce desired behavior.
- 5. Train in the physical environment where animal will be used most, e.g. ocean, lake, pool.
- For training in water do not use tanks immediately (use schnorkle and mask).
- 7. Provide bed for animal (soft surface). Treat all open wounds with tincture of bencoin if animal to go in water.
- 8. Eliminate any animal that bites.
- 9. See attached information and study selected references.

#### MISCELLIMEOUS

Following is a list of miscellaneous information on pinnipeds:

- 1. Pinnipeds (Zalophus and Phoca) will live well in either salt or fresh water. Both dry rapidly upon leaving the water.
- 2. Zalophus migrates farther, but both travel well and have excellent homing sense.
- 3. Sense of smell useless under water but quite acute in air.

  Female can smell human if he has touched her pup.
- 4. Males generally more difficult to handle than females.
- 5. Phoca becomes immediately attached to any human who handles it during first few weeks of life. Dislikes of people may also manifest themselves rapidly --- but rarely.
- 6. Behavior will be influenced by sexual maturity unless steps are taken to prevent it (surgically or chemically).

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  Pinnipeds. Stanford Univ. Press, Stanford: 1958.



# Period from February 1, 1967 to October 15, 1967

# I. Summary of Progress

The previous phase of this study afforded evidence for a model of the electrodermal response which implied that the recovery limb contained information of value. An approximate method for obtaining a characteristic measure of this limb, the recovery half-time, was adopted and used for initial explorations into possible applications of the new measure. Results were very encouraging and as a consequence a major effort has since been exerted toward the development of a more refined measure for characterizing the recovery limb and toward the evaluation of its behavioral indications. At the same time a parallel effort was maintained to continue experiments aimed at clarifying the nature of the peripheral mechanism of the response. The following summarizes progress made in these areas.

The subsequent section on Specific Findings (II), details the quantitative data of those items whose analysis has proceeded far enough for reporting.

# A. Recovery Limb Measures

1. A superior manual method was developed for obtaining the time constant of the recovery limb. Its reliability between scorers and in repeated measures exceeds 0.90.

- 2. The basis for two automated systems for evaluating the time constant was established; one of these is an analog system, the other digital. Both are relatively simple.
- 3. The discrimulating power of the new measure as an indicator of stimulus situation has been tested on several populations, using the manual method. It successfully distinguished between several paired categories of stimulus conditions with remarkable reliability.
- 4. The recovery limb time constant for a given individual during a standard stimulus situation was found to be characteristic and was correlated with his rate of habituation to a series of repeated stimuli. Individuals who had a short time constant also tended to have a slower habituation in their electrodermal response to a series of reaction time tests but not to a series of tones.
- 5. The variation in time constant was examined in a population of subjects in which each was exposed to a succession of eight conditions ranging from resting with eyes closed through a series of simple to complex tasks. A cold pressor test was also included. The time constant varied with the situation in a characteristic manner, being longest for the rest situation and becoming shorter as the task becomes more involving. This finding was a consistant one across subjects and was independent of amplitude. The cold pressor test, although producing high activation, was accompanied by a long time constant (about the same order as that of spontaneous responses during rest). These results strongly supported the interpretation of short time constants as accompaniments of goal directed behavior.
- 6. Shorter time constants were found, as predicted by the model, to be associated with positive skin potential responses and with reabsorption responses.

# B. Studies of the Peripheral Mechanism

4

- 1. A major question regarding the nature of the absorbtion reflex (and presumably, therefore of the origin of the positive skin potential response believed to be related to it) is whether it depends upon absorption through the horny layer, mediated by the underlying epidermis, or upon sweat duct activity. An optical device for observing surface moisture has supported the hypothesis that reabsorption occurs via the sweat duct.
- was previously shown to contain a fast and a slow component which often respond differently to changes in surface conditions. A given variable may produce either potentiation or attenuation of the LPR in a manner which defies prediction at this stage, but the variation in amplitude of the experimental site is consistently greater than the control and an effect of the surface variable is consequently statistically significant. However, only three effects are consistent in direction of change:
  - a. Reducing surface temperature produces an increase in LPR amplitude.
  - b. Exsanguination produces an increase in LPR amplitude.
  - c. Background negative electrodermal potential activity produces an increase in LPR amplitude.
- 3. The striking effect of the aluminum ion in selectively potentiating the positive wave of the skin potential response was utilized as an aid in an attempt to identify which component of the biphasic potential response was primarily responsible

rather wide variation in their response to local application of AlCl₃, concordance between effects upon positive potential responses and effects upon conductance responses was examined. The results of this study on 20 subjects: raised more questions than it answered. Although potentiation of the conductance response was correlated with the potentiation of the potential response across subjects, the specific relation to SPRs of negative opposed to positive direction, and the relation of polarity of current flow to degree of potentiation presented a confused picture. Moreover, the associated measurements of capacitance and impedance revealed no significant effect of AlCl₃ on these for the group as a whole. These results are presently undergoing intensive examination and will not be reported here.

4. The repo	ort ·	of a findir	ng of sweat glands
under the nail plate was	clarified		
	indica	ting that these we	re observed only at
the distal tip near the m	nargin with the naked	skin. A new meti	nod for insuring that
the nail plate site was c	confined to the center	of the nail and for	precluding spurious
contributions by activity	v of the reference site	s demonstrated the	following:

- a. Positive or negative potential responses may be observed from the center of the nail plate.
- b. These are not appreciably influenced (if at all) by the application of various surface electrolytes.
- c. Local potential responses of high magnitude (all positive) are readily elicited from this same area.

### II. Specific Findings

### A. Recovery Limb of the Skin Conductance Response

1. Manual measurement of the recovery limb time constant.

Gildemeister (1923) and Darrow (1937) had described the recovery limb as an exponential decay curve. All responses whose recovery limb has the same time constant should fall along this curve independent of amplitude as shown in figure 1. In actuality only the first portion of this limb falls upon an exponential slope, since the latter portion apparently represents a separate component as described in the previous report. Because this second component may come in at various levels, the half-time measure previously described is subject to considerable variation in the activity of the slow component (figure 2). In addition, if a second wave occurs during the recovery of the wave in question, measurement of the half-time is often precluded. For these reasons, a method for examining the time constant of the early portion of the recovery limb was developed. In this method a transparent template consisting of a family of exponential curves, each having a slightly longer time constant than the one to its left, is slid sideways over the response, its baseline at the level of response onset, until one of the calibrated slopes corresponds with the early portion of the recovery limb (figure 3). Interpolation is easily accomplished. A reading takes about 7 seconds, and reliability both for repeated measures and between scores is high (better than 0.9). If the baseline (during inactive periods) has an appreciable slope, a correction must be applied. This is accomplished by lowering the baseline of the template to a level half way between the level of wave onset and the

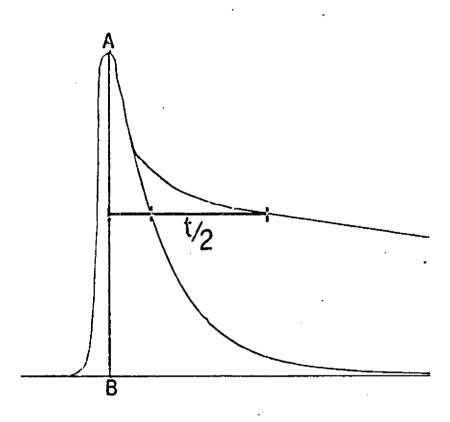


Figure 2. Variation in value of t/2 for same initial recovery limb but with varying activity of the slow component.

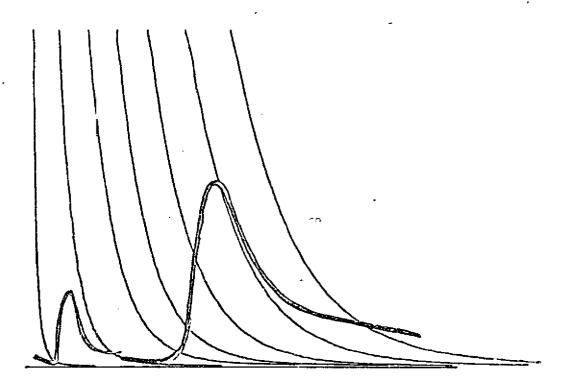


Figure 3. Method of determining recovery limb time constant by template method.

level at which it takes on the slope of the resting baseling. In practice this is a simple operation which is not commonly necessary. It less to say D.C. recordings are mandatory whenever quantitative treatment of the time constant is attempted.

- 2. Automatic determination of the time constant.
  - a. Analog method:
    - (I) Since the equation for an exponential curve is

$$\frac{dE}{dt} = -kE$$

where E is the voltage, t is time and a is a rate constant which is the reciprocal of the time constant.

$$\frac{d^2E}{dt^2} = -k \frac{dE}{dt}$$

Сľ

$$k = \frac{-Y''}{Y''}$$

where Y' and Y" are the first and second derivatives of the recovery limb with respect to time. These me be readily obtained by the use of operational amplifiers as shown in figure 4. Y' and Y" are fed into a simple division circuit which takes advantage of the logarithmic characteristics of a silicon diode field, H. L. Review of Scientific Instruments 33, 235-238, 1962. The information of interest in the output will be the negative peaks of the rate constant which may be measured by a digital voltmeter.

(2) Another form of the exponential equation,

$$\log E = -kt + c$$

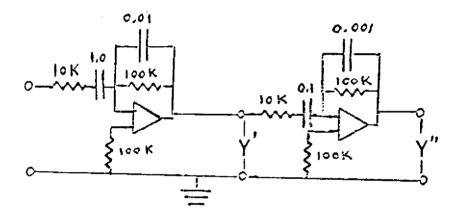


Figure 4. Circuit for obtaining the first and second derivatives (Y' and Y'') of the recovery limb.

suggests that the rate constant can be obtained by the slope of log E against time or d(log E)/dt. Unfortunately this would be useful only if E represents voltage referred to final asymptotic level (i.e., to baseline), an arrangement which would be complicated, if indeed attainable.

### b. Digital method:

An approximate solution for obtaining the rate constant lends itself readily to analysis by digital voltmeter and simple digital computation. It is based on the fact that exponential decay is assentially a percentage relation, i.e., in a small increment of time, the percent recovery is constant regardless of the amplitude chosen. From this it follows that the ratio of the absolute increments of recovery in two successive increments of time is related to the time constant. Thus if recovery is taking place at 5 percent per millisecond, the recovery rate may be obtained, for example at the 1 volt level, by taking

$$\triangle$$
 E₁ = .05 x 1 volt = .0500

$$\triangle$$
 E₂ = .05 x 0.95 volt = .0475

To calculate the rate constant, take

$$1 - \frac{\triangle 1}{\triangle 2} = 1 - \frac{.0500}{.0475} = .05$$

In practice, voltages are sampled by a digital voltmeter at 3 successive points on the recovery limb, e.g., at 0.2 second intervals, (figure 5) starting 0.5 seconds after peak and the

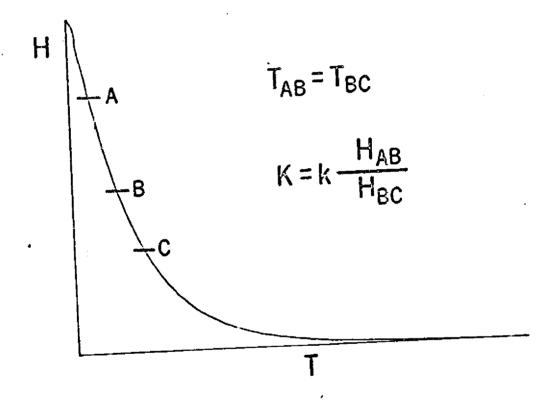


Figure 5. Method for determining time constant of recovery limb by digital measurements.

appropriate calculation made either manually or by computer.

3. Testing the discriminating power of the time constant measure.

The t/2 measure was previously shown to be capable of discriminating between rest and task performance and between the response to an alerting signal and the response to a task execution signal (for some subjects). The new time constant measure was tested on additional populations and under different conditions. One was a comparison on 35 subjects of the time constant associated with the orienting response to a series of tones as compared with that to a series of reaction time tests. Figure 6 shows the characteristic acceleration of the recovery limb attending the reaction time effort. Figure 7 shows the results for the entire population (P < .001). Only two subjects failed to show the acceleration.

In another evaluation (this one of the power of the t/2 measure) a population of 16 subjects was exposed to a series of moderate light flashes and their orienting responses obtained. They were then instructed that when the light flashed (same light) they were to observe the position of a moving pointer, but to withhold reporting until requested. Thus no motor activity was overtly involved in this perceptual task. Table 1 shows the result and also summarizes other tests for comparative purposes. All but 3 of the 16 subjects showed an acceleration of the recovery limb during the perceptual task.

Another example of the ability of the recovery limb to discriminate is seen in figure 8 which shows simultaneous recordings from the dorsal (hand) and palmar surfaces of two individuals. The letter A indicates an alerting signal for a forthcoming

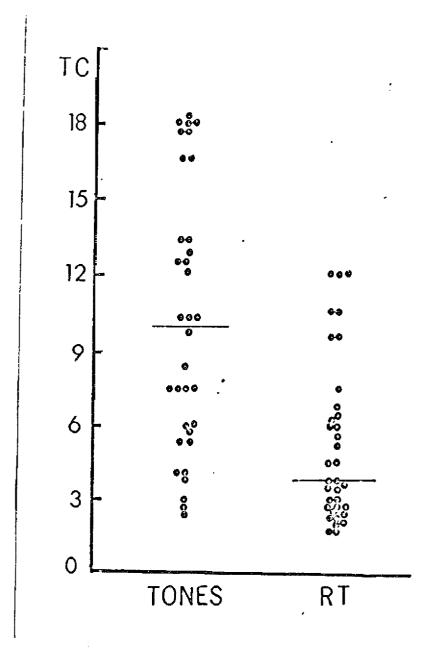


Figure 7. Scatter diagram of recovery limb time constants of responses to tones and reaction time signals for 35 subjects.

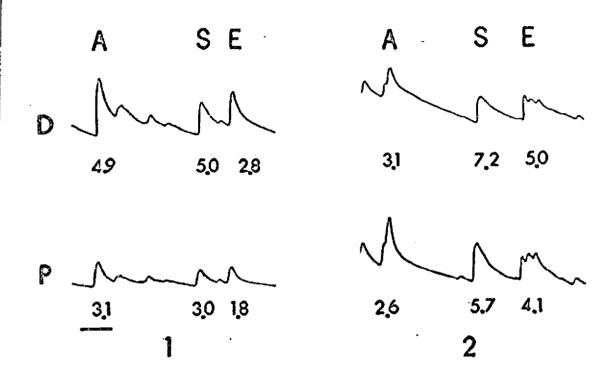


Figure 8. Simultaneous dorsal and palmar traces for two different subjects showing recovery limb time constants of responses to alerting signal (A), spontaneous activity (S), and reaction time execution signal (E).

`				MEAN	
•				CHANGE	
<u>N</u>	MEASURE	CONDITION A	CONDITION B	A to B	<u>_p</u> _
12 / 12	t / 2	Rest	Aggressive Game	-2.3	<.001
		5. 6 sec	3. 3 sec	(-41 %)	
16 / 13	t / 2	Light Flashes	Perceptual Task	-2.3	<.05
		7.9 sec	5. 6 sec	(-29 %)	
35 / 32	t. c.	Tones	Reaction Time	-5. 5	<.001
		10. 4 sec	4. 9 seċ	(-53 %)	

Table 1. Effect of various stimulus conditions upon recovery limb time constant.

reaction time effort; E is the execution signal and S denotes a spontaneous wave occurring during the foreperiod. Below these responses are shown the time constants. In the dersal trace of the first subject, the time constant of the spontaneous response is approximately equal to that of the alerting response while the execution response has a time constant of approximately half this length. Although the absolute levels for the palmar and dorsal traces are different, the same relationships hold.

The second subject (right hand panel) shows a different sort of relation. This subject has a short time constant in the alerting response. That of the spontaneous response is almost twice as long. The execution response for this subject has a considerably slower recovery limb than does his alerting response. Here again the palmar responses though of different absolute value are in the same ratio as those from the dorsal surface. These autonomic pattern differences will be examined for possible use as an indicator of characteristic behavior patterns in an individual.

Figure 9 exemplifies the application of this measure in the identification of qualitatively different states, despite similarities in response amplitude. In the upper trace a subject is being presented with his first series of reaction time (RT) and word association (WA) stimuli. There was a forewarning signal for the reaction time and the subject in each case responded to this alerting signal as well as to the execution signal. In trace B which occurred 8 minutes later, the subject has apparently habituated to the situation and has ceased responding to the alerting signal. Notice the marked slowing of the recovery limbs, and especially that the response to the word association, though of similar amplitude to that in A, has a greatly differing time constant.

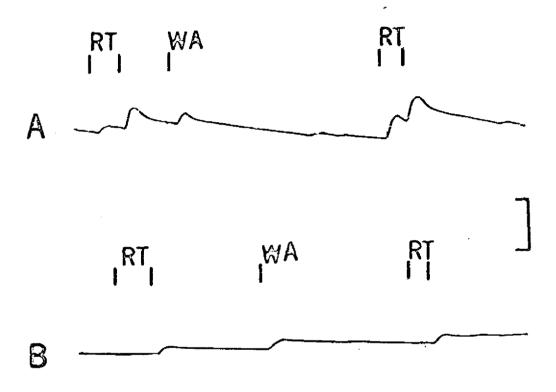


Figure 9. Conductance responses to reaction time signals (RT) and word association (WA). Traces A and B are taken on the same subject 8 minutes apart.

4. Correlation of an individual's time constant with his behavioral pattern.

One naturally wonders whether this measure which can differentiate between conditions within a subject independently of response amplitude can also differentiate between subjects having different behavior patterns in similar situations. To answer this question, the recovery time constants of responses to reaction time efforts were used to characterize the individual subjects. Also determined for each subject was a measure of the rate of habituation of their responses either to a series of tones or a series of reaction time efforts as seen in figure 6. The measure of habituation was the quotient of the amplitude of the second response of the series divided by that of the third response. The larger this ratio, the more rapid the habituation. Table 2 shows the results of comparisons across subjects. (Square root transformation was In all cases the time constant used in some cases to obtain a linear regression.) measure was that of the skin conductance response obtained during the reaction time series. Various measures of habituation rate were compared with this. In the first case it was the skin conductance response during the reaction time series. This showed a 0.33 correlation with the recovery time constant, (P < .05) which is interpreted as indicating that a short time constant is associated with sustained activation (motivation?) in the RT task.

In another comparison, the habituation rate for SCR was obtained during the tone series and compared with the same time constants as above. There was no significant correlation.

Surprisingly the time constant obtained during the reaction time series <u>did</u>
correlate significantly with the rate of habituation of the finger pulse volume response

HABITUATION

<u>N</u>	MEASURE	r	<u>p</u>
53	SCR during Reaction Time	.33	<.05
32	SCR during Tones	. 13	N. S.
51	FPV Change during Tones	. 30	<.05 ·

Table 2. Correlation of recovery limb time constants obtained during reaction time with various habituation measures taken across subjects.

obtained during the same tone series examined above  $(r = 0.30, P \ .05)$ . This relation of SCR recovery rate to an entirely different autonomic measure in a different stimulus situation is viewed as an indication of the basic significance of this measure.

## 5. Relation of time constant length to quality of stimulus situation.

To shed light upon the behavioral significance of changes in the time constant, its relation to a series of 8 graded stimulus situations was examined. Although data on 21 subjects are available, only 9 have been analyzed to date. The situations were:

Relaxing - Eyes open - 2 minutes

Relaxing - Eyes closed - 2 minutes

Counting aloud - 2 minutes

Reading aloud - 1.5 minutes

Counting backwards by 7's - 2 minutes

Deep breaths, 3 at 20 second intervals

Cold pressor test (ice bath) - 2 minutes

Mirror drawing - to completion

Average time constants were determined for each situation and the 8 categories rank-ordered for each individual, using a rank of 1 for the longest. These ranks were then averaged for each condition. Results were in the following order:

Situation	Average Rank
Rest, eyes open	$2.2 \pm 0.8$ (Longest)
Cold pressor	$3.1 \pm 1.2$
Rest, eyes closed	$3.3 \pm 1.2$
Deep breaths	4.2 ± 1.5

Situation	Average Rank
Count, forward	$4.4 \pm 1.2$
Count, backward	$5.6 \pm 1.9$
Read aloud	$6.1 \pm 1.3$
Mirror tracing	6.6 + 1.3 (Shortest)

shorter apparently as the goal direction of the behavior increases. The second is that the cold pressor test, though it produced high activation showed waves with time constants as long as those under resting conditions. This seems consistent with the above inference regarding the association of rapid recovery limbs with goal directed behavior. It is suggestive of a system in which mobilization for goal-directed activity, involves activation of a reflex mechanism which hastens electrodermal recovery.

Tests of statistical significance have not been made on this sample because of the additional analysis in progress. Nevertheless, inspection of the means and deviations makes it clear that the extreme categories are significantly different.

on the basis of relations suggested in the last report. It had been hypothesized that the fast component of the recovery limb might represent an epidermal membrane process, associated with the reabsorption phenomenon and with the positive skin potential response. Records from 11 subjects were examined, and two "pure" negative SPRs and two with significant positive components were chosen from each. The time constants of the associated conductance responses were measured and for

all 11 subjects, were shorter when associated with positive SPRs (8.7 vs 14.9 seconds,  $P \le 0.001$ ). An example of a recording is seen in figure 10.

Since the reabsorption reflex had previously been shown to be associated with the positive wave, the association of short recovery times with reabsorption was to be expected. Figure 11 shows an example (panel B) of the faster recoveries associated with the activation of reabsorption (Hydration increases upward). Note the concomitant change in skin potential activity from negative to biphasic with a positive (downward) component appearing. The average time constant for the left hand panel was 7.4 seconds, for the right, 4.8. A comparison on 12 subjects showed that reabsorption waves were associated with steeper recovery limbs at the .01 level of significance.

### B. Peripheral Mechanism

Because of the implicit involvement of the reabsorption reflex as a possible cause of the variation in recovery limb slope, efforts were made to clarify its mechanism. It had been previously postulated that this phenomenon represented a reflex increase in epidermal permeability. When this permeability increase occurred, the passive movement of water down its concentration gradient would appear as an inward movement if surface vapor tension were high enough. However, data on the low permeability of the corneum cast doubt that the route was through this layer (and then across the epidermis). It was considered more likely that the moisture was returning via the sweat duct. This possibility was investigated by a modification of the Netsky prism method described by Thomas and Korr (1957) which is sensitive to frank sweat (droplets). In this modification, a photocell was substituted for the

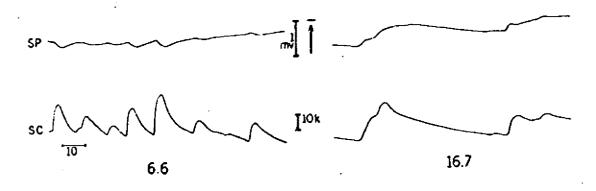


Figure 10. Relation of recovery limb time constant to presence and absence of positive skin potential responses.

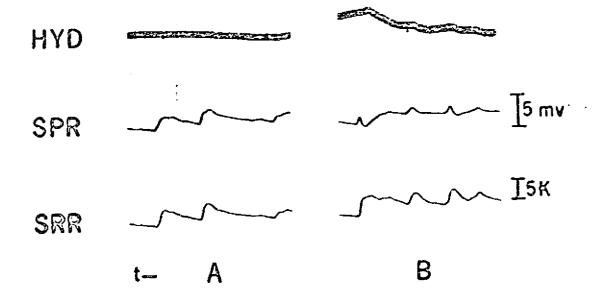


Figure 11. Relation of recovery limb time constant to presence or absence of absorption reflex (upper trace, absorption is downward). Note acceleration of recovery limb with appearance of reabsorption responses.

photographic equipment so that continuous recordings of sweat droplet concentration could be made. Unlike the photographic method it is very important in this method that the light be well collimated to prevent contamination of the records with vascular changes (figure 12). It is also necessary that there be no possibility of variation in skin contact at the edge of the masked area. Test of contamination by vasomotor activity were accomplished by inflation of venous and arterial cuffs on the arm to produce artificial vascular changes in the fingers. The system finally adopted was demonstrated to be free of such contamination. The recordings (figure 13) showed increases in sweat and also reabsorption. Although the device has been used thus far on only 5 subjects, all have manifested the phenomenon. It is now being used in conjunction with recordings of SPR, SCR, and hydration (electrical method). The implications of the findings with this device is that the droplets of sweat formed at the sweat pore rather suddenly disappear. This has been confirmed by microscopic observation of the finger tip. This would indicate that the cause of the reflex reduction of hydration previously observed is not due to drying of a uniformly moistened corneum but rather to draining of the sweat droplets back into the sweat duct. This may perhaps represent activity of the sweat duct wall at a relatively superficial level, e.g., at the germinating layer.

### Local Potential Responses

The collection of data on the effects of variation in surface conditions upon LPR amplitude has been completed. As discussed in the summary, a relative range measure is a better indicant of effects than is an absolute comparison because of variation in direction of these effects. The data may be summarized as follows:

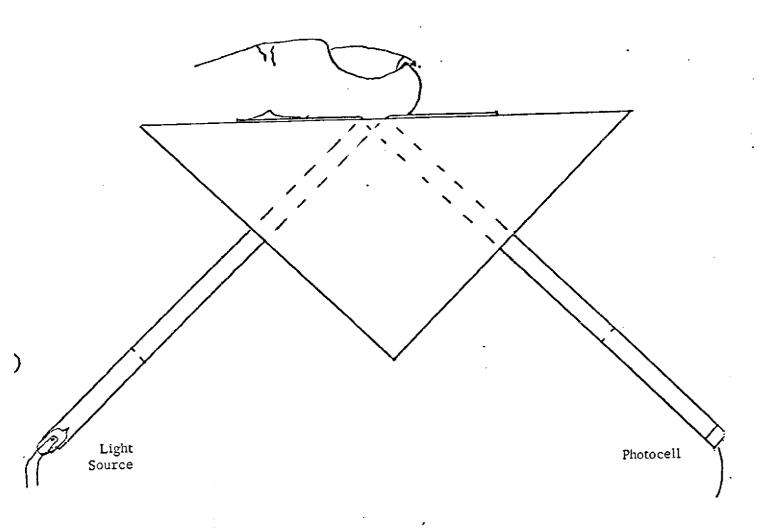
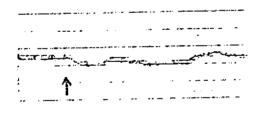


Figure 12. Arrangement of light source and photocell for observing changes in concentration of sweat droplets by the prism technique.



Increase in Sweat



Reabsorption

Figure 13. Records of sweat evolution and of reabsorption obtained by the photoelectric prism technique.

(The control sites were subjected to a blank procedure.)

Procedure <u>C</u>	Componen <b>t</b>	Number of S Experimenta ing Widest R Proced	il Site Show- lange After	Number of Subjects With Control Site Showing Widest Range After Procedure
		5	•	. 1
0.5M Na2SO4	Fast	J		
•	Slow	6		0
5M NaCL	Fast	4	(1 equal)	1 .
	Slow	5		1
0.3M AlCl3	Fast	3		6
Exsanguination	Fast	6		0
	Slcw	3		<b>3</b> ·
Temperatur <b>e</b> .	Fast	5		1
	Slow	4		2

In addition, of 7 subjects examined for effect of background negative activity upon LPR amplitude, all showed a substantial increase for both fast and slow components (average 430%, P < .001).

### C. Bio-Psychological Adaptability

In the initial examination of adaptability or "gear-shifting" capacity, a population of 60 subjects was run through a battery consisting of the following:

a) Several paper and pencil psychological evaluations including personality trait inventories, and manifest anxiety ratings.

- b) Performance tests: designed to examine rigidityflexibility characteristics.
- c) A knob-turning test designed to examine maintainance of appropriate motor inhibition over an extended period. The subject was instructed to turn a large knob as slowly as possible through 180 degrees. The time course of this effort was recorded and a comparison made of the angular velocity in the first third with that in the last third to detect breakdown of inhibition. This was expressed as a ratio K; a large ratio signifies a speeding up in the last third (i.e., loss of inhibition).

Following these tests the subject was fitted with electrodermal electrodes and a reflectance plethysmograph. He was exposed in sequence to:

- a) 3 minutes of rest
- b) a series of 5 tones, ca 80 db, 1000 cps
- c) a series of 5 similar tones for reaction time test effort
- d) 3 minutes of rest
- e) a difficult discrimination task
- f) 5 minutes of rest

Although analysis is not yet completed, it appears that the psychological and performance tests, except for the knob-turning task showed low correlation with the physiological data. The relation of SCR recovery limb time constant to habituation rate in these runs has already been described. A relation between performance and physiological behavior was also found. In these runs, as a measure of the "gearshifting" ability of the subject, his time for 50% recovery from the difficult

discrimination task to base level during the final rest period was determined for skin conductance, skin potential and finger pulse volume. The recovery half-time for the electrodermal level measures (not responses) was significantly related to K, the inhibitory index in the knob-turning task (P < .05). Longer recovery times were associated with a tendency to speed up toward the end of the task. Put another way, the capacity to maintain inhibitory motor control over an extended period was associated with an ability to shift autonomic gears rapidly.



PHYSIOLOGICAL MECHANISMS, ANALYSIS AND BEHAVIORAL SIGNIFICANCE OF THE ELECTRODERMAL RESPONSE

FINAL REPORT

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## PHYSIOLOGICAL MECHANISMS, ANALYSIS AND BEHAVIORAL SIGNIFICANCE OF THE ELECTRODERMAL RESPONSE

### 1. INTRODUCTION

This project was directed toward exploration of physiological mechanisms underlying the electrodermal response in the hopes of establishing a rational basis for quantitative treatment of this measure as a behavioral indicant. A further objective was to gain a better understanding of the adaptive function of electrodermal activity. It was presumed that the role of such activity in our "psychological" life can be understood if such behavior is regarded as essentially a biological adaptation, modified to fit a social structure. Thus, if electrodermal activity is associated with profuse palmar sweating, and this can be shown to be defensive in function, one has grounds for interpreting such activity as a sign of fear or anxiety. If, on the other hand, other forms of electrodermal activity facilitate manipulation or exploration, one would put an entirely different interpretation on its appearance. For example, if, in a situation which is potentially threatening, one notes evidence of the manipulative type of electrodermal activation, it would seem appropriate to conclude that the subject is engaged in coping behavior rather than that he is beset with alarm.

The first portion of this three-year program was devoted primarily to physiological investigations. An assortment of evidence, covered in the interim reports, helped to round out the partially elaborated physiological model of the electrodermal system.

Among these experiments were microelectrode observations on sweat ducts and the areas between the ducts, confirmation of potential responses from the nail bed, study of the machanically elicited local response. further examination of the effect of specific

electrolytes on electrodermal responses, and finally continuing studies on the sweat reabsorption mechanism and its reflex control. These various findings, when integrated with other experimental evidence, lead to the formulation of a model in which sweat reabsorption played a prominent role and in which such activity was reflected in the recovery limb of the skin conductance or resistance response.

According to this model the sweat gland has a dual function; if it secretes profusely, the skin surface becomes well-hydrated and resilient and is thus protected against abrasion. In a biological sense the animal is now able to scamper over the rough ground away from danger without undue mechanical damage to his contact areas. For fine manipulation, however, as may be involved in exploration and assessment of objects in the immediate surrounds, tactile requirements are such that the optimum level of surface moisture is somewhere intermediate between dry and wet. It was supposed that regulation of surface moisture at light to moderate hydration is largely a function of the activity of the sweat reabsorption mechanism. Observation of conditions under which reflex sweat reabsorption occurs led to the conclusion that this mechanism goes into action in preparation for "manipulative" tasks. This activity is reflected in increased positive-going skin potential responses and in acceleration of recovery of conductance responses.

The major effort of this investigation was then directed toward the elaboration of this recovery limb measure, in terms of its measurement, its relation to amplitude, to conductance level, and to behavioral state, and to the comparison of its discriminating strength with that of other electrodermal measures. This report summarizes progress to date. It is broken into a series of separate topics related to these objectives.

rought in as appropriate to render as complete a

picture as possible within this report. One full-length paper, "The information content of the recovery limb of the electrodermal response" (in press) has been in part supported by this contract and is included as part of this final report since it summarizes the approach and findings in an optimal manner.

In addition to the various sections on the recovery limb, there is one on the relation of vascular changes to skin potential shifts at the surface. Although some of this material was described in an interim report, it has now been completed and composed as an integrated manuscript to be submitted for publication, and is, therefore, included in toto in this report.

coupling time constant of 10 seconds, the loss of sensitivity becomes negligible for all but the very slowest recovery limbs.

Recovery rate was found to be capable of distinguishing between many behavioral states, even when response amplitude or response frequency could not. Thus, to name a few, it distinguished: orienting responses to a light flash from responses to the same flash when it took on signal properties, responses to an alerting signal from those to a task-execution signal, the resting state from various task situations, mirror tracing from backward counting or cold pressor exposure, problem solving from perceptual or psycho-motor behavior, a deception task from a reaction time task. In the course of these comparisons it was found that recovery rate became slower with habituation, even in a deception task, and that it was also slowed by the entry of a fright stimulus into a task situation. It failed to distinguish a deceptive response from a non-deceptive response in a given series of queries when differences were compared across the entire population, but individual subjects did frequently show a difference. The design of this experiment was unfortunately aimed at group analysis and the number of deceptive responses for a given subject was insufficient to evaluate this individual effect statistically.

An overview of the effect of the various task and stimulus situations upon electrodermal recovery rate indicates that acceleration of recovery reflects mobilization for goal-oriented performance. That the determining factor was not general activation per se was evidenced by the slow recovery accompanying a cold pressor exposure, shown by other electrodermal indicants to be as activating as were performance tests associated with rapid recovery.

shown to be relatively stable over a period of 5 consecutive weeks. There were large characteristic individual differences between individuals even though they changed in the same direction when changing behavioral conditions. Efforts to find a behavioral trait associated with recovery rate were generally unsuccessful although fast recovery in a standard task (reaction time) was found to be associated with low anxiety (\$AQ), and with a tendency to maintain electrodermal response without habituation during a reaction time series. This was seen as further evidence supporting the interpretation of fast recovery as reflecting mobilization for goal-directed behavior, since these same subjects habituated to a series of non-signal tones just as fast as did subjects with slow recovery rate. It is still uncertain as to whether the difference in recovery rate between problem solving and simple perception indicates a specific difference in the effects of cognitive and perceptual behaviors on recovery, or whether this simply means that the problem-solving task was associated with higher anxiety.

An examination of the relationship of recovery rate to other parameters of the response showed it to have a low negative correlation with amplitude, that is, responses of higher amplitude in a given behavioral state tended to have slightly slower recovery. When measured between different behavioral states, however, there was often a tendency for the reverse to be true. In view of the evidence showing that mobilization for goal-directed behavior is associated with faster recovery, this observation probably reflects the fact that mobilization for task performance frequently causes an increase in activation resulting in electrodermal responses of high amplitude. This same consideration probably explains the fact that recovery rate is related (positively) to skin conductance level in

During the course of a comparison of the discriminating strength of the recovery rate measure with other electrodermal measures, a new frequency measure was devised. This measure is different from other measures of "GSR frequency" or "count" in that it examines, for any given task or epoch, not the total number of responses but rather the maximum frequency displayed in a "burst" of three consecutive responses. This measure, termed f max, demonstrated a surprising strength in distinguishing between stimulus conditions, although not the same conditions as were distinguished by recovery rate. Thus f max distinguished the deceptive response from listening to instructions, but recovery rate was not able to do so. Contrariwise, recovery rate distinguished perception from problem solving while f max did not. The highest f max and the fastest recovery rates were both found during the reaction time test, but the level of f max reached by any subject during this task, unlike recovery rate, bore no relation to his trait anxiety.

A companion study, one directed at the physiological basis of skin potential levels and changes, demonstrated that a one minute engorgement of cutaneous vessels produces a slow negative shift and upon release of the cuff a sudden positive shift. With arterial occlusion these potential shifts were opposite in direction and greater in magnitude. Although changes were generally not over 0.5 mv they raise the possibility that vasomotor responses may be accompanied by surface potential waves. Whether these shifts were mediated by an effect of the vascular state on sweat gland potentials or whether they represent changes in vascular potentials remains to be determined.

# 3. ON THE MEASUREMENT OF ELECTRODERMAL RECOVERY RATE: RATIONALE

The measurement of electrodermal recovery rate may be approached in several ways, all of which have in common the assumption that there is an intrinsic recovery rate characteristic which may be the same for waves of greatly varying amplitudes.

An example of such a condition is that for the exponential curve in which a characteristic time constant or rate constant may be common to all members of a family of curves of different amplitudes. Darrow (1937) concluded that the recovery limb of the skin resistance response (SRR) is exponential in form, and additional evidence, to be presented here, supports this interpretation.

Methods for evaluating the rate constant of the electrodermal recovery limb are suggested from examination of the differential equation describing the exponential relation. The process described by this relation is one in which a variable changes at a rate, dE/dt, which at any instant is a linear function of the magnitude of that variable. Thus, for the case of voltage change in a condensor discharge.

1) 
$$\frac{dE}{dt} = -kE$$

which may signify, for example, that the voltage drops by 5% per second, in which case .05 is the constant characteristic of such a process.

### Rate Constant

The integral of the above expression provides the common expression for exponential decay, namely

where  $E_0$  is the starting level and E is instantaneous voltage at time, t; k is the rate constant (rc). If E is decaying to zero as its asymptote,

3) 
$$E = E_0 e^{-kt}$$

When t = 1/k,  $E = E_0/e$ , that is, it equals 37% of its original value. This time, which is equal to the reciprocal of the rate constant, is called the time constant (tc) and, like the rate constant, is characteristic of the process and independent of amplitude. All curves having this same characteristic regardless of their starting point may be superimposed upon the same large exponential curve. Thus, to the extent that the electrodermal recovery limb is exponential, it may be matched to an exponential curve of the same rate constant. This is the basis of the use of an overlay method for determining the time constant by curve-matching as described in section 6.

### Half-Time

From equation (2) it can be shown that decay half-time, that is, the time taken for decay to become 50% completed, is equal to 0.7 to and is a constant for all waves having the same time constant, independent of their amplitude. This measure, the recovery half-time, represents a second means of expressing recovery rate and is also described in section 6.

### Logarithmic Writeouts

Equation (2) represents a means of determining the degree to which the recovery limb fits an exponential curve. Expressed in common logarithmic form,

from which it follows that a writeout having logarithmic vertical compression should give for exponential curves a straight line whose slope is a - k/2.3. The upper trace in Figure 1 is a writeout of an exponential curve obtained by capacitor discharge and a recording of a few skin conductance responses. Baseline of the skin conductance trace has been adjusted so that responses are recovering to approximately zero voltage. Below are the same waves recorded through a logarithmic compression circuit. Note that the portion of the recovery limb which is exponential in form starts about one second after response peak. The slope of the linear portion of the logarithmic recovery limb is proportional to the rate constant provided the asymptotic voltage is zero. Since this is not so, such a method cannot be used directly. One may, however, apply the second derivative to achieve this end.

The time derivative of equation (1) is

$$\frac{d^2 E}{dt^2} = -k \frac{dE}{dt}$$

which may be written:

5) 
$$\frac{dE'}{dt} = -kE', \text{ or } E'' = -kE'$$

Integrating,

which indicates that the first derivative of an exponential curve is also exponential as is its second derivative. The slope of the log-compressed writeout of the first derivative is then proportional to k and unlike the case for the primary (DC) writebut, the curve, as required, decays toward zero because of the capacitative coupling

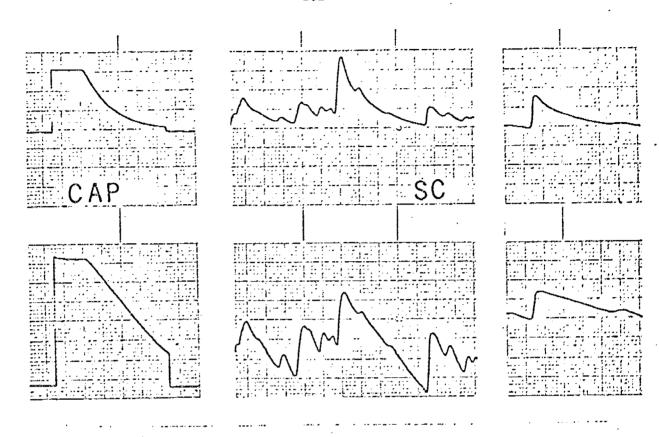


Figure 1. Upper trace: direct writeout of a condensor discharge (CAP) and skin conductance trace (SC). Paper speed 1 mm/sec. Lower trace: same as upper but with logarithmic compression.

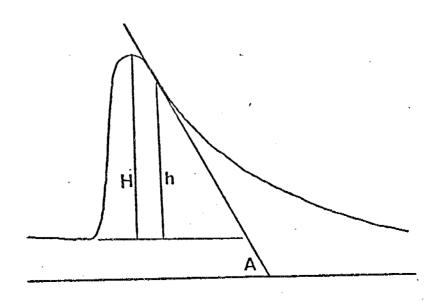


Figure 2. Diagram of method for measuring the rate constant by tan A/H.

$$\frac{d(\log E')}{dt} = -\frac{k}{2.3}$$

one is tempted to produce a writeout of d log E'/dt to obtain an amplitude reading directly proportional to the rate constant. Unfortunately, d log E'/dt often has such a low magnitude in the exponential portion of the recovery limb that its analog form cannot serve reliably as the expression for the rate constant. A similar problem arises if one attempts to determine the rate constant from the log-compressed first derivative curve (log d E/dt) by manual measurement of the tangent of the acute angle produced between the linear portion of the recovery limb and baseline.

# Second Derivative

Yet another method may be derived from the second derivative form. From equation (5)  $k = -\frac{E}{E}$ 

Thus, one may determine the recovery rate constant by calculating at any point on the recovery limb the quotient of the second derivative  $\frac{\cdot}{\cdot}$  the first derivative. In practice the method is not too feasible because the magnitude of E' is so low in the exponential region of the recovery limb that it frequently is exceeded by the noise level of the trace, which becomes rather high for the analog second derivative.

### Amplitude-Slope Method

Another solution is one which requires an amplitude measure as well as a slope. From equation (1), it is seen that

the slope of E, or its first derivative. This is a most useful expression. From it, one can obtain the value for k by taking the slope and amplitude of any point on the exponential portion of the decay (Figure 2). The slope is tan A. In practice it must be chosen at a point at or beyond the inflection point on the recovery limb. Because a measurement of wave amplitude would seem to be more precise and because such a measurement could be used independently as an index of responsivity, a test was made of the relation of H to h (Figure 2), i.e., of peak amplitude to the amplitude at the inflection point. The product-moment correlations for 20 responses on each of 6 subjects were: .97, .99, .99, .99, .99, and .96. Thus a convenient substitute measure for the rate constant is

$$\lambda' = -\frac{E'}{H} = -\frac{\tan A}{H}$$

This method showed a correlation of 0.81 with measurements made by the template method on the same 66 responses. In making the slope measurement, a line is drawn parallel to the recovery limb at its inflection point. The acute angle at the intersection of this line with the horizontal is measured and its tangent obtained from tables. Anothe relation in conjunction with this method permits a relatively simple approach to automated calculation of the rate constant. The peak slope of the ascending limb is found to be linearly related to the maximum amplitude of the primary writeout (Edelberg, 196). A validation check of this relationship in the present investigation confirmed this.

Measurement of 44 responses having uncomplicated ascending limbs gave a correlation of 0.94 between the two measures. Hence one may substitute for H the maximum first derivative of the ascending limb, and for tan A the maximum first derivative of the

described separately

4. ON THE MEASUREMENT OF ELECTRODERMAL RECOVERY RATE BY PREFERRED METHODS: TESTING AND COMPARISON

### A) Logarithmic Compression

In the discussion of the various means of computing electrodermal recovery rates it was shown that the first derivative of the logarithmic writeout of the recovery limb is directly proportional to the rate constant. This is true when logarithmic compression is accomplished by electronic means, but only if the wave is recovering to a zero voltage level. In such cases, the region of the recovery limb immediately following the peak (by about 1 second) is linear, and it is this portion which should reflect the rate "constant." Unfortunately the DC-recorded trace rarely recovers to zero voltage as its asymptote. Since the first derivative does have essentially a zero voltage asymptote, logarithmic compression of such a writeout should offer a linear section of the recovery limb whose slope is proportional to the rate constant. Unfortunately, the electronically differentiated recovery slope is often of such low amplitude that log compression and manual measurement pose a problem in accuracy.

It has been shown, however, (Section 5) that the recovery rates of electrodermal responses recorded with capacitance coupling are highly correlated with those computed from a DC record provided the coupling has a time constant of 6 seconds or longer. Such condenser-coupled records do approximately satisfy the requirement that the asymptotic voltage is zero. If a record of this kind is subjected to logarithmic compression, the recovery limbs should show a linear portion whose slope is proportional to the rate constant (Figure 3). This study examined such records to determine the degree to which the rate measure computed from their slopes were correlated with the

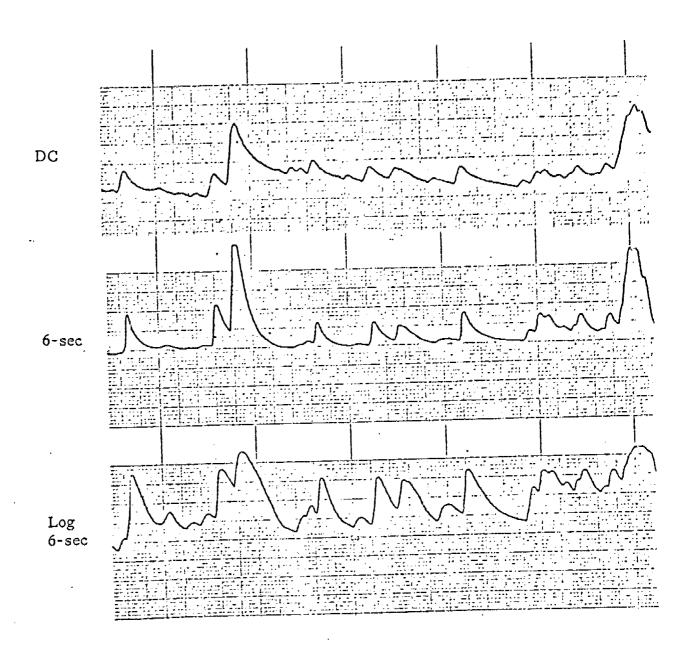


Figure 3. Recording of skin conductance through normal DC (upper), capacitance coupling with a 6-second time constant (middle), and log compression of the 6-second writeout (lower). Paper speed 1 nnm per second, normal size.

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#### Method

### Instrumentation

Skin conductance was recorded on a Beckman Dynograph with direct coupling (channel 1). The pen (1) output was coupled to the 2 megohm input of another DC channel through a 3-microfarad condensor to obtain the 6-second time constant. The pen (2) output of this second channel was placed in series with a 220 K resistor and a silicon diode (Texas Instruments G-129). The voltage developed across the diode is a logarithmic representation of the pen (2) output (Kahn, 1962). This voltage was fed into a third channel of the Dynograph and, with zero input into channel (1), and the recording completely restored to baseline, the zero position of pen 2 was adjusted until the voltage across the diode was forward biassed by 0.25 volt. Polarity was arranged so that an electrodermal response produced increasing forward bias on the diode.

# Measuring Technique

A straight line is drawn parallel to the linear portion of the recovery slope in the region immediately after the peak of the response (Figure 4). On can then measure the acute angle (A) which this line makes with the horizontal, and obtain its tangent from tables. This value is directly proportional to recovery rate constant. An alternative method is to use the L-shaped scale shown in Figure 4. The vert al limb is set so that it passes through the intersection of the slope with the upper edge of the paper channel. The horizontal distance from this point to the intersection of the slope with the bottom edge of the paper channel can be read directly off the metric scale on the foot of the L. Since tan A is proportional to the rate constant,  $1/\tan A$ 

1/ton A - h God where h is a constant).

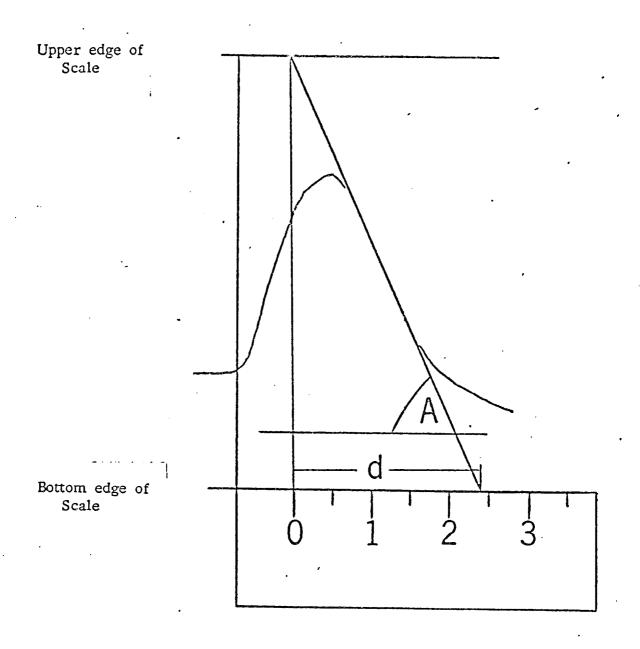


Figure 4. Measurement of recovery rate by measurement of angle A or intercept d.

Also, since  $\tan A = H/d$  where H is the scale height and d is the horizontal distance measured,  $d = \frac{H}{\tan A} = b H(tc)$ . Since H and b are constants, d is directly proportional to the time constant.

#### Results

The recovery time constants of 66 responses recorded on magnetic tape were read by the electronic method described in Section 4C. This method consists of measuring the peak positive and peak negative first derivatives of the electrodermal response and dividing one by the other. The same population of responses was subjected to the template measurement (Section 6), to the amplitude-slope method (H/tan A), and also to the log-compressed AC recording as described here. Product-moment correlations were determined between the values obtained by the logarithmic method and those from the three other methods. Values were as follows:

Log'E	vs. electronic computer	0.59
Lcg'E	vs. amplitude-slope	0.87
Log'E	vs. template	0.86

The range of d in the log method was 3 to 47 mm which corresponds to an 8:1 range in time constants. The correlation of the log measure with response amplitude was like many of the other measures low and positive (r = 0.37, p < .01).

Because of the simplicity of the manual measurement involved in the measurement of log'E, and especially because of its independence from knowledge of baseline level, this seems to be a measure of choice. It has one draw-back, namely the neces-

amplication in obtaining its

# B) Measurement of the Altitude-Slope Intercept Along Baseline (D)

The notation H/tan A, that is, the amplitude-slope measure, leads to yet another approach to time constant measurement. In Figure 5 it is seen that tan A is approximately equal to H/D where D is the distance along the extended baseline included between the altitude (line H) and the extension of the recovery limb slope. As a result, H/tan A reduces approximately to D. The measurement of D in practice is not unlike the task of measuring t/2, the time for half recovery, but it has the advantage that D is about 75% larger than t/2 and, therefore, incurs a smaller relative error in measurement. Furthermore, it allows measurement of a considerable number of responses which fail to recover by 50% prior to the onset of the subsequent response.

To test the usefulness of this method the values of D were measured for the same 66 responses used to compare the other methods. Values of D ranged from 1.2 to 8 seconds. Because the paper speed was only 1 mm/second, measurement was not very precise, but the correlation with the measurements obtained by H/tan A was nevertheless 0.90, and with those obtained with the curve-matching method, 0.82. Correlation with the electronic method was 0.63 and with log'E 0.86. At a somewhat higher paper speed, e.g., 2 to 2.5 mm/second, this is a very satisfactory method, especially since the value of D, when expressed in seconds, can be readily converted to the time constant by the use of a constant factor. The use of a standard notation is highly desirable in making comparisons between results at different laboratories, and the use of the time constant or rate constant seems a reasonable choice for such standardization. To derive the conversion factor for D, one must keep in mind the fact that in precise terms, to = h/Tan A which is equal to d in Figure 5. From this

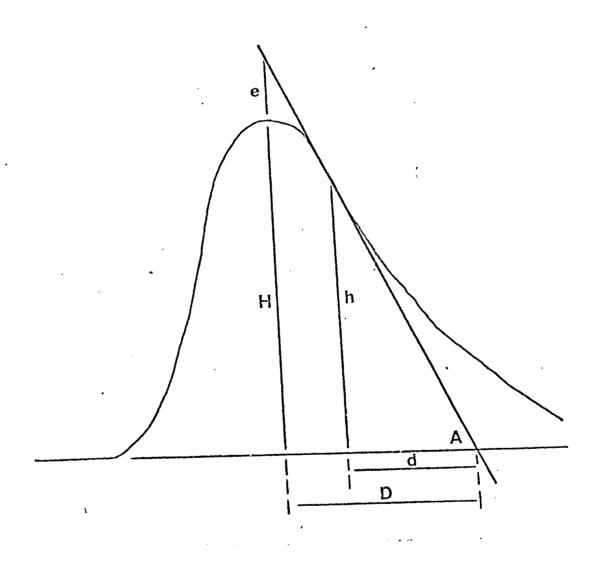


Figure 5. Measurement of recovery rate by altitude-slope intercept, D.

$$\frac{h'}{d} = \frac{H+e}{D}$$
 or  $d = \frac{h}{H+e} \cdot D$ 

Measurements on 40 responses gave a mean value of 0.74 for h/H+e, whence

$$tc = 0.74D$$

To convert H/tan A to tc, one must consider the relation of H/tan A to h/Tan A. Since

$$tc = \frac{h}{tanA} = \frac{h}{H} \cdot \frac{H}{tanA}$$

the conversion factor h/H must be determined. Calculations of h/H from 20 responses on each of 6 subjects gave mean values of:

From this

$$tc = 0.84 \frac{H}{tan A}$$

The agreement of these two relations were tested on 65 responses, with results as follows:

<b>**</b>	$\overline{\mathbf{x}}$	Factor	Computed to
Notation '	^		
D H/tan A	2.70 2.34	0.74 0.84	2.00 seconds 1.97 seconds

This agreement is surprisingly close and gives confidence in the reliability if not the validity of these measures. Their agreement with to values obtained by curve-matching is not nearly as impressive, the mean of that measure being 2.59 seconds. The possible cause of this discrepancy is described below.

# The Position of the Asymptotic Level and Its Effect upon Recovery Rate Measurement

All methods described, whether curve-matching, t/2, D, or H/tan A, depend for their validity upon the accurate choice of the asymptotic level to which the exponential portion of the recovery limb is decaying. The only exceptions to this are cases in which E'/E' or d (log E)/dt are used to determine to. In the other four measures, the conductance or resistance level at point of response onset has been used as the asymptote, but it is clear from inspection that in numerous cases such an assumption is erroneous. Uncertainty as to the level of the asymptote, and in fact a systematic error in estimating it may explain the fact that recovery rate is found to have a correlation with response amplitude. This correlation though low is consistent for different methods of measurement and is significant. Examples of the correlation for measures on the same population of 65 responses are:

	r	p
Amplitude vs. Electronic to	.37	<.01
Amplitude vs. Template to	.35	<.01
Amplitude vs. Log'E	.37	<.01

True asymptotic level may be determined in the following way. In Figure 6, tangents to the recovery limb have been drawn at points 1 and 2. It has been shown earlier that the time constant of an exponential curve = h/tan A or d in Figure 5. If

from either point should be identical. The correct asymptotic level will be that at which  $d_1 = d_2$ .

When this method was applied to a number of skin conductance responses, the asymptotic level was found to vary, sometimes falling almost on the baseline, but . more often considerably above it, occasionally near the peak of the wave. As a consequence, the values for to calculated from curve-matching, t/2, D or H/tan A, are usually too large, but since all are altered in the same direction by this effect, the inter-correlations are not seriously disturbed. Moreover the error introduced after conversion of either D or H/tan A to tc is the same, hence the agreement of the mean time constants obtained from these two measures. Such is not the case for the curve-matching technique. In this case the error is considerably greater and is a likely explanation for the discrepancy shown in the previous section. Since the other methods are less subject to this error, it argues in favor of the abandonment of curve matching in favor of D, H/tan A, or t/2. Since measurement of D allows measurement of more responses than does t/2 and entails no more work than for t/2 and less work than for H/tan A, it is considered the method of choice. Moreover, it is faster than curve matching, requires less training, and the one judgement to be made, namely the placing of a straight edge parallel to the recovery limb at its steepest point is a simpler one than is curve fitting.

To reiterate, the most advantageous method for measurement of tc is to measure D, using the conversion:

or, for rate constant:

$$rc = \frac{1.35}{D}$$

It will be recalled that two alternative methods for measurement of recovery rate are inherently independent of any knowledge of baseline or asymptote. The first of these is E'/E", i.e., the ratio of the first to second derivative at any point on the exponential portion of the recovery limb. The difficulties with this approach have already been discussed. It does not appear to be feasible at this time. The second alternative, d (log E)/dt, that is, the slope of the linear portion of the logarithmically-compressed recovery limb does appear useful, but only with a condensor-coupled recording and with log-compression circuitry.

# C) Electronic Computation

As discussed in Section 3 the notation H/tan A forms the basis of an approach to automatic on-line calculation by an analog computer. The analog approach takes advantage of the high linear relation of the peak first derivative of the ascending limb of the DC electrodermal recording and the peak amplitude of the wave (Pearson's r close to 1). Also convenient is the fact that tan A is the maximum first derivative of the recovery limb. Hence:

$$\frac{H}{tanA} = 3 \frac{E_{+}}{E_{-}}$$

where  $E'_{+}$  is the maximum first derivative of the ascending limb,  $E'_{-}$  is the same for the recovery limb, and g is a constant.

There are several complications in the use of this expression for computing

so that a storage requirement exists. The use of h/tan A (Figure 5) would be more precise and because h and tan A are taken simultaneously, would be easier to program, but it would require measurement of h in terms of its distance above the baseline or preferably above the asymptotic level. This becomes a problem in DC recording, because of expected baseline shifts, and such an approach does not lend itself readily to analog computation without cumbersome programming.

Secondly, because responses in close sequence interact, contingencies must appear in the program for selection of waves meeting standard criteria. These criteria are:

- (a) The time of onset of any measurable response must be at least 7 seconds after the onset of the previous response. This is necessitated by the fact that recovery rate of a small wave superimposed upon the recovery of a preceding larger one is spuriously rapid. The effect is shown in Figure 7a.
- (b) Responses which do not last at least 4 seconds prior to the onset of
  a successive wave must not be accepted for measurement. This
  requirement prevents measurement of a wave whose peak negativegoing first derivative is cut short by the onset of another wave (Figure 7b).

#### Method

A combination of analog computer and digital logic circuitry is used to meet the conversion, storage, and contingency gating requirements of the computation.

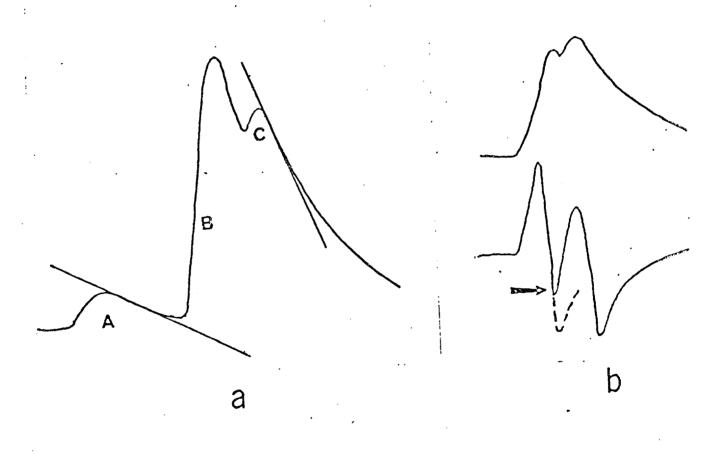


Figure 7. (a) Spurious acceleration of recovery limb of response C by reason of its position on the recovery limb of response B. Response A is similar to C but occurs on a resting baseline. (b) Spurious registration of peak slope of recovery limb due to interruption prior to peak (at arrow).

### Analog-To-Digial Conversion, Storage, and Computation

The skin conductance response is recorded with a constant voltage bridge whose output, proportional to skin conductance, is fed into a Beckman Dynograph amplifier. The voltage at the pen output is fed into two other channels, each using a 0.1-second coupling time constant, thereby achieving derivation of the trace. The output of one of these is used to fire a Schmitt trigger to start analysis at the onset of a response. The output of the other is sorted into positive-going and negative-going components by the use of diode clippers which feed their respective signals to storage capacitors. This storage is arranged as a peak memory circuit so that after a response is over, one of the two capacitors is charged up to the peak voltage of the positive first derivative, the other the negative. Upon a command signal from the associated logic circuitry, both capacitors are read simultaneously by two separate voltage-to-frequency converters. These feed into a preset counter programmed to divide one frequency by the other, thus accomplishing the computation of  $E_{+}^{\prime}/E_{-}^{\prime}$  or its reciprocal. The quotient is fed into a digital printer and at the same time the value of the positive-going derivative (E') is printed out on another printer to furnish amplitude data. Details of the arrangement are shown in Figures 8a and 8b.

### Control Logic System

This system must recognize the onset of a response, must screen out responses which fail to meet the two time criteria, must time and command readout and print, and must reset the storage capacitors. It must also decide, on the basis of a minimum amplitude criterion, which responses are large enough to measure without incurring unacceptable error because of low signal-to-noise ratio. These demands are met by

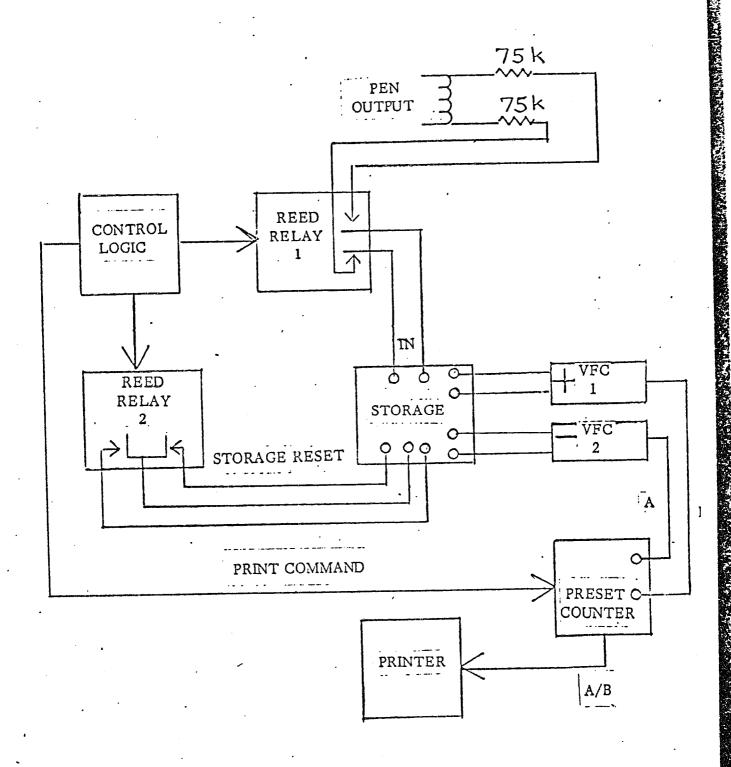


Figure 8a. Diagram of electronic programming for automatic analysis of recovery rate.

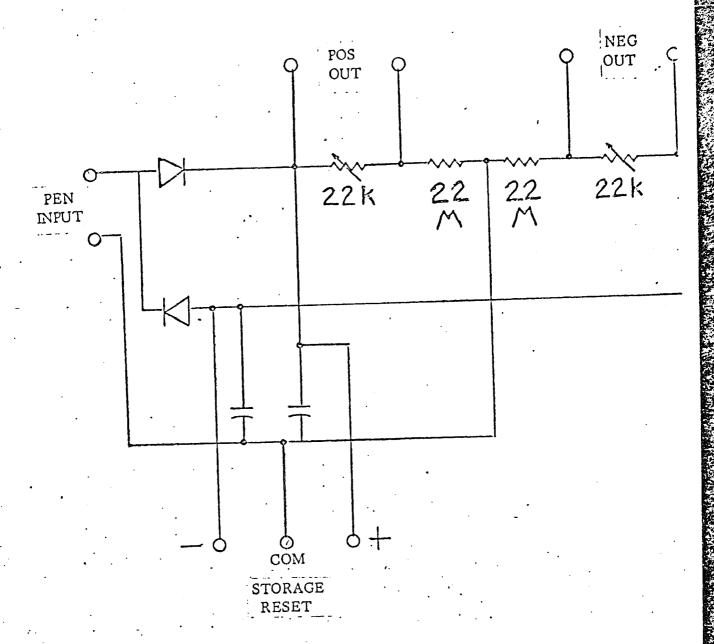


Figure 8b. Storage circuit.

A free-running pulse generator (A) is set to fire at a rate of one per second. Its output is fed into a binary counter (Figure 9). The onset of a response serves to zero the counter sc that time gating of subsequent operations may be standardized. This is accomplished by using the first derivative signal from pen 2 of the dynograph. This signal is fed to a Schmitt trigger which fires whenever a positive-going wave occurs in the first derivative trace. Firing of the Schmitt trigger not only resets the binary counter to start counting at the next second, but also fires a one-shot having a 4.1-second output pulse. The ascending limb of this pulse fires a second oneshot whose 0.5-second output is used to trip a reed relay to discharge the storage capacitors (reset). The primary purpose of the 4.1-second one-shot, however, is to act as a gate to prevent processing of the response if a second wave starts within 4.1 seconds after onset. This is accomplished by feeding these one-shot pulses into a quadruple and-gate, the other three inputs of which are fed from the 0-0-1 terminals of the binary counter. When 4 seconds of counting are up, the and-gate can fire only if the one-shot has not returned to its off-state. If this condition is met, the and-gate output acts as a command to the pre-set counter to take the quotient of the two storage outputs. The preset counter, after finishing the division, signals the printer to print. The quadruple and-gate also fires a one-shot which advances a decade counter used to number the responses on the printout. If a second or third response occurs during the initial 4-second period, the 4.1-second one-shot is reset and its off condition output serves as an inhibit signal to the and-gate.

The requirement for at least 7 seconds between processed waves is met by the use of a triple and-gate and two flip-flops interposed between the Schmitt trigger and the 4.1-second one-shot. The triple and-gate is fed by a 1-1-1 output from the

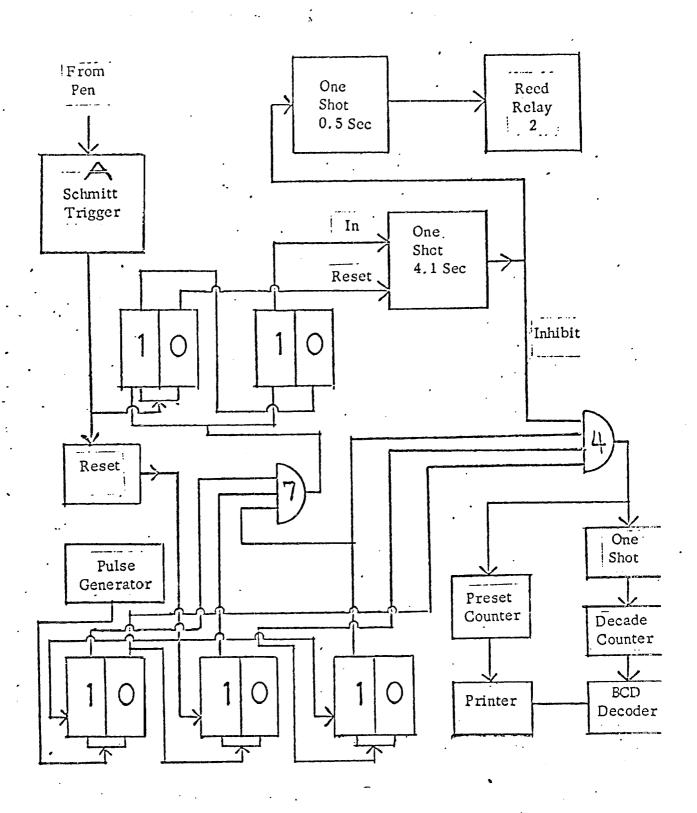


Figure 9. Control logic circuitry.

)

binary counter so that it fires at 7 seconds after the Schmitt trigger has signalled start of the response. Its output resets the two flip-flops and allows a subsequent firing of the Schmitt trigger to fire the 4.1-second one-shot. Until this triple and-gate fires again seven seconds later, any pulse coming through after the 4 seconds of processing cannot fire the one-shot and therefore cannot initiate another computing sequence. The two flip-flops are connected in such a way that the 4.1-second one-shot cannot be fired again until the triple and-gate fires again. Thus no computation can be started unless the binary counter has been allowed to count for seven seconds after the start of the last response. Any response occurring during these seven seconds starts the count over again.

#### Results

This system proved to be very accurate, the print-out data agreeing very closely with values obtained by hand measurement of the positive and negative peaks of the first derivative trace. Values of E' and of the time constants obtained by the two methods for each of twenty solitary responses of a writeout are plotted against each other in Figure 10. From this standpoint the system is very reliable. The major source of error is caused by responses in which the ascending limb is in fact a slurring of two responses into a single one without an intermediate peak. In such a case the Schmitt trigger fails to recognize the second response because the derivative has not recrossed baseline (Figure 11). The maximum slope is that of one of the two slurred components rather than being additive and is not consistent with total H. The value computed electronically is, therefore, considerably less than that computed

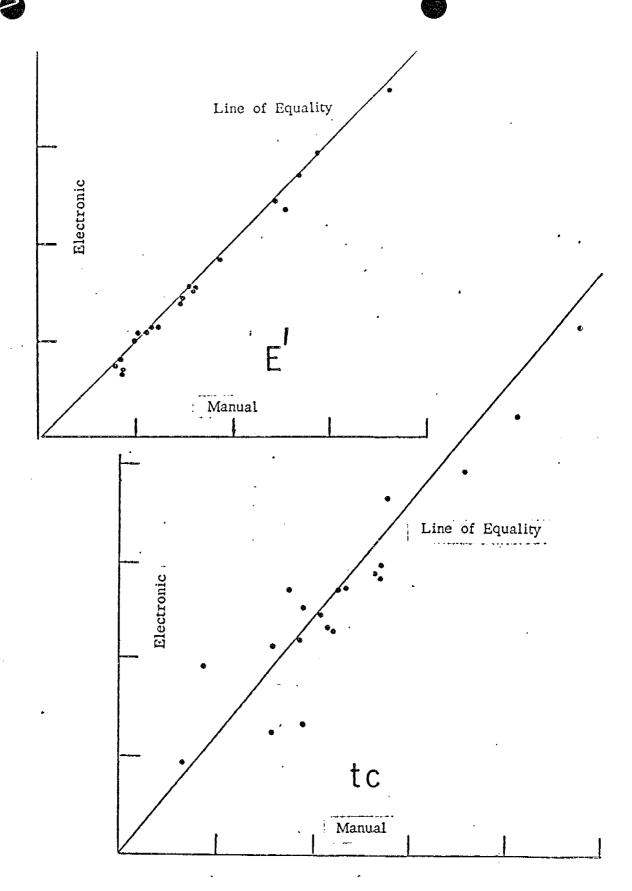


Figure 10. Comparison of manual and electronic measurement of peak first derivative amplitude and of tc.

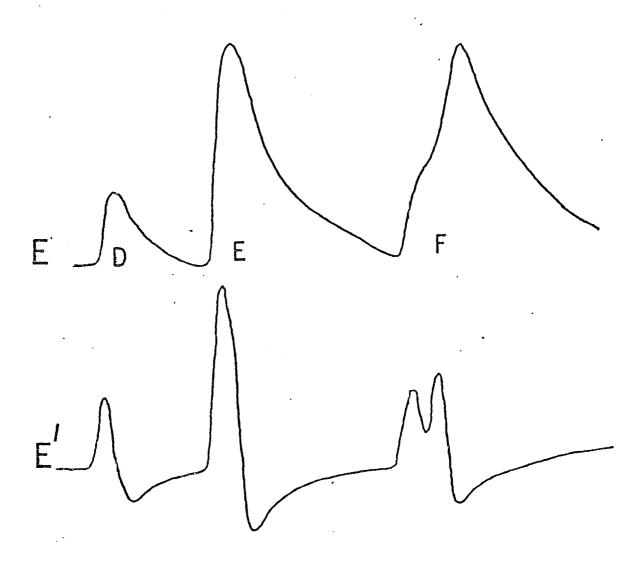


Figure 11. Breakdown of linear relation between primary amplitude and first derivative amplitude in duplex response F. Simple responses D and E show linear relation.

The above deficiency may explain the relatively low correlation of time constants derived electronically from those obtained by the various manual methods. The correlations with other measures for the same population of 65 responses analyzed elsewhere in this paper were as follows:

Electronic vs. Log'E	0.59
Electronic vs. H/tan A	0.68
Electronic vs. Template	0.42

Another problem with the electronic method lies in the selection of the minimum threshold for triggering the Schmitt trigger. If this is chosen too low, many clean high amplitude waves are lost because of the occurrence of a miniscule wave in the previous 7 seconds. If set too high many perfectly useable waves are lost. The compromise between these two conditions is difficult. With the particular threshold used in this test (16% of half scale), the system accepted 65 of 86 responses which met amplitude criteria, the remainder being rejected because of temporal contingencies. The total number of responses, however, was far greater than the 65 having adequate amplitude. For a threshold 8% of half scale (i.e., 4% of full channel width), the total number of responses reaching amplitude criterion would have been 188.

While this automatic system meets minimum requirements for an operationally satisfactory system, its susceptibility to spurious readings of relative wave amplitude when multiple responses fuse in the ascending limb is a rather serious disadvantage. It appears possible to construct an on-line analog system using one of the other approaches and in this regard the measurement of the slope of the log-compressed

# D) Summary of Comparisons Between Measures

For convenience a summary of the various intercorrelations examined is shown in the matrix in Table 1.

Table 1. Correlations between time constants measured in different ways on the same 65 responses.

	Template	Electronic	Log'E	H/tan A	<u>D</u>
t/2 Template Electronic Log'E H/tan A	.94	.42	.86 .59	.81 .68 .87	.82 .63 .86 .90

The overall high correlation between the various manual measures gives confidence that a fundamental form characteristic of the recovery limb is in fact under examination.

various couplings into a Beckman Dynograph equipped with rectilinear ink writers. Time constants of 1, 2, 3, 4, 6, 8, 10 seconds and DC were used. Time constants were measured by the amplitude-slope method described elsewhere. Forty responses were selected with the qualification that they must start at least seven seconds after the start of the previous wave, must have an amplitude at least 5 mm (full scale was 40 mm) and must not be interrupted by a successive wave until at least 50% recovery was completed. In each case the rate constant was calculated from tan A/H. Values for each coupling condition were matched with those from the DC record to compute a Pearson's product-moment correlation.

#### Results

The correlations found at each value of coupling time constant are shown in Table 2.

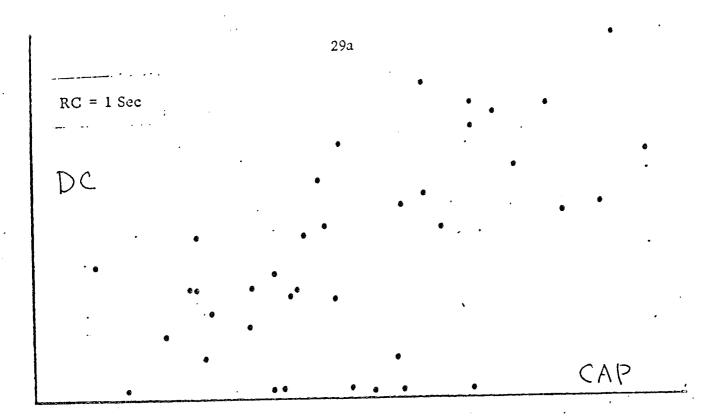
Table 2. Correlation between recovery rates (tan A/H) computed from DC records and those from capacitance-coupled records taken with various coupling time constants.

R-C Time Constant (Coupling)	Pearson's r	Slope Of Line Of Regression
1 Seconds 2 " 3 " 4 " 6 " 8 " 10 "	.33 .51 .72 .80 .86 .90	.32 .44 .27 .59 .43 .68

Note that high correlations are found for 6, 8, and 10 second coupling constants, that is when the coupling time constant approaches the time constant of the slowest waves in the population (see Sections 6 and 8). The correlation reaches a relatively constant level at coupling constants of 6 seconds or longer. This constant level is less than 1, and is in part indicative of the departure of the relation from linearity and in part of the repeat measurement reliability. By comparison the repeat measurement reliability for the template measure found in the earlier study was 0.93 (coefficient of concordance).

The DC values of the recovery limbs are plotted against the <u>rate</u> constants found with each coupling constant in Figure 12. As expected, rate constants are increased as compared with the DC value, with greatest acceleration found when shortest coupling constants were used. Moreover, at any given coupling constant, those recovery limbs having the shortest rate constants (longest time constants) are affected the most. Because of this, the relationship between DC rate constants and those found with capacitance coupling is non-linear. Short coupling constants not only cause a greater scattering of points, making the measure less sensitive, but also affect the slope of the relation as seen in Table 2.

Since, as discussed elsewhere, the rate constant of the first derivative is the same as that of the primary wave, one may wonder why intermediate coupling constants, e.g., I second, do not give as good a relation. The answer lies in the fact that the time constant for obtaining the first derivative must be so short that all responses, long and short, are affected similarly. With the



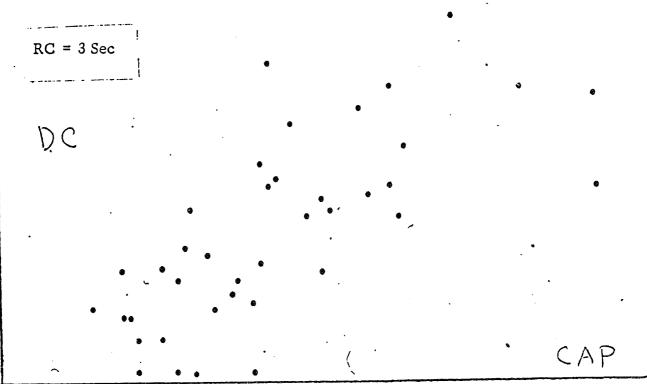


Figure 12. Relation of rate constants of direct coupled responses to rate constants computed on same waves recorded with capacitance coupling.

C

DC

CAP

RC = 6 Sec

DC

CAP

RC = 8 Sec

DC

CAP

RC = 10 Sec

DC

intermediate coupling constants used here, the slower waves will be differentially affected and the relationship breaks down.

These results imply that the use of a capacitance-coupled system having a time constant of 6 seconds or longer is suitable for the determination of recovery time constants. Though values obtained from such recordings are not directly comparable with those from DC recordings, they have similar capacity to reflect changes incidental to shifts in behavioral state.

6. THE INFORMATION CONTENT OF THE RECOVERY LIMB OF THE ELECTRODERMAL RESPONSE

showed that during an electrodermal res-A previous study ponse (EDR) there is frequently a sudden decrease in the hydration of the covered skin surface, and that this phenomenon occurs much more often during cognitive activity such as listening to instructions than with startle responses. These hydration responses, which are attributed to absorption of water from the surface, commence at about one second after the onset of the skin resistance response (SRR) and reach peak in about three to four seconds. Their occurrence is not determined by the amplitude of the SRR but is associated with the presence of positive waves in the skin potential response (SPR). Where pure negative SPRs occur, hydration under the electrode either increases (Figure 13) or remains unchanged. These observations suggest that two different kinds of EDRs might be occurring, a supposition consistent with conclusions drawn in an earlier study Moreover, since skin conductance is in part determined by the level of fluid in the sweat ducts and by the hydration of the corneum! an absorption response might be expected to speed return of resistance or conductance to base level and thereby steepen the recovery limb. An indication of this is seen in Figure 13, where recovery rate of SCRs in the second panel averages twice that of the first.

The absorption response appeared to hold promise as a useful qualitative index of behavioral set, but there are serious difficulties in its direct quantitative measurement due to the complicating effects of simultaneous sweat secretion. It was hoped that the recovery limb of the SRR or SCR might carry the information reflected in the absorption response and at the same time be more amenable to quantitative measure-

ment. This section is concerned with the development of quantitative methods for examining the recovery rate of the EDR and with an examination of its relation to other measures and its scasitivity to behavioral state.

#### Method

### Evaluation of the Recovery Rate

Quotient for describing the rate of return of skin resistance to base line after response to stimulation. They did this by determining the percent recovery reached in five minutes after peak displacement. Their measure ordinarily was applied to a complex long-lasting response and they interpreted it as an indication of the capacity of the central nervous system to reestablish homeostasis following a disturbance. The Recovery Quotient did not deal with wave form and theoretically should be unrelated to the measure of concern in this paper. For the present purposes, the recovery limb was, as a first approximation, assumed to be exponential, a conclusion also reached by

One fundamental characteristic of such a curve, its rate constant, or in reciprocal terms its time constant, is independent of amplitude and was selected as a best first approximation of recovery rate. It is viewed as a useful reflection of this rate, but not as indicating a truly exponential form for the recovery limb. Examination of the exponential equation reveals numerous methods for evaluating this constant, but two convenient ones were adopted for use in this study. For either one, DC recordings are mandatory.

Half-time measure. To determine the time constant (tc), one should measure the time required to attain 63% recovery (i.e., 1 - 1/e), but the recovery half-time

relation to to (to = 1.43 t/2) and is more easily measured. It can be quickly determined by the use of a transparent overlay containing a series of parallel horizontal lines bisected by a single vertical line. The central parallel line is made longer than all the rest and contains a metric scale on the right side of the vertical, with zero at the intersection. The vertical line is made to pass through the peak of the wave perpendicular to the base line. The template is moved up and down until the central line is midway between onset and peak of the wave, as indicated by the short parallel lines. The distance from the vertical line to the intersection of the central horizontal line with the recovery slope is read from the scale and converted to half-time by the appropriate calibration. This method can only be used on responses which recover at least 50% before a second response occurs.

Curve-matching. A second method is based on curve-matching. As seen in Figure 14a, if the members of a class of responses of differing amplitudes all have the same recovery time constant, it is possible to superimpose them on a single exponential curve. One may use a transparent overlay bearing a family of exponential curves of known time constant (obtained, for example, by recordings of a condensor discharge through various resistances). The te for any response may be quickly determined by placing the overlay such that its base line (asymptote) is horizontal and passes through the point of onset of the response. A straightedge is then held against the lower margin of the overlay, which should be parallel to the base line, and the overlay is moved horizontally until one of the standard curves coincides with the recovery limb or a best interpolation is made (Figure 14b).

Each of the above methods has its advantages and disadvantages. The half-time

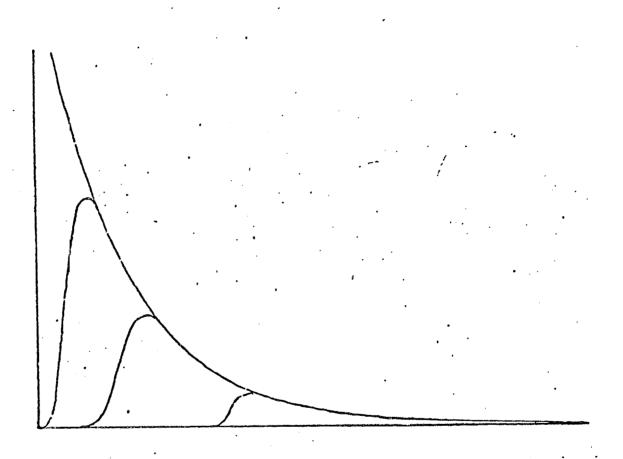


Figure 14a. Drawing of three electrodermal responses of different amplitudes but same recovery rate superimposed upon an exponential curve.

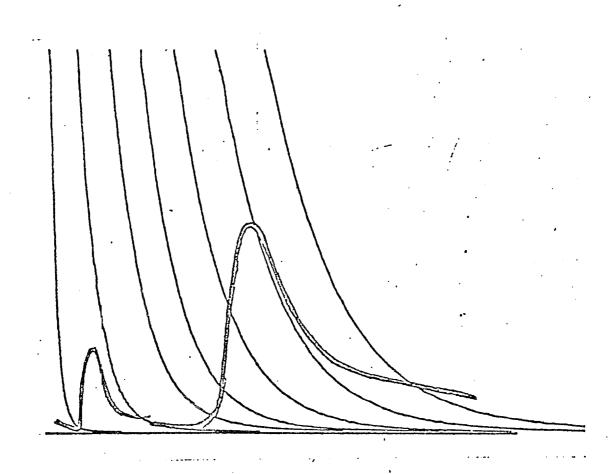


Figure 14b. Illustration of curve-matching to determine the "time constant" of the steepest portion of the recovery limb.

not recover by 50% prior to onset of a subsequent wave and cannot be evaluated. The curve-matching method is somewhat more difficult; it soon becomes clear that many waves depart from the exponential shape and matching is ambiguous. However, by using the early portion of recovery just after the steepest slope has been reached, satisfactory matching can be made for practically any response. Since this can be done on a portion which reaches only 25 to 30% of recovery, many more waves lend themselves to this measure than to the half-time measure. As might be expected, curvilinear recording produces a distortion in the recovery limb which becomes appreciable if the writeout extends beyond the middle third of the scale. The half-time measure is therefore recommended for curvilinear recordings since it is possible to make objective corrections for this effect, for example, using an overlay with an appropriately curved vertical line. Corrections for the curvilinear effect in curve-matching is considerably more difficult and more approximate, and it is recommended that the use of this method be restricted to rectilinear recordings or to the middle third of the curvilinear scale.

# Procedure

Subjects were 106 normal adults of both sexes, ages 17 to 45. The number used in each experiment varied and is indicated in the presentation of results. Each experiment was run on a different population. Electrodes were silver-silver chloride plates applied to masked sites, 1/4-inch diameter, with a thickening agent in 0.1M NaCl as an electrode paste. A constant current bridge (current density 8 microamp/cm²) was used to obtain SRRs and a constant voltage bridge (0.75 V across two active sites) for SCR.

All exosomatic electrodermal placements were on the volar

The subject was seated in a small room and after a 15-minute stabilization period was exposed to stimuli which differed for each experiment as described below.

Experiment 1. This was a replica of an experiment by

which was run for another purpose. In this the subject is given a 3-minute rest period followed by a 1-minute task in which he is frustrated by the experimenter in his attempts to count backwards. He then participates with the experimenter in a guessing game in which the experimenter attempts to guess the number which the subject selects. If he fails, the subject presses a button which supposedly shocks the experimenter. Following this two-minute "aggressive" game, he is given a second rest period.

Experiment 2. A mixed series of eight tones and eight light flashes of moderate intensity is presented to the subject who has been instructed to relax with his eyes open. Following this he is instructed as follows: "This time, when you hear a tone it will be a warning signal for a second one which will occur at any time up to a half-minute later. At the sound of the second tone you are to press this footswitch as rapidly as possible so we can measure your reaction time. In the same way a light flash will be

a warning to expect a second light flash at which time you are to note the position of the moving pointer. A third flash will occur shortly after that, at which time you are to report the letter indicating its position." The inter-stimulus interval for each task ranged from 10 to 30 seconds. The pointer rotated at 60 r.p.m. This series was continued until eight trials of each task had been run in randomized order.

Experiment 3. The subject was told to relax with his eyes open and was exposed to a series of five tones (approximately 75 db at the subject, 1 second duration) presented through a speaker at a varying inter-trial interval (10 to 25 seconds). As soon as this habituation series ended, he was instructed for the next sequence which followed immediately. In this series, tones of the same intensity and range of intertrial intervals as for the first series constituted signals for a reaction time effort (finger-press) without a foreperiod.

Experiment 4. The subject is given two reaction time trials with a foreperiod of 4 to 10 seconds. Both warning and execution signals are 0.5-second tones delivered from a speaker (approximately 65 db at the subject). These trials were intermixed in random order with two word association trials to form a block in which the inter-trial interval varied between 20 and 60 seconds. Blocks were repeated with two-minute intervening rest periods.

Experiment 5. In this series, run earlier for another purpose the subject wore a contact hydration detector as well as skin resistance and potential electrodes. Stimuli were a mixed series of sounds and lights of moderate intensity interrupted at intervals with a period of conversation.

### Results and Discussion

### Characteristics of the Recovery Measure

Reliability. Inter-scorer reliability of the more subjective of the two methods of measuring recovery rate, namely curve-matching, was determined by having each of three individuals score the same 30 isolated responses chosen at random by a lottery method from a population of 100 useable responses. Time constants ranged from 2.2 to 7.2 seconds. The Kendall coefficient of concordance among their scores was 0.93. The time consumed in making a single measurement was approximately seven seconds. Despite the high inter-scorer reliability indicated in the measurement of isolated responses, i.e., responses which occurred at least five seconds after the peak of the last previous response, there is an apparent source of error in the measurement of recovery rates of responses which themselves fall on the steep portion of the recovery limb of a previous larger wave. For this reason, scoring of responses is best accomplished on waves which occur at least ten seconds after the peak of the preceding wave.

Relation between to and t/2. The reliability of the half-time measure should be even greater than that of the curve-matching measure, in view of the rigorous method by which it is obtained. It does, however, frequently demand the reading of very short time intervals with precision, a chore which can be difficult when for convenience in making other measurements, slow paper speeds are used, e.g., 1 mm per second. To see how the two measures compared, 22 consecutive responses recorded with rectilinear pens were analyzed by two persons, each using one of the two methods. Time constants ranged from 1.6 to 8.7 seconds. The mean values for to and t/2 respectively were 5.40 and 3.88 seconds. The ratio of these values, 1.39, agrees rather

well with the theoretical ratio of 1.43. The product-moment correlation between to and t/2, 0.94, can be regarded as a combined test both of the accuracy of measurement and of the validity of the exponential treatment. This result, together with the 1.39 ratio, implies that either measure is acceptable, and that the portion of the curve used does not deviate appreciably from an exponential form.

Resistance vs. conductance responses. In some instances responses were measured concurrently from two sites, one with a constant voltage bridge, the other with constant current. Recovery half-times were determined for corresponding SCRs and SRRs and found to be highly correlated, though different in absolute magnitude. Correlations between 20 pairs of responses on each of three subjects were .83, .82 and .95. Mean values for measurements on SCR and SRR respectively were: subject A, 4.9/6.3; subject B, 3.6/7.3; subject C, 3.6/3.8. Thus although either SCR or SRR may be used for studying changes in recovery rate, if individuals are to be compared it would be desirable to standardize on one of the two systems. Differences between the mean SCR and SRR values, however, may well reflect differences between sites rather than between methods of recording, since despite high correlations, appreciable differences are found between measures taken from simultanous palmar and dorsal SRRs as seen in the example in Figure 18.

Relation of recovery rate to amplitude. The assumption of an exponential form for the recovery limb implies that the rate constant should be independent of amplitude. This assumption was tested by an examination of the relation of recovery rates to amplitude using the half-time measure on 20 SCRs from each of six subjects. The product-moment correlations were .21, -.20, .28, .62, .74 and .19. These results

two may for some subjects be related through a common influence. The positive signs for the two significant correlations (.62 and .74) would indicate that there is a tendency in some subjects for responses of higher amplitudes to be associated with slower recovery rates.

Relation to positive SPR. From the relations described in the introductory section, it was predicted that positive SPRs should be associated with fast recovery rates. Out of 30 subjects run in Experiment 2, 13 showed both clear positive SPRs (biphasic) and "pure" negative SPRs. These were used for the comparison. Since the magnitude of positive-going activity associated with a negative SPR cannot at present be quantitatively evaluated rather than correlation was made. In each case two clearly uniphasic negative responses and two biphasic responses with a pronounced positive deflection were selected from the skin potential record. The time constants of the corresponding skin resistance responses were measured and for 12 of the 13 subjects the average time constant associated with positive SPRs was shorter than that associated with "pure" negative SPRs. The respective group means were 3.7 and 7.4 seconds (p < .005). Amplitudes in the two categories were not significantly different, although responses accompanying positive SPRs tended to be somewhat larger, the mean log ratio being 0.126, equivalent to an amplitude ratio of 1.34:1. If anything this would reduce the differences between time constants rather than account for them.

The relation of recovery rate to occurrence of absorption responses was also examined for an associative relationship rather than a correlation because absorption, like the positive SPR, is difficult to measure quantitatively

The manages on the hydratio

trace showing marked absorption and two showing an increase in hydration were selected in a randomized manner, without regard to stimulus. The time constants of the recovery limbs of the corresponding SRRs were measured and an inter-individual comparison made between the two categories. In 12 of the 13 subjects examined, recovery was faster in association with absorption (p < .001). The group means were 6.0 and 9.1. The association of faster recovery rate with the occurrence of absorption responses and with positive SPRs is consistent with the third combination of these variables, namely that between occurrence of absorption and of positive SPRs previously reported

# Sensitivity to Behavioral State

Both measures, t/2 and tc, proved highly sensitive to change in behavioral set. In some cases, for example in the comparison of a rest period with a task period, the conventional amplitude or frequency measures would discriminate just as well, but the strength of the recovery rate in differentiating between conditions did not depend upon amplitude. Moreover, in many cases, it distinguished between conditions when amplitude per se could not. In this initial examination of the resolving strength of this measure, t/2 has been sampled in some experiments, tc in others. Each clearly demonstrated its value, and the choice of which to use is largely a matter of preference. The results of the various experiments are presented below.

Experiment 1: Rest vs. aggressive game. In examining differences between the recovery limb half-times of spontaneous waves in the rest period and those during the aggressive game, an effort was made to minimize any intrusion of an amplitude effect. The first three responses of at least 5 mm amplitude which met the half-time

subjects these were taken from the pre-task rest period, for the other half from the post-task period. The first three responses from the game period which fell in the same amplitude range as those of the rest period were used for comparison. Figure 15 shows representative strips taken from each of these periods. The pre-task and post-task relaxation periods (upper and lower panels) both show responses which recover more gradually than those during the task period. As for the other subjects, t/2 in the pre- and post-task periods are rather similar. It is significant that the sharpening of the recovery limb started during the instruction period. A portion of the instruction period is shown in the section of the middle strip to the left of the arrow designating start of the task. The group mean t/2 for the rest period was 5.6 seconds and for the task period 3.3 seconds (p < .001). All of the 12 subjects showed a reduction during the aggressive game, the mean decrease being 41% (Tables 3 and 4). The amplitudes of the two groups of response samples were well matched and the small mean difference of 12% with the task responses being larger fell far short of significance (t = .87).

Experiment 2: Simple stimuli vs. signals. The half-time measure was also used in this comparison made on 16 other subjects. Here the responses to light flashes during the relaxation period before instructions were compared with responses to the warning lights (not the execution signal) for the perceptual task. The last three useable responses during the rest period were compared with the first three useable responses during the task period. An acceleration of recovery rate occurred in 13 of the 16 subjects (Table 4) when the light flash took on signal properties. The average decrease in t/2 was 29% (p < .05). The amplitudes of the response samples averaged 9% less during the task period (t = 1.14, NS).

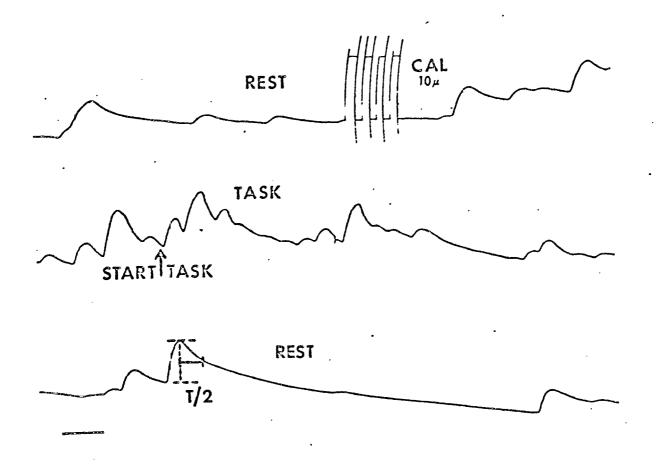


Figure 15. Recordings of skin conductance during pre-task rest (upper), instructions and task (middle) and post-task (lower), showing acceleration of recovery rate during instructions and task. Illustration of half-time measure is shown in lower trace. Time line is 10 seconds.

Table 3. Comparison of average values of recovery half-time (t/2) for resting state and guessing game task in 12 subjects.

	t/2 (seconds)	econds)	•	
Subject	Resting	Task	% Change	
1	6.7	5.6	-16	
2	. 5.0	3.6	-28	
3	4.9	3.1	-33	
· 4	5.7	3.1	-46	
5	5.3 ·	2.9	-45	
6	7.5	2.8	-63	
7	3.6	3.1	-14	
8	10.0	5.0	-50	
9	3.9	3.2	-22	
10	3.9	2.9	-26	
11	2.2	1.7	-23	
12	8.1	3.1	<del>-</del> 63	

Table 4. Summary of results from three experiments showing change in recovery rate with change in stimulus condition. Symbol "n" designates number of subjects who showed a decrease.

<u>N</u>	n	Measure Used	Condition A	· Condition B	Mean Change A to B	<u>p</u>
12	12	t/2	Rest 5.6 sec	Aggressive Game 3.3 sec	-2.3 (-41%)	<.001
16	13	t/2	Light Flashes 7.9 sec	Perceptual Task 5.6 sec	-2.3 (-29%)	<.05
35	32	t.c.	Tones 10.4 sec	Reaction Time 4.9 sec	-5.5 (-53%)	<.001

Experiment 3: Simple tones vs. reaction time effort. The curve-matching method was used to determine to on the 35 subjects used in this experiment. The largest response to the five tomes presented during the habituation series was compared with the response which was nearest in amplitude during the five reaction time trials. Of the 35 subjects, 32 showed acceleration of the recovery limb during the reaction time series, as seen in the representative example if Figure 16. The mean decrease in recovery limb to for the group was 53 percent (p < .001). The mean to presentation of non-signal tones was 10.4 seconds for this population (Table 4). In Experiment 2, the mean half time for responses to non-signal light flashes was 7.9 seconds. Converting this to to by multiplying by 1.43 gives 10.3 seconds, in remarkable agreement with the results of Experiment 3. This similarity though perhaps fortuitous provides an added degree of confidence in the measure.

# Change in Arousal

So far this section has been concerned with the power of the recovery rate in discriminating between responses in two qualitatively different stimulus situations. It can apparently also distinguish between two similar stimulus periods in which the state of the subject is different. Representative examples may help illustrate this point without statistical treatment. Figure 17 shows strips from two consecutive blocks in Experiment 4. In trace A, the subject is exposed to his first block of reaction time and word association stimuli. In trace B taken from a later block, the subject has apparently habituated to the situation, as indicated by reduction in response amplitude and by the fact that he has ceased responding to the alerting signal for the reaction time trials. The slowing of the recovery limb with repeated trials is especially marked

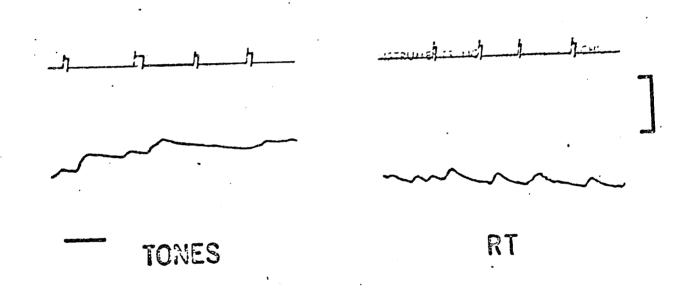


Figure 16. Representative skin conductance recordings from Experiment 3 showing acceleration of recovery rate during reaction time trials. Time line is 10 seconds.

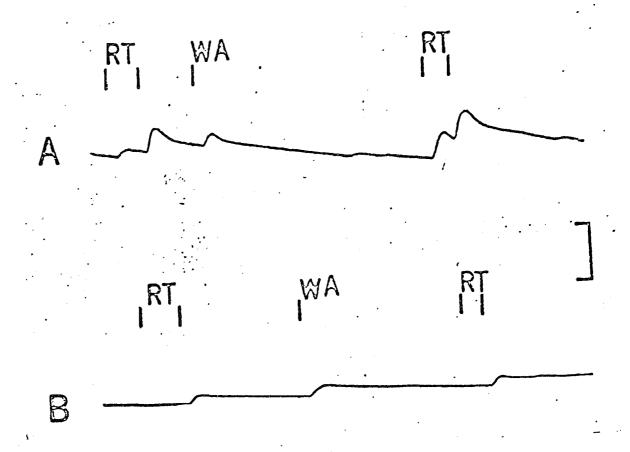


Figure 17. Recordings of skin resistance from blocks 1 (upper) and 2 (lower) of Experiment 4 showing slowing of recovery rate with adaptation. Stimuli are reaction time trials (RT) and word association trials (WA). Vertical calibration line is 25 K; time line, 10 seconds. Resistance of upper trace is 200 K, lower trace 190 K.

tendency, only 7 of these showed an increase of over 30%.

The recovery limb may also distinguish between responses to dissimilar stimuli in the same task period. An example is shown in Figure 18, taken from Experiment 2. It shows simultaneous recordings from the dorsal and palmar surfaces of the fingers of two individuals. The letter A indicates an alerting signal for a forthcoming reaction time trial and E, the execution signal. S denotes a spontaneous wave occurring during the foreperiod. The number below each response is the value of its time constant. For the first subject, the spontaneous response has about the same time constant as does the alerting response, but the execution response is considerably faster. The dorsal and palmar surfaces reflect this same pattern despite absolute differences in their recovery rates. For the second subject, the constant for the spontaneous response is over twice as long as that for alerting; the constant for the execution response is also longer. The difference between recovery rates of responses to alerting and execution responses is in general not a reliable one, but six of the 19 subjects did show an appreciable difference between the two. Two were significant at the .005 level of confidence, three at the .025 level and one at the .05 level. In five of these six cases, the shorter to occurred with the execution signal.

# Individual Differences

The sensitivity of the recovery rate to differences in stimulus condition and in state of the subject suggested that inter-individual differences in recovery rate, seen for example in Table 3, might be associated with differences in characteristic behavior pattern. The behavioral index chosen to test this idea, namely rate of habituation to tones or to reaction time trials, was derived from Experiment 3. The quotient of the

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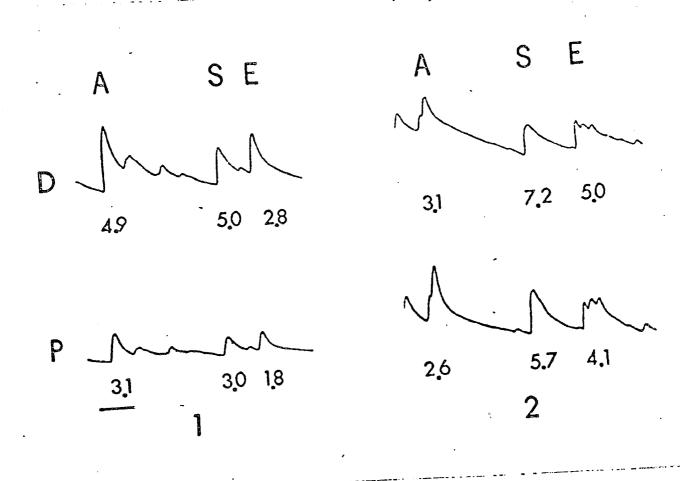


Figure 18. Simultaneous recordings of skin resistance from dorsal surface of the finger (upper) and palmar surface (lower) from two subjects. Stimuli are alerting tone (A) and execution tone (E) for a reaction time trial. S denotes a spontaneous response. Numbers denote recovery limb time constants in seconds. Time line is 10 seconds.

of habituation rate, higher values indicating faster habituation. Time constant measures were taken only from the reaction time series and for 35 of the subjects were the same as obtained for the earlier analysis of this experiment. In 13 other subjects who showed no responses to the tones, the response of median amplitude was used. The group correlations between this time constant and the various measures of habituation are shown in Table 5. Comparison of to with rate of habituation of the reaction time res-

Table 5. Summary of results from Experiment 3 showing product-moment correlation between recovery rate and habituation rate.

<u>N</u> .	Habituation Measure	<b>r</b>	P.
53	SCR during Reaction Time	.33	<.05
32	SCR during Tones	.13 ·	NS
51	FPV Change during Tones	.30	<.05

ponses (r = .33, N = 53, p < .05), shows that individuals with fast recovery rates tend to habituate more slowly during the reaction time series.

Of these 53 subjects there were 32 whose records permitted analysis of habituation rate of the SCR during the tone series. The correlation between this measure of habituation and the time constant was very low and not significant. However, when instead of SCR, finger pulse volume change was used as the response measure, the rate of habituation to tones showed a significant correlation with to (r = .30, N = 51,

gression. The two positive correlations found between recovery limb to and different habituation measures indicate that individuals with fast recovery rates tend to habituate more slowly (Table 5).

#### Conclusions

It has been demonstrated that the time constant or the half-time of the recovery limb of the exosomatic electrodermal response can be used to distinguish between a resting state and a task state, between responses to the same physical stimulus under qualitatively different sets, between responses to the same stimulus at different stages of habituation and finally between individuals who habituate at different rates. In some cases, significant discrimination would also have been made by treatment of amplitude data but in other cases, amplitude could not have distinguished between the two conditions. The rate of recovery accelerated markedly under three conditions, all of which involved activation from a resting state for performance of a task. However activation per se does not imply acceleration of the recovery limb. Bursts of strong spontaneous activity during "relaxation" periods were composed of EDRs showing the gentle recovery limbs characteristic of isolated responses elsewhere in the rest period. A reasonable interpretation is that fast recovery rates reflect a mobilization for goal-directed behavior. Spontaneous activation during rest does not possess this quality. To the extent that slow habituation represents longer maintenance of a set to respond, the inter-individual relation between fast recovery limbs and slow habituation rates is consistent with such an interpretation. For the electrodermal (but not the vasomotor) response the difference in the relationship between to and habituation rate for the reaction time series, where it was appreciable, and for the tone series, where it was negligible,

*:

These findings also have an important implication in regard to the nature of electrodermal activity. The recovery limb time constant is a response characteristic by which two exosomatic electrodermal responses may be qualitatively differentiated according to the nature of the stimulus. Another method is by comparison of relative amplitudes of palmar and dorsal finger responses.

This stimulus specificity, together with the independence of the recovery rate from a direct amplitude effect, its relation to the occurrence of positive components in the SPR and its relation to the occurrence of absorption waves suggests the existence of a second component in the EDR under independent control. The steeper recovery slopes apparently associated with goal-directed activation are viewed as representing the activity of a sweat reabsorption mechanism which in some way serves as an adaptive process during such behavior.

7. THE ELECTRODERMAL RECOVERY LIMB AS AN INDEX OF COAL-DIRECTED BEHAVIOR

It was demonstrated in Section 6 that the rate of recovery of an exosomatic electrodermal response varies as a function of the state of behavioral activity of the individual, becoming faster when the subject changes from rest to any of a variety of tasks. The rate of recovery, which was expressed in terms of the time constant (tc) of the exponential region of the recovery limb, is faster in the presence of positivegoing skin potential responses, and in the presence of the recently discovered sweat reabsorption response Although observations in the initial study appeared to indicate that acceleration of recovery rate indicates a mobilization for goal-directed behavior, the evidence was suggestive rather than definitive. The tasks and stimuli used generally caused an increase in activation level as reflected in electrodermal activity or finger vasomotor activity, and an equally tenable hypothesis would be that acceleration of recovery rate merely reflects increased general activation. The obvious experiment needed is one in which activation is achieved in one instance by task performance, and in the other by a none-task condition, for example, noxious stimulation. Such an experiment was one of the key aims of this experiment. In addition further data to evaluate the degree of the dependence of recovery upon such things as response amplitude and base level were needed. Information was also needed in regard to the stability of this measure in a given individual over a period of time. This section deals with additional findings relevant to some of these questions.

#### Method

In one phase of this experiment a group of 16 male medical students was run on

were monitored. Twelve of these subjects were tested on four successive occasions one week apart, under the same stimulus schedule. Five additional subjects were run only on selected tasks from this list.

Electrodermal electrodes were applied, after which the subject was seated and a stabilization period of 12 minutes allowed. The following schedule of conditions was followed without randomizing the order. Constant order was used to allow maximum similarity of the 5 repeat sessions despite the danger of an uncontrolled order effect.

Sequence	Duration	Situation
1 .	2 min.	Relax (eyes open)
2	1 1/2 min.	Count by ones at own pace
3	1 1/2 min.	Count backward from 500 by 7s.  A new starting point near 500  was used on each successive week.
4	1 1/2 min.	Take deep breaths on command (3 at approximately 30-second intervals)
5	1 1/2 min.	Read aloud
6	2 min.	Mirror tracing
7	2 min.	Relax (eyes open)
8 .	40 sec.	Cold pressor (hand immersed to wrist in ice water)

Time constants were measured with the curve-matching overlay technique described earlier, the first useable wave following the first 15 seconds of each procedure being taken as the sample. One requirement was that the wave used should

their recovery rates. The average of the initial and final resistance levels for each of the eight procedures was computed for each subject.

### Results

# Effect of Task and Activation on Time Constant

The time constant (tc) was found to vary considerably as a function of task situation, as found in the earlier study. The range of time constants ran from an average of 3.1 seconds in the mirror tracing task to 7.8 seconds for resting with eyes closed. The time constants for the 8 task conditions were ranked for each of 16 subjects and the average rank for each task computed. Results are seen in Table 6. The

Table 6. Average ranks and standard deviations for each of 8 task conditions on 16 subjects.

Order Run	. Rank .	S.D.
7	2.5 (longest tc)	1.5
1 .	3.2	1.5
8	3.8	2.3
4	4.2	2.2
2	4.8	2.0
3 ,	5.2	1.9
. 5	5.9	2.0
6	6.4	1.5
	7 1 8 4 2 3 5	7 2.5 (longest tc) 1 3.2 8 3.8 4 4.2 2 4.8 3 5.2 5 5.9

average ranks have been arranged in order with the longest to at the top. The order in which these procedures were run is also shown, and a Spearman's rho test indicated no significant relation between the ranks of the time constants and the order run (rho = -.05, N.S.). A Wilcoxon signed-ranks test showed that many of these

test) are shown in Table 7. Slowest recoveries were associated with the two rest conditions and with the cold pressor exposure. The remaining conditions appear to rank themselves essentially in order of increasing task complexity.

In view of the fact that recovery rate during the ice water exposure was not significantly different from that at rest, although that of the last 4 tasks was, it appears that activation per se is not an adequate condition for acceleration of electrodermal recovery. One may challenge the contention that the cold pressor was as activating as mirror tracing, but the report of strong pain by 14 of 16 subjects would suggest that there at least occurred the kind of arousal associated with strong noxious stimulation. Moreover, mean skin conductance levels for the test population were very similar for the cold pressor and mirror tracing conditions, being 28.1 and 27.6 micromhos/cm² respectively (t = 0.36, N.S.). The rate of change of skin resistance during these two tasks also did not differ (t = 0.12, N. S.), nor did the frequency of spontaneous responses (t = 0.12, N. S.). Thus, at least according to a few so-called electrodermal activation measures, activation levels during ice water exposure and mirror tracing were not demonstrably different, although both differed from the resting condition.

Twelve of the above 16 subjects were run once per week for 5 weeks and an analysis of variance was performed on the time constants (Table 8). This also demonstrated a significant difference between tasks (p < .001).

A final test of the sensitivity of to differences in task situation was by analysis of the similarity of rankings of these tasks across the 16 subjects, using Kendall's Coefficient of Concordance. This confirmed the significance of the differentiation (W = .31,  $X^2 = 34$ , p < .001).

Table 6. Average ranks and standard deviations for each of 8 task conditions on 16 subjects.

Condition	Order Run	Rank	S.D.
		and the second s	•
Rest (eyes closed)	7	2.5 (longest tc)	1.5
Rest (eyes open)	1 .	3.2	1.5
Cold Pressor	. 8	3.8	2.3
Deep Breath	4	4.2	2.2
Count Forward	2	4.8	2.0
Count Backward	3	5.2	1.9
Read Aloud	5	5.9	2.0
Mirror Tracing	6	6.4	1.5

Table 7. Levels of significance of Wilcoxon signed-ranks test for various combinations of task situations.

Condition	Backward	Deep	Cold	Rest (Eyes	Rest (Eyes
	Counting	Breath	Pressor	Open)	Closed)
Mirror Tracing Reading Aloud Backward Counting Deep Breath	.05	.02	.01	.002 .02	.005 .005 .005

# Stability of the Time Constant in Repeated Trials

Not only did the to offer a stable index of differences between task situations, but also of differences between subjects. The analyses of variance of the to's of 12 subjects run in the eight task situations on each of 5 consecutive weeks (Table 8) demonstrated a significant difference between subjects (p <.001). In addition there was a significant task-by-subject interaction (p <.005) as well as the difference between tasks already noted.

Table 8. Analysis of variance of time constant data from 12 subjects, run in 12 task situations on 5 consecutive weeks

Source	df	Mean Square	F	P
			and the state of t	
Subjects	11	109.7	14.5	<.001
Tasks	1	355.0	47.0	<.001
Subjects x Tasks	11	28.4	3.8	<.005

. An indication of the stability of this measure on repeated trials was obtained by examining the degree to which the 12 subjects maintained the same rank for a given task, over the 5 sessions. The Kendall Coefficient of Concordance for the Backward Counting task was .53 ( $X^2 = 29$ , p<.01) and for the cold pressor exposure .65 ( $\chi^2$  = 36, p<.001). These results indicate that a given subject may show variation in time constant according to the task, but the magnitude of his time constants takes a characteristic position in relation to the rest of the population. The 5-week data for the backward counting task are presented graphically in Figure 19. Each vertical line represents the 5-week mean and  $\pm~1$  standard deviation of one of the 12 subjects. They have been ranked in order of their mean time constants (upper series) and rate constants (lower series). The rate constant scale increases downward. Note that fast recovering subjects are consistently fast and slow recovering subjects are consistently slow. Note also that the rate constant shows less dependence of variance upon mean (r = -3.21) than does the time constant (r = 0.34). The solid circles represent the mean rate constants for the cold pressor condition over the five weeks and in every case they are slower than those for backward counting. An example of the range of time constant means over the 8 conditions for the 5 weeks for a single

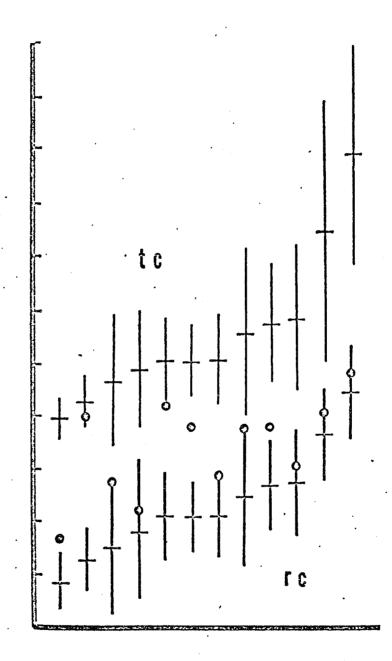


Figure 19. Means and  $\pm$  1 SD of recovery limb time constants (upper group) and rate constants (lower group) for each of 12 subjects tested over 5 consecutive weeks. Vertical line data are for the backward counting task. Solid circles represent the corresponding means for the cold pressor rate constants.

subject chosen at random is given in Figure 20. Each vertical line represents the mean time constant  $\pm 1$  standard deviation.

Thus the recovery limb measure, preferably its rate constant, constitutes a rather stable measure of differences in behavioral situations, and appears to reflect the level of involvement in goal-oriented performance. It is capable of discrimination under conditions in which base conductance level and (from the earlier study) skin conductance response amplitude do not.

### Relation of tc to Conductance Level

Although conductance usually increases when a resting subject becomes activated for a task, there is no reason to suspect a necessary correlation between conductance and tc, i.e., that the two are causally related. If the type of activation which produces a rise in conductance does not entail mobilization for a goal-directed task, it is to be expected that the correlation would break down. This prediction was tested upon a group of 21 subjects. Two tasks were chosen, both activating, but only one of them involving a cognitive task. The first was a Cold Pressor exposure, the second, the Backward Counting task. Correlations were essentially as predicted. The Pearson's r between SC and to during Cold Pressor was -.23 (N.S.) whereas that for Backward Counting was -0.49 (p < .05). The above determinations are in themselves inadequate to justify the conclusion that to is independent of skin conductance level. Another analysis does, however, point toward such a conclusion. The data for the above correlational analysis was subjected to a t-test for differences between tasks. The time constants were significantly different (p < .01), but the SC levels were not.

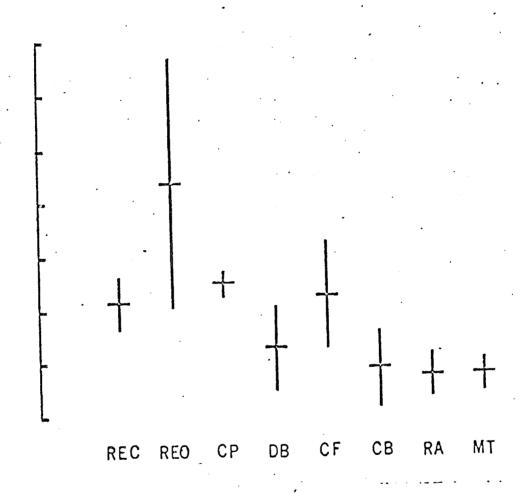


Figure 20. Means and ± 1 SD of recovery limb time constants for a single subject for each of 8 conditions over a series of 5 consecutive weeks. Abbreviations are: REC, resting (eyes closed); REO, resting (eyes open); CP, cold pressor; DB, deep breaths; CF, counting forward; CB, counting backward; RA, reading aloud; MT, mirror tracing.

### Relation of Time Constant to Performance

The earlier interpretation that the recovery limb time constant was related to mobilization for goal-directed activity implied a relation between the degree to which mobilization occurred and the level of performance. The relationships between to and two measures of performance in the Backward Counting (by 7's) task were examined. One measure was the number of errors made, the other the rate of counting. The number of errors was determined by determining the number of times subtraction of seven from the previous number was in error. The rate was expressed in terms of total span for the backward count in the 90 seconds allowed. Results on a population of 12 showed that subjects with shorter time constants tended to count faster (t = 1.96) and to make fewer errors (t = 1.82). Levels of confidence for these, using a two-tailed test, were at the 0.1 level. (Note: Although the direction was predicted, this investigator has discontinued the use of one-tailed tests).

### Functional Interpretation

In looking for a functional interpretation, one may point to the results of experiments over the last several years which show the relation of the recovery limb to rate of reabsorption of sweat. In some recent experiments, a new method has been utilized for demonstrating this relation. If a prism is illuminated for maximum internal reflection and placed on the skin as was done by sweat droplets appear as black points on a white field. This method may be carried to its logical next stage, namely, the placement of a photocell at the proper point in the light path to integrate and follow the field of punctate sweat droplets. Figure 21 shows such a recording. The abbreviation OSR refers to what I call the optical sweat response, the

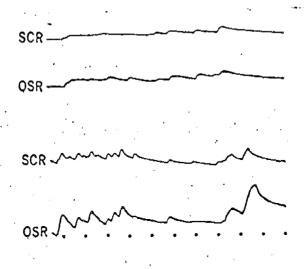


Figure 21. Simultaneous tracing of skin conductance response and optical sweat response from each of two subjects. Time marks are 10 seconds.

covered by a glass plate, do not simply accumulate on the surface during and following a response, but are immediately reabsorbed, so that despite continuing activity, the moisture content of the surface remains relatively constant. The second point of interest is that when the skin conductance trace shows slow recovery limbs as in the upper pair, so does the optical sweat response as compared with the lower pair in which electrical and optical recovery rates are rapid. Such demonstrations, along with those already reported using other methods, imply that changes in the recovery limb are at least in part indicative of a change in the rate of the reabsorption process.

Because differences in the state of hydration of the skin surface are known to influence tactile and manipulative performance, one is tempted to hypothesize that control of reabsorption, like control of sweating, may be part of the adaptive preparation for these types of behavior. This may explain the apparent relation of recovery rate to mobilization for goal-oriented performance.

#### Conclusions

The time constant measure appears to be capable of reflecting differences in 'e-havioral situations with a relatively high resolution. It has been demonstrated to discriminate when the base level measures did not, and in the earlier study when amplitude did not. It is relatively stable over time, at least insofar as the position of an individual in a group is concerned. Finally, since to is longest with the subject at rest or exposed to a cold pressor task, and becomes progressively shorter as the task becomes more goal-directed (calculation, reading, and mirror tracing), the findings support the earlier interpretation of to as reflecting mobilization for goal-directed performance.

### VASCULAR EFFECTS UPON SKIN FOTENTIAL

Although' produced experimental evidence that vascular changes play only a negligible role, if any, in accounting for electrodermal activity, the focus of these experiments was upon conductance changes. The possibility that vasomotor effects could account for at least some skin potential changes remained. The observation that potential responses could be recorded from the nail bed which is devoid of sweat giands suggested that blood vessels might indeed account for some potential shifts observable at the skin surface.

This study examines the possible role of vasomotor changes in producing change of surface potential. The approach was to induce alterations in the state of peripheral vessels by mechanical means and to observe any concomitant potential changes not ascribable to central reflex effect. Venous occlusion was used as a method for engorging the veins while maintaining flow and arterial occlusion for interrupting flow without engorgement. A simultaneous recording of a non-occluded homologous contralateral sale would serve as a control for centrally induced changes in potential.

#### Method

Subjects were 11 males and 2 females in the age range from 18 to 42. Skin potential (SP) was recorded from the palmar and the dorsal surfaces of the middle phalanx of the middle finger of each hand. Each site was recorded with reference to an inactive skin site above the ipsilateral clavicle. This reference was chosen to be outside the occluded region so that common-mode effects would not cancel out elicited

changes. A direct-coupled reflectance plethysmograph was attached to the dorsum of the middle segment of the index finger of the experimental arm, i.e., the arm around which the blood pressure cuff was placed.

## Procedure

The pressure cuff around the upper part of the experimental arm was rapidly inflated to 60 mm Hg or to 180 mm Hg and kept at that pressure for one minute. Following deflation at the end of the one minute period of inflation a rest period of one to two minutes preceded the next inflation. Each S received at least 5 trials at 60 and at least 4 at 180 mm Hg. The experimental arm was alternated from one S to the next. Inflation of the cuff to 60 mm Hg prevented venous return from the arm and lead the arm to become engorged distal to the cuff due to the unimpeded arterial flow. Inflation to 180 mm Hg collapses both the arterial and venous systems, thereby completely occluding blood flow to the arm below the cuff. Plethysmographic recordings confirmed these differential hemodynamic effects associated with the two levels of pressure.

# Data Treatment

The analysis was guided by the need to answer two experimental questions.

First, does either of the two inflation pressures result in fluctuations of SP at experimental sites and not at control sites? Second, if shifts of SP level are demonstrated for the experimental sites, are these shifts different for venous engargement than for arterial occlusion?

Each of the four SP channels was scored identically. Since it appeared that the neriod of greatest change in the two experimental channels occurred about 5 seconds

after the release of pressure, this point was chosen as an arbitrary reference. The slope of SP curing the 10 seconds preceding this point was determined by measuring the difference in potential between the reference point and a second point 10 seconds earlier. Likewise the SP slope was also found between the reference point and the level of SP at a point 10 seconds later. If the change during any 10 second period was towards increasing positivity the slope score was also assigned a positive sign, and conversely. A change score ( $\Delta$ -slope) was calculated from the two slopes by taking the absolute difference between them. Thus, each  $\Delta$ -slope score represented the magnitude of the algebraic change in slope between the first and last 10 seconds of the 20-second scoring period, independent of the direction of change.

#### Results

# Comparison of Experimental Versus Control Sites

It was predicted that either engorgement, occlusion or both would lead to alterations in SP levels at the experimental sites but not at control sites. This assumption was tested by a between-S comparison of  $\Delta$ -slope scores between experimental and control sites. Analyses were accomplished separately for the 180 mm and 60 mm conditions and, within each of these, palmar and dorsal comparisons were also examined separately. In each of these four conditions, the average  $\Delta$ -slope score of the control site was computed for each S. These average  $\Delta$ -slope scores for experimental and control sites across subjects were subsequently subjected to analysis by t-tests for correlated means. The results of the four between-S t-tests are summarized in Table 15.

Table 15. Change in slope of SP after release of pressure: between-S comparisons of experimental vs. control sites.

	Pressur	re Level
Site	60 mm Hg	180 mm Hg
Dorsal	3.30*	5.74*
Palmar	3.40*	5,25*

p < .01

The significant levels of these tanalyses indicate that, for the group as a whole, there were larger shifts at experimental sites than at control sites. This was true for both palmar and dorsal regions and for both 60 and 180 mm Hg.

An effort was also made to examine the intra-subject reliability of this effect. This was accomplished, for each of the  $13 \, \underline{S}s$ , by computing four t-tests for correlated means, based on the distribution of his  $\Delta$ -slope scores across trials. Table 16 indicates how many of these 52 comparisons were significant (i.e., magnitude of SP change greater at experimental than at control sites), and at what level of significance.

Table 16. Change in slope of skin potential: within S comparisons of experimental vs. control sites. Values are in terms of the frequency of each level of significance obtained by t-test.

	Significance Level				
Condition	.01	.05	. 10	Nonsig	
60 mm Hg - Dorsal	7	1	2	3	
60 mm Hg - Palmar	5	1	1	6	
180 mm Hg - Dorsal	10	0	. 1	2	
180 mm Hg - Palmar	9	2	0	2	

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180 mm Hg - Palmar	9	2	0	2

As can be seen from this table, at least 8 of the 13 Ss in each group, except 60 mm Hg-Palmar, demonstrated t values significant at the .05 level or better. In addition, the physiological recordings for certain comparisons which were not significant, clearly appeared to show the experimental effect, but due to variability of the control site significance was not obtained.

# Folarity of SP Shift as a Function of Venous vs. Arterial Occlusion

)

The first two analyses confirmed the existence of a shift in SP slope at a point approximately 5 seconds after release of pressure. The two sites on the experimental hand exhibited significantly greater SP fluctuations than control sites for both 180 and 60 mm Hg. However, the pattern of change in SP seemed different for these two degrees of pressure. Typically, with the initiation of venous occlusion, SP became gradually more negative during occlusion and upon release reversed this trend and became more positive beginning about 5 seconds after release. This contrasted with the pattern of SP change induced by arterial occlusion. In this condition SP dipped sharply towards increasing positivity about midway through the inflation period and then changed to a more negative level, again beginning at a point about 5 seconds following deflation.

These distinct response patterns for 60 and 180 mm Hg may be illustrated simply by counting the number of Ss whose SP tended to snift in a positive direction following the termination of venous occlusion and in a negative direction upon the conclusion of arterial occlusion. Table 17 contains these figures. In three groups there was nearly complete congruence; all Ss but one shifted in parallel directions. Five Ss in the 60 mm Hg-Dorsal cell shifted in a negative direction, but for only two of these Ss was this paradoxical reversal at all proncunced.

Table 17. Frequency and average magnitude of positive and negative SP shifts after release of pressure (experimental sites only).

	Pos. Shift	Neg. Shift	X Pos.	X Neg.
60 mm Hg		•		•
Dorsal Palmar	8 13	5 0 .	0.31 my 0.17 my	
180 mm Hg				
Dorsal Palmar	0 1	13 12		0.73 mv 0.56 mv

The average magnitudes of the positive shifts occurring at the offset of 60 mm and of the negative shift following the end of a 180 mm trial are listed in the last two columns of Table 17. The five subjects whose mean change was negative were not included in the 60 mm Dorsal mean; likewise, the one subject for whom a positive shift appeared after 180 trials and not added to the 180 mm Palmar group for this analysis. As these magnitude figures indicate, changes of SP levels that occurred in relation to 180 mm Hg trials were more salient than the less marked shifts associated with the 60 mm Hg condition.

# Summary

It has been demonstrated that certain changes in surface potential are consistently brought about by manipulation of vascular state. These changes are particularly marked during the sudden return from the altered state and may indicate a local reflex involving compensatory changes in smooth muscle of the blood vessels. This experiment does

not demonstrate that such changes are also produced by central effects but such a likelihood is made plausible by these findings. While secondary alterations, e.g., of sweat glands, could explain these data, the most parsimonious explanation is that they reflect local vasomotor alterations.

# THE SENSITIVITY AND RESPONSE OF WEAKLY ELECTRIC FISH TO STATIC AND PULSED MAGNETIC FIELDS

June 1, 1970

#### I. INTRODUCTION.

The study of bioelectrogenesis, particularly in the various species of electric fish, has been of increasing scientific concern in recent years. This interest stems primarily from the potential usefulness of research in this area in contributing to our understanding of a number of fundamental and significant problems. By defining the electric fish's unique sensitivity to electric and magnetic fields, and how it codes and utilizes such sensory information in its detection and navigation behavior, current evidence is providing a more complete concept of such basic questions as migration and territoriality, and is leading toward the development of various bionic devices in the form of underwater sensors and power sources. In addition, knowledge of the effects of magnetic and electric fields on physiological and behavioral processes has assumed great importance in view of man's exposure to drastic changes in such stimuli during space travel.

Living things produce a changing electric field at and near the surface of their bodies; all fish, being sheathed in a conductive substance and living in a conductive medium, produce an electric field that may be detected at relatively great distances. However, there are certain fish which produce electric fields exceeding the norm by hundreds or thousands of degrees of magnitude. The electric eels of the Amazon can produce bursts in excess of 600 volts. Other electric fish, i.e., weakly electric fish, produce continuous fields measured only in millivolts, but by means of interpreting distortions in these fields are able to sense and navigate through their environment to a degree comparable to that of other species in which vision is used for these purposes. The weakly electric fish, having very poorly developed visual abilities, must depend on information acquired through their electric fields in order to survive.

The magnetic field is a form of energy to which all plants and animals are exposed. Its influence on living systems, however, is subtle and not well understood. One approach to studying the effects of magnetic fields upon behavior is through the use of an organism which produces an electric field and uses it as a detection and navigation mechanism. The electric fish is just such an organism, and this report will review a one-year study of two of these species (Sternarchus albifrons and S. leptorhynchus; see Figure 1) which has just been completed

In these fish, impulses are discharged from the tail and received by the head, which becomes positive in regard to the tail. This potential difference creates an electric field about the fish's body, permitting it to detect objects through distortions in the field. Several studies have shown that these fish can perceive a static (constant strength) magnetic field, but only when either the organism or the field is in motion, thus generating a current in the fish. It was thought that the fish was responding to the current generated in itself by the magnet. However, in these experiments the magnetic field was presented as a static field, and the sensitivity of the fish to a pulsed field presented at various frequencies, particularly the frequency at

which the fish discharges its own electric field (500-1500 cps), was not investigated. Other investigators have shown dramatic increase in sensitivity to applied A.C. approximating the frequency of the fish's discharge. In addition, the strength of the field was not systematically varied in terms of the gauss level in the fish's proximity. Therefore, there are considerable gaps in our knowledge of the degree of sensitivity of the fish to magnetic fields at various frequencies and strengths. The present study was undertaken to clarify some of these problems regarding the perception of and response to a magnetic field which is systematically varied along several continua.

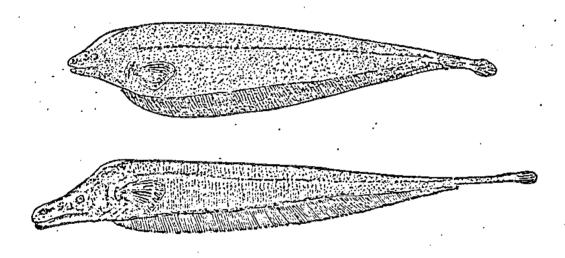


Figure 1. Sternarchus albifrons (top) and Sternarchus leptorhynchus (bottom)

#### II. BACKGROUND.

Comparatively little work has been done on the sensitivity of weakly electric fish to various types of electrical and magnetic fields, although the evidence that is available indicates that these fish have an extremely low threshold for such stimuli. Lissmann(1958) and Lissmann and Machin (1958), for example, have shown that Gymnarchus niloticus will perceive the movement of a magnet or an electrified insulator when either is moved outside its tank or aquarium.* A small bar magnet was held against the

^{*}Szabo et al. (1969) write that the electroreptors respond to both the presence and movement of an object or field.

wall of the aquarium and moved in a vertical direction, with the result that a "single downward sweep produced a response in the fish if the movement was sufficiently rapid and the distance between the fish and the magnet sufficiently small. With the particular magnet used a response could be elicited at a velocity of about 3 m/sec when the fish was about 50 cm from the magnet" (Lissmann and Machin, p.451). When an electrostatic charge* was moved horizontally in front of the tank, the fish was seen to respond to a voltage of 60 kV when the distance from the fish was 50 cm and the charge was moved at 3 m/sec. The authors conclude that Gymnarchus is able to detect potential gradients of about  $0.30\,\mu$  V/cm in the surrounding water. Table 1 shows the remarkable sensitivity of this species as compared to other fish. It is apparent that the perceptive ability of Gymnarchus is of a different order

Table 1. The sensitivity of six species of fish to direct current. (After Lissmann and Machin, 1958.)

Species	Current density (MA./cm. ² )
Phoxinus phoxinus (minnow) Cyprinus carpio (carp) C. auratus (goldfish) Parasilurus asotus (catfish) Gasterosteus aculeatus (stickleback)	10 60 16 8 110
Gymnarchus niloticus	2 x 10 ⁻⁵

of magnitude than other fish. Since it can detect a direct current of about .15 microvolt per centimeter, an individual sense organ in Gymnarchus should be sensitive to a current change as small as .003 micromicroampere.

Lissmann (1958) has observed that <u>Gymnotus carapo</u> can be conditioned to feed in response to a stationary permanent magnet mounted outside its tank and to inhibit feeding responses when the magnet is absent. He notes that although there is no specifically relevant data, it would seem that this fish should be able to perceive a field of about 10 oersted when moving at a rate of 10 cm/sec.

In a subsequent paper by Machin and Lissmann (1960), it was shown that the receptors responding to small direct currents were also used in the fish's object detection and location. That is, "the sensitivity of the fish to externally applied currents gives information about the electric receptors for object location " (Machin and Lissmann, p.802).

^{*}A small aluminum cylinder on an insulated handle and charged from a Wimshurst machine was used.

# A. Magnetic field effects.

The effects of various types of magnetic fields on living organisms has been a subject of increasing interest in recent years for both theoretical and practical reasons. "Basically, the magnetic field, being a form of energy, just as are light, heat and sound, impinges upon all living organisms whether plant or animal. The question as to its effect on living matter is what we are seeking to learn. Is it an active or passive process? How will an organism react to an environment that is devoid of a magnetic field? Further, what will happen if the field is altered or distorted?" (Caldwell and Russo, 1968, p.233).

Caldwell and Russo studied the effects of an A.C. magnetic field upon the behavior of the Italian honeybee (Apis mellifica), and found that the bee would respond to the magnetic energy field with a stereotyped nodal reaction, i.e., three of the four subjects would situate themselves and become rigidly fixated over one of the magnetic nodes when the magnet was on. Gottlieb and Caldwell (1967) investigated the magnetic field effects on the compass mechanism and activity level of the snail Helisoma duryi endiscus. Using a bar magnet with a weak field (1.5 gauss), they obtained significant effects on the activity level of the subjects.

Since astronauts have and will continue to be exposed to magnetic fields which are much less intense than the Earth's magnetic field while exploring the surfaces of neighboring celestial bodies, "the question arises as to whether the human body has during its evolution become dependent on the presence of the Earth's magnetic field for the maintenance of its normal functional integrity. Accordingly, it has become most important to ascertain whether a low-intensity magnetic field exposure could possibly lead to an impairment of health or performance of an individual" (Busby, 1967, p.7). However, there is also the possibility that astronauts could be exposed to intermittently high-intensity magnetic fields up to 1,000 gauss for varying periods during space travel. Beischer (1963, 1969) and Beischer et al. (1967) have studied the effects of both low- and high-intensity fields on man and animals. Their results show that man does not seem to be affected by a two-week exposure to 50-gamma fields; mice survive a one-hour exposure to 120,000 gauss; and in a low-intensity magnetic field, there is a significant gradual decrease of the scotopic flicker fusion threshold in man.

Agalides has recently completed a series of studies on weakly electric fish, including some work on their sensitivity to moving magnetic fields. Using Gymnarchus and Sternarchus as subjects, he observed that they responded to a permanent bar magnet of 930 gauss. The magnet was moved at 3 m/sec and was perceived by the fish at a distance of 120 cm. This was very close to the fish's sensitivity to static electric fields, and corresponds to a gradient of 3 emu, or 0.03,  $\mu$ V/cm.

#### B. Electrosensitivity

Granath et al. (1967) worked with <u>Sternarchus albifrons</u> in their effort to determine its sensitivity to imposed electric fields. To study the frequency response continuum, the authors used a conditioning problem in which both uniform and nonuniform alternating current (A.C.) fields were employed as signals for the subjects to leave a porous cylinder and swim to a vertical plastic tube for a food reward. After the conditioned response was established with high stimulus values, the signal was reduced to determine the threshold of the fish. The results indicated that <u>Sternarchus</u> is most sensitive at its own discharge frequency at room temperature, i.e., in the area of 1,000 cps, with a maximum sensitivity of 0.2 microvolts per cm. However, a secondary maximum was observed at the second harmonic of the discharge frequency.

Watanabe and Takeda (1963) employed the South American gymnotid, Eigenmania, in their study of the effects of externally applied electric current. Like Granath et al., they found that the effective stimulus was an alternating current presented at a frequency very close to that of the fish's own discharge. In this case, Eigenmania has a discharge rate of about 300 cps at 25°C. Their results showed that "when a sinusoidal (or a square pulse) electric signal with a frequency similar to that of the fish's own discharge is applied to the fish, the latter's discharge frequency changes as if to escape from the applied signal frequency. The effectiveness of the stimulus depends on the difference beween the two frequencies ( $\Delta$ S); when  $\Delta$ S is more than 10 cps the response is barely recognizable. The smaller  $\Delta$ S, the more effective the stimulus, except when  $\Delta$ S is very small, where the response again fails to occur" (Watanabe and Takeda, p.65)

Dewsbury (1966b) believes that stimuli* differ and interact in the kind and/or amount of change they induce in the discharge frequency of weakly electric fish. He observed several different species, but not Sternarchus albifrons, which does not appear to behave in this way.

Dewsbury attempts to relate his data to a concept of arousal, wherein discharge frequency changes with arousal level. In another study (1966a), he confirmed the hypothesis that electric organ discharge frequency in gymmotids is higher in darkness than in light. This would normally be expected, although we have not found such evidence in S. albifrons.

The effect of temperature on discharge frequency is a particularly important problem in that the exact nature of this relationship must be known in order to establish baseline data for further study on the fish's discharge behavior. Gallon et al. (1967) and Enger and Szabo (1968) have found that the rate of discharge varies with temperature in mormyrids and

^{*}For example, light-darkness, shock, aeration, metallic objects, and a buzzer (Dewsbury, 1966c).

gymnotids. Their results are summarized in Figures 2 and 3.

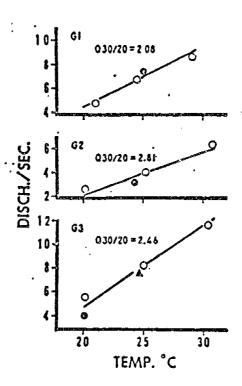


Figure 2. Discharge rate as a function of temperature. Open circles, ascending series; filled circles, return to lower temperature; triangle, second ascending measurement. (After Gallon et al., 1967.)

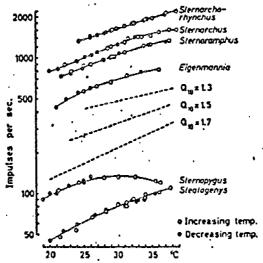


Figure 3. Relation between water temperature and discharge rate. Open circles, increasing temperatures; closed circles, decreasing temperatures; broken lines, Q10- values for comparison. (After Enger and Szabo. 1968.)

Attempts have also been made to condition the discharge rate of . mormyrids with both classical and operant methods. Mandriota et al. (1965) report that three species of Mormyridae would briefly increase their discharge frequency (conditioned response) in response to light (conditioned stimulus) following training trials in which light was paired with shock (unconditioned stimulus). Mandriota et al. (1968) later discovered that operant (avoidance) conditioning was also effective in these fish and, in fact, was more efficient than classical conditioning in that fewer shocks were required to establish the response.

# III. CURRENT STUDY: THE SENSITIVITY AND RESPONSE OF STERNARCHUS ALBIFRONS TO STATIC AND PULSED MAGNETIC FIELDS.

#### A. Problems and hypotheses.

The primary hypotheses of this study were concerned with the problem of determining whether weakly electric fish are sensitive to magnetic fields and, if so, how this sensitivity might vary as the field is changed from a static to an alternating and to a pulsed one, as the frequency of the field is increased or decreased in relation to the normal discharge frequency of the subject, and as the strength of the field is varied. A secondary problem concerned with effects of various drugs on the electrical activity of the fish was also investigated. However, before the data could be collected, it was necessary to find a source from which weakly electric fish could be obtained, develop life-support systems for the subjects, and design and construct the required equipment and apparatus.

#### 1. Subjects.

A total of 18 fish were purchased, consisting of 9 Sternarchus albifrons, 6 S. leptorhynchus, and 3 weakly electric fish of an unknown species. Most of the specimens were bought from the Cappet Corporation in Alexandria, Virginia, and a few from local pet shops. Four of the fish, all S. albifrons, remained healthy during the period of the study, and were the only ones used in the final experiments. Their size is shown in Table 2. With few exceptions, the others died within one week of purchase.

Table 2. Size of the four experimental S. albifrons.

Subject	Length
Fish #1	18 cm
Fish #2	21 cm
Fish #3	14 cm
Fish #4	11 .cm

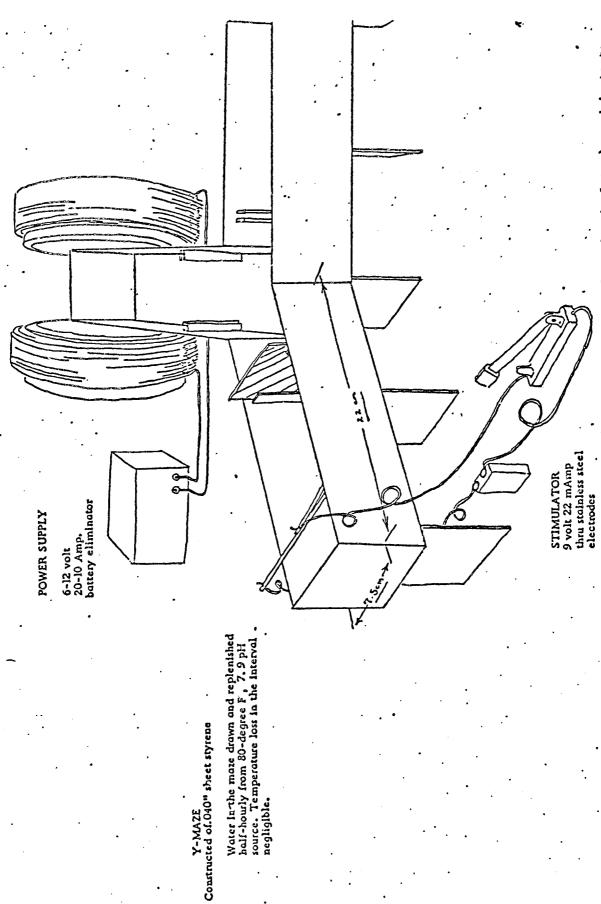
The subjects were kept in individual tanks of either 14 or 20 liter capacity. The water was aerated with conventional air pumps working through charcoal and glass wool filters. The temperature was maintained at about 26.8°C and the pH at 6.7 to 6.9. Food consisted of either live or dehydrated brine shrimp. The fish were fed 2 - 3 times a day, and once a week an antibacterial agent was added to the water to suppress the growth of bacteria.

#### 2. Equipment and apparatus.

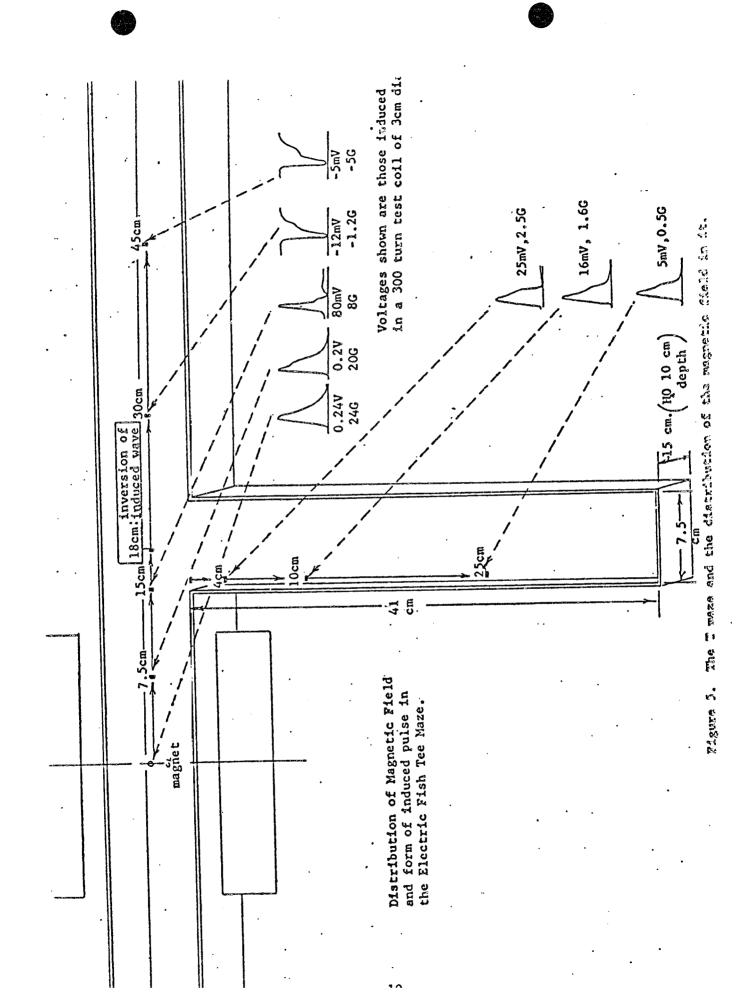
A plastic Y maze (Figure 4) was constructed for tests with the the static or steady magnetic field. Its three arms were joined at angles of 1200, and the maze itself made of 0.040" sheet styrene fastened with styrene solvent. The water in the maze was drawn from a continuously aerated and filtered source with a pH of 6.8 and a temperature of 26.8°C. It was exchanged every & hour, within which time the temperature drop was approximately 0.2°C. However, because of its inadequate size, this maze proved unsatisfactory, i.e., the larger subjects could not be used in it. In addition, with a magnetic field of 8-10 gauss and the magnet centers at the distal end of one test arm, a minimum field of 2 gauss was present at the farthest point in the starting chamber. The field was 4 gauss in the area of the fish's head when the subject was released from the starting chamber. These problems with the Y maze may have contributed to the failure to find any response by the fish to the magnetic field in the initial experiments.

A larger T maze (Figure 5) was then designed and constructed in an attempt to demonstrate a more positive response to one arm at the choice point with the magnetic field as a cue. In the Y maze, the subject appeared to swim into the arm on the side of the starting chamber that the fish was closest to when the door to the starting area was opened. The length and depth of the T-maze arms were much greater than those of the Y maze, permitting the use of the largest specimens. This maze was also provided with continuous filtration and heating. It had a 10-liter capacity, with an auxiliary 16-liter and 50-watt heater. An air lift and siphon were arranged so that heated, filtered water was slowly and continuously fed into the leg of the T from the tank. A return siphon ran from the distal end of each arm to the auxiliary tank. Temperature in the maze was held at 26.8°C by maintaining the temperature in the external tank at 32.5°C. The tank and siphons were wrapped with paper lagging and jacketed with aluminum foil to achieve and hold the desired temperature. The maze itself was made of \{ \text{" sheet clear acrylic plastic, joined with an appropriate solvent. The material proved to be light and strong, and permitted good observation of the fish.

The magnets were made by winding 5 pounds of #12 copper magnet wire on each of 2 aluminum tins of 23 cm diameter. When in use, the



The plastic Y maze shown with the equipment (wagnets, power supply and stimulator) used in tests Figure 4. The plastic X maze of the static magnetic field.



2 coils were wired in series and placed on either side of the maze arm, 13 cm apart.

The discharge patterns of the fish were recorded by means of probes of pure carbon rod. Above the water level, these probes were shielded in thickwall aluminum tubing. Shielded cable was used to connect the probes with the oscilloscope input. The oscilloscope was a TEKTRONIX 502 A, and the built-in preamp was found to be sufficient to record these fish at distances over 50 cm, which exceeded our needs for these experiments. In recording, the probe shields, the cable shields, and the scope ground were all connected to a double wrap of heavy aluminum foil around the chamber containing the fish. With this arrangement the "noise" level on the system was held to 0.3 mV, which was acceptable.

The electrical equipment which surrounded the experimental apparatus was a source of an electrical noise electromotive force (EMF) which drove current through the input resistor,  $R_{\rm input}$ , of the measuring device (in this case an oscilloscope). The noise power dissipated in such an input resistor is a constant,  $P_{\rm n}$ , so the noise voltage developed at the input of the scope is

$$V_n = \sqrt{P_n R_{input}}$$
 (1)

and therefore by reducing the input impedance, Rinput, noise voltage is reduced. The network shown in Figure 6 reduced the input impedance of the oscilloscope from its usual value of 1 Megohm to 20 kilo-ohm and allowed the input impedances for the two separate beams to be balanced in order to eliminate any assymmetries in the external network. The noise improvement achieved by this method is a factor of 7; the measurements were not affected since the impedance of the source electrodes and tank was about 500 ohms. As long as the source impedance is low with respect to the input impedance of the measuring device the source is not affected by the measurements.

The operation of the device is straightforward. After all of the shields have been connected, the 40K potentiometer is adjusted until the noise on both beams of the oscilloscope is minimized. This is the best operating point.

The distribution and strength of the magnetic field were determined with a test coil of 300 turns, 15 mm in diameter. The induced electromotive force (EMF) was converted into a field strength measurement in gauss by application of Faraday's law

$$EMF = \frac{d\overline{\Phi}}{dt} \qquad (2)$$

where  $\phi$  is the magnetic flux through the circuit. Equation (2) says that the EMF induced in a circuit is equal to the rate of change of the magnetic flux through the circuit. The magnetic flux is

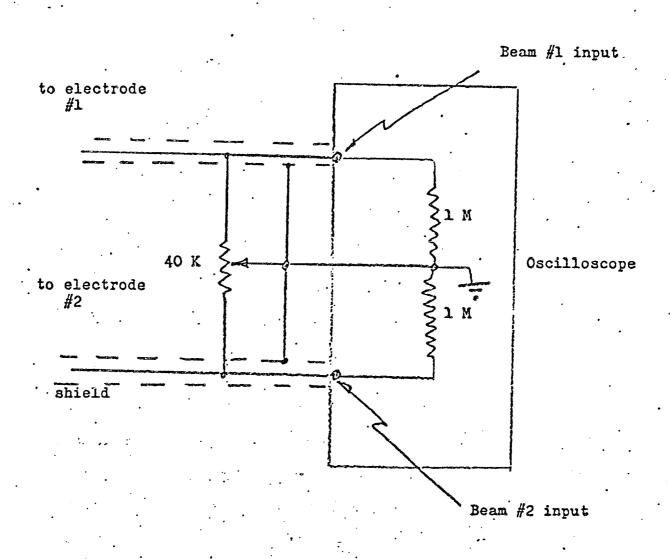


Figure 6. Input impedence reduction network.

been added. By varying the voltage output of the power supply, the voltage output at the signal generator, and by careful adjustment of a variable bias-resistor at the signal input to the transistor "switch", a pulsed field of the desired characteristics was achieved.

The circuit schematic is shown in Figure 7. The circuit consists of four npn transistors, three of which (#2N3055) switch all of the current through the magnet, and one (#2N3054) receives the signal from the signal generator (Lafayette #99-5014) and drives the three power transistors. The resistors in the circuit are bias resistors and the capacitors tend to round off the switching pulses and prevent oscillations.

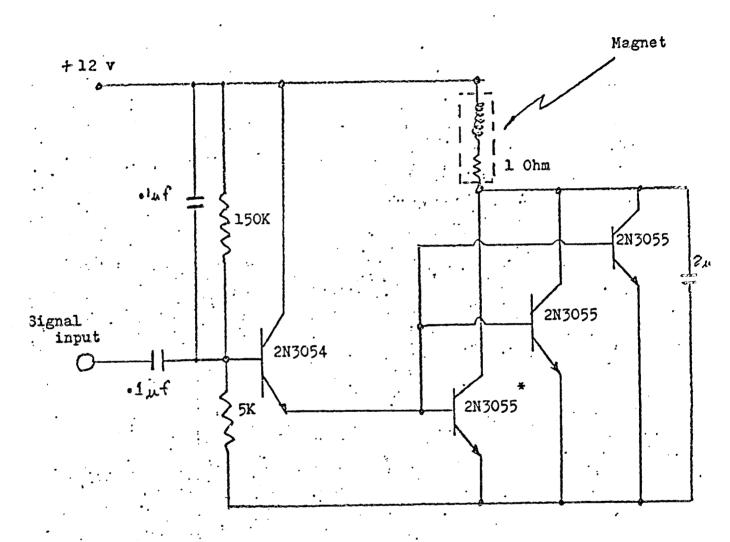
When the sinusoidal signal from the signal generator goes positive the transistor switch turns on and the current flows from the 12V power supply through the magnet. When the signal reaches the negative portion of its cycle, the switch turns off and current is prevented from flowing. By putting in a 1000 Hz signal we therefore put 1000 pulses per second through the magnet with a maximum of 12 amps peak current. The actual current through the magnet is considerably less since the inductance increases the impedance.

The transistors dissipate a great deal of power and must be placed on heat sinks in order to operate properly and to prevent thermal failure.

#### B. Experiment 1: Temperature-frequency baseline data.

We had observed that the discharge frequency of each fish at a given temperature was different from that of the other fish. Agalides reports that temperature-related frequency changes in <u>S. albifrons</u> are complex, but are on the order of  $\triangle 50$  cps/ $\triangle C^{\circ}$ , which our work confirmed. Since the current experiments required an accurate prediction of discharge frequency, a study was made of the temperature-frequency relationship in the fish in order to provide baseline data.

Each fish was monitored for frequency at 10-12 points in the 21 to 31°C range and over a period of 6 weeks. The test chamber was a plastic box 25  $\times$  45  $\times$  20 cm, double wrapped on the exterior with heavy aluminum foil. Three liters of water were drawn from the test fish's home tank and placed in the box. Temperature variations were achieved with a heat exchanger made from a plastic pitcher and a length of plastic tubing. The tubing was coiled in the pitcher, which was filled with either hot or cold water. Water from the test apparatus was forced through the tubing at such a rate as to change its temperature 1°C/15 min. When the desired change was achieved, as determined by an electric thermometer, 2 minutes were allowed to elapse, and then the frequency of the test fish was recorded. Before recording, the sensing thermistor of the thermometer was removed from the apparatus because it introduced extraneous signals into the water and, thus, into the oscilloscope used for frequency determinations. Fifteen-minute observation periods indicated that frequency always stabilized in less than 2 minutes.



*Note: The 2N3055's may be replaced by the more costly SK3027

Figure 7. Schematic of magnet switching circuit.

A series of observations with the fish maintained in close fitting rigid styrene tubes showed no variations in either the amplitude or the phase relationships of the discharge accompanying the change in frequency. These results are not in keeping with those of Agalides, who reports amplitude changes.

Within the limits of accuracy of our test situation, we found these fish to have straight-line plots of temperature-frequency response with a range of ±15 to ±50 cps at any given point, depending on the fish. Whether this variation resulted from individual differences or variability in the method is not known, but the experimenters lean toward the latter interpretation. Our laboratory was by no means temperature controlled, and the fish may have been responding to changes in temperature over the entire apparatus, which was not apparent in the small area actually sampled for temperature. The results of this experiment are shown in Figure 8.

- C. Experiment 2: Response to unpulsed magnetic fields in the Y maze.
  - 1. Environmental preference using a static magnetic field.

The equilateral Y maze was initially used in an attempt to demonstrate a sensitivity to a relatively strong static magnetic field in the small specimens of S: albifrons and S. leptorhynchus. It was thought that these fish, with electric fields having a maximum potential as observed in our lab of only 6.2 m volt, and an ability to detect one another by means of these fields at distances exceeding 1 meter, would respond (a) to changes in this field induced by a large magnet, or (b) to currents induced in their bodies by such a magnet. However, no gross responses from the fish were observed in either swimming behavior or in electrical discharge pattern when the magnetic coils were arranged so that a magnetic field calculated at 9-10 gauss was centered in a 40 x 20 x 30 cm aquarium in which a fish had been previously placed. Consequently the Y maze was used for further experimentation.

The dimensions of this maze allowed relatively low levels of the magnetic field in the first 5 cm of the experimental arm with intensity increasing to a maximum of 9 - 10 gauss at 11.5 cm. The overall dimensions of the apparatus allowed minimal swimming room for the four smallest fish: two albifrons and two leptorhynchus 15 - 15.5 cm in length.

The current induced over a short distance in the environment by a standard 9-volt transistor radio battery proved to be a noxious stimulus, and electrodes were installed at the starting point in the event that subjects did not move rapidly to the choice point.

The subject was placed in the starting arm and a short period allowed to elapse. Both experimental species were passive fish and

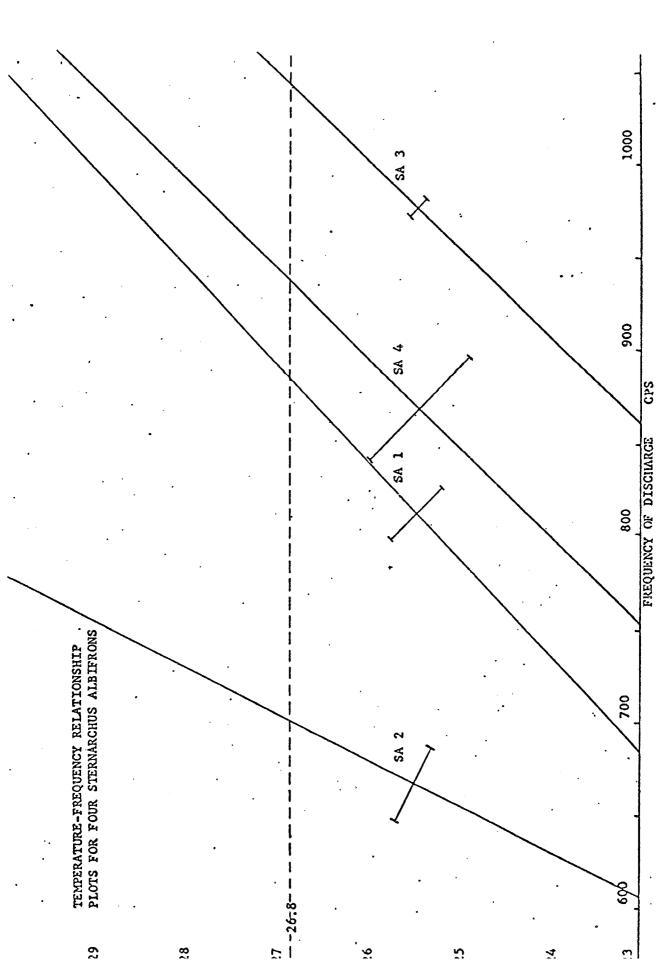


Figure 8. The discharge frequency-temperature relationship.

short accomodation periods of about one minute were sufficient before the door to the choice point was opened. The subject was allowed 2 seconds to move to the choice point. If this had not occurred at 2 seconds, the experimentor made contact in the stimulator circuit. Out of 120 trials, this was necessary only about 10% of the time, largely with one particular fish. Stimulation once initiated was maintained through the trial. The fish is not greatly affected, if at all, except in the area directly between the electrodes, but in order to control the possible effects of other variables, this technique was used.

The magnet was kept at the left arm, and was left on for 10 trials, off for 10 trials, and then on for a final 10. After a trial the fish was allowed to return to the starting chamber by the process of blocking the unoccupied choice arm, waiting till the fish had moved from the other arm, blocking it, and then blocking the starting chamber as the fish returned to it during normal exploratory behavior. These fish are nocturnal and exhibit continuous searching during the dark hours. The hours preceding and during experimental sessions were dark with only low level red illumination. The interval between trials was thus variable, but the fish was kept in an unexcited state. Elapsed time for 30 trials was about 30 minutes.

The results of this series of trials (Table 3) indicated no significant preference or aversion for the static magnetic field, although the subjects did tend to turn left in the maze. The mean percentage of left turns with the magnet off was 52%, and with the magnet on 54.3%.

Table 3. Preference trials in the Y maze with the static magnetic field.

Choice	25	to	the	1e	ft
(Magnet o	n	the	lef	t	arm)

Fish	Magnet on 10 trials	Magnet off 10 trials	Magnet on 10 trials
S.A.3 ¹	30%	50%	60%
S.A.4	40%	50%	40% (magnet off)
S.L.2	50%	60%	70%
S.L.3 ²	70%	60%	60%

This fish required stimulation on the 1st trial.

This fish required stimulation 10 times (3,4,3 distribution)

#### 2. Conditioned response to the static magnetic field.

In a further attempt to obtain some indication that S. albifrons is sensitive to a non-pulsed magnetic field, a conditioning technique was used in which the presence of the field (conditioned stimulus) was paired with electric shock (unconditioned stimulus).

The S was selected on the basis of size, i.e., the most suitably sized fish for the experimental chamber, which consisted of one arm of the plastic water-filled Y maze. Electric shock was administered from a 9-volt battery through electrodes fastened to the walls of the chamber. The two magnets were placed on either side of the arm and activated by an 8-volt, 9-amp power source.

When the fish was placed in the chamber, the magnetic field (9 - 10 gauss) was turned on, and ½ second later, the electric shock was administered for a period of one second, at which point both stimuli were turned off. The S responded in a characteristic manner to the shock with a "startle" reaction (unconditioned response). It was hoped that after a sufficient number of trials the S would respond (conditioned response) in this way to the magnetic field alone, or, when both stimuli were used, would anticipate the presentation of shock by responding to the field in the initial ½-second interval. However, after four series of 25 trials each, giving a total of 100 trials, the S failed to show any response to the magnetic field. Consequently, there was no indication that the fish was able to perceive the non-pulsed magnetic field.

#### 3. Conditioning with the magnets at reduced intensities.

S. albifrons #3 was confined to one arm of the Y maze. Two electrodes were fixed to the sides of this arm, and the magnets placed on either side. In contrast to the first experiment in this series, the magnets received only 4 volts and 4.8 amps from the power supply, producing a magnetic field of considerably less intensity (3½ gauss) than that used previously. In the first experiment, the fish failed to respond to the magnetic field, i.e., it gave no evidence of sensing the field at full strength, and it was decided to attempt another test with the field at half strength on the possibility that the original was too strong, thereby interfering with the fish's afferent processes. With the fish confined to one arm of the maze, the magnetic field was turned on for a period of two seconds, and after the first second, electric shock (9 volts, 200 μA/cm²) was administered to the subject for one second. At the end of two seconds, both the field and shock were turned off. As expected, the fish responded to the shock (unconditioned stimulus) with a "startle" movement (unconditioned response), but after 50 trials, when the field (conditioned stimulus) was used by itself, there was no anticipatory conditioned response. It appears that the fish did not sense the magnetic field as presented.

A second series of 50 trials were then run with S. albifrons #4 with the magnetic field power source at 2 volts and 1.8 amps. The results, however, continued to be negative. But over the course of the trials, both fish showed some habituation to the electric shock, which had been reduced with a recalibration of the variable resistor to 100  $\mu$ A/cm² at 9v for the second set of trials.

## D. Experiment 3: Drug study.

In contrast to various reports in the literature on other gymnotid fish, no stimuli to which Sternarchus would normally be exposed were found to affect their discharge frequency. Such things as noise, physical manipulation, light, dark, feeding, starvation and illness failed to change the frequency of the fish in the current study. As we have seen, frequency changes with temperature in a highly predictable manner, and Watanabe and Takeda (1963) demonstrated a response to applied AC current. They found that AC at the fish's own frequency caused the fish to alter his own frequency in response. The greatest relative changes occurred when the applied current was closest to the fish's own frequency.

In an effort to determine the degree of stability and control the fish is able to maintain over its discharge frequency, a study of the effects of various drugs on their discharge patterns was undertaken. Two depressants, Nembutal (sodium pentobarbital) and Pontocaine (tetracaine hydrochloride), and L-dopa (levodopa) were tested.

Nembutal at 750 mg/liter anesthetized the fish with no effect on the amplitude or frequency of their discharge. The L-dopa effects are discussed separately; they did not show a direct effect on frequency. Pontocaine, however, modified the fish's discharge frequency. At a concentration of 3 mg in 500 ml water, the discharge rate dropped 140 cps. Twenty minutes after a final total dose of 1.12 gms/500 ml, the discharge was 375 cps below the expected level. The fish rested on its side and was unresponsive to stimuli. At this time, the amplitude and phase relationships of the discharge were unaltered. The results are summarized in Table 4.

Table 4. The effects of Pontocaine on discharge frequency.

Time	Dose	Temp.	Drugged Frequency	Normal	ge frequency.
od: eranners erans			rrequency	Frequency	Remarks
09:25	0.375gm	27.5		980 <u>+</u> 30	
09:30	ı	27.5	839		
09:37	0.375gm				
09:43		27.35	787	965 <u>+</u> 30	
09:45	0.375gm	•		•	
09:51					
09:56	-	27.2	649	955 <u>+</u> 30	
10:02		•			200 ml water re- placed with fresh, fish lethargic
10:08	·	27.1	575	950 ± 30	
10:11					fish lying still

In view of the considerable interest in the neurotropic drug levodopa (L-dopa), and because the experimental techniques developed in the current study are capable of providing direct telemetric evidence of nervous system functions, it was decided to test L-dopa on selected fish in order to determine its effects on their electrical discharge patterns and behavior.

The first subject was S.A.#4, who received the drug for 27 days. Long exposure to relatively large doses is necessary to produce behavioral effects in other species. A technique of repeated injections as one way of achieving this was ruled out as impractical; therefore, a method for dissolving L-dopa into the aquarium water was worked out. Data provided by the manufacturer of the drug (Hoffmann-LaRoche) indicated that L-dopa is not very soluble in water; approximately 0.4% at 80°f. An airlift was arranged to bubble aquarium water from the 20 liter home tank at a very slow rate through a chamber containing the drug and lined with filter paper. The charcoal was removed from the tank's filter. Every day, weekends excluded, 100 mg of the drug on fresh filter paper was placed in the dispenser. We found that L-dopa, under these conditions, rapidly combined with other substances present to form a heavy, dark, flocculent precipitate, which clogged the tank filter and the filter paper in the dispenser. The principal change was a conversion of the dopamine to melanin, which was later prevented by the addition of 50 mg of ascorbic acid every time L-dopa was added. S.A.#3 also received the ascorbic as a control.

No unusual behavior or alteration in the form or amplitude of the electrical discharge of S.A. \$\forall 4\$ were noted for 14 days. Then an increasing disorientation, reduced ability to find food, and abnormal discharge frequencies were noted. On the 21st day of drug experimentation a thorough series of temperature-frequency studies was performed in the previously described manner. These revealed that the slope of the temperature-frequency plot was unchanged, but whereas a variability of \(\pm 50\) cps had been previously noted, variability was now found to be \(\pm 150\) cps as tested over a period of 3 consecutive days. The drug was stopped at the end of this time, the water in the tank changed, and charcoal filtration resumed. Four days after this, the temperature response was still quite erratic. The next close evaluation came 50 days after cessation of the drug. Temperature-frequency response at this time had returned to the pre-drug parameters.

The control, receiving ascorbic acid alone, showed no such effects.

S.A.#2 was given L-dopa and ascorbic acid over 47 days. The dispenser in this case was a plastic funnel suspended with the narrow end of the cone submerged; discs of filter paper, folded in half twice and opened to form a cone lined the funnel. Fifty mg each of dopa and ascorbic acid were placed into the cone and were dispersed by simple diffusion over a period of 2 days. This was a more reliable, less troublesome method of dispensing the drug than that used earlier. In this case, the tank filtration was left intact, but the air flow to the bubbler

was reduced, lessening the water flow through the charcoal. We assumed that with an undissolved supply of the drug at hand, an equilibrium would be achieved, and the amount of drug in the water would be constant despite uptake by the fish and/or the charcoal.

Several tests were tried, removing the fish through 2 changes of distilled water which had been aereated and brought to the proper condition with reagent grade chemicals, to test for metabolized dopamine with ferric chloride. However, there were no differences demonstrated in the color or quantity of precipitate between experimental and control fish.

S.A.#2, during and after 47 days on the drug, showed no altered behavior and no change in his electric field.

The drug studies were terminated at this point. The exact cause of S.A.#4's reactions are not definitely known. Because of his small size, the drug may have had more effect on him than on S.A.#2. He may have suffered an illness, or been affected by a toxic buildup of some substance or substances due to a lack of filtration in his tank for 27 days. Another possibility is that the operating filter in S.A.#2's tank may have reduced the concentration of L-dopa below an effective level.

- E. Experiment 4: Response to AC and pulsed magnetic fields in the T maze.
  - 1. Conditioning of the sixty-cycle field.

The acrylic plastic T maze was prepared and the apparatus suitably modified to initially produce an alternating magnetic field and later a pulsed, but unidirectional field. A new line of investigation was then undertaken. We were now able to change the intensity of the magnetic field over a considerable range from 0 to over 50 gauss with a simple adjustment of a variable AC ("Variac") transformer, or 0 - 20 gauss with the DC power source. The AC field was pulsed at the 60-cycle commercial frequency; the previously described circuit allowed the DC field to be pulsed from 0 - 1500 cps with no directional change in the field. The changes in frequency and intensity could be made concurrently, although the complete range of intensities could not be achieved at every frequency.

The first trials were run with a 60 cps AC magnetic field at 6 intensity levels (see Table 5). S.A.#3 was placed in the T maze, with the two magnets encircling one arm. The intensity of the magnetic field in that arm was varied by adjusting the voltage on the Variac. Frequency was maintained at a constant 60 cps. At 41 gauss (50 volts), the fish was given 250 trials (on alternate trials, the field was turned on and off). When the field was on, each time the subject entered the experimental arm of the maze it was shocked briefly. With the field off, the S could enter and swim in the arm freely. It was hoped that in this way, i.e., by conditioning the S to avoid the field as an aversive stimulus by pairing it with shock, evidence could be obtained as to whether the fish was sensitive to the field. If conditioning was achieved, then it would be definite that the S could perceive magnetic stimuli, and its threshold for such stimuli determined by lowering the

intensity of the field. The first tests (250 trials) were made at 41 gauss. After 100 trials at this level, the fish never entered the arm with the field on, but swam into it when the field was off. Twenty trials were then attempted at 34, 36, 18, 9 and 1 gauss, with similar positive results at the three higher settings. However, at 9 and 1 gauss, behavior became inconsistent, with the S responding correctly about half the time.

Table 5. Sixty-cps trials at intensities from 1 to 41 gauss.

Intensity	No. of trials	Results
41 gauss	250	Positive response
34 gauss	20	Positive response
26 gauss	20	Positive response
18 gauss	20	Positive response
9 gauss	. 20	Partially positive response
l gauss	20	Partially positive response

#### 2. Conditioning of variable-frequency fields.

In each series of these trials, the intensity of the magnetic field was held constant while frequency was varied by changes of 100 cps from 500 cps below the fish's (S.A.#3) own frequency to 500 cps above it (Table 6). A total of 1100 trials were run, 100 at each frequency. The method used was similar to that of the previous experiment. That is, the field was turned on and off on alternate trials during each series of 100, and each time the fish went into the arm of the maze with the field on it was shocked. When the field was off, no shock was used. The results in each case were negative; the fish did not learn to respond to the field as a noxious stimulus as we had expected on the basis of previous results, but tended to enter and stay in the field regardless of the shock. Thus, the field seemed to have some positive reinforcement value to the fish. This surprising outcome was checked in another series of 300 trials with S.A.#3, 100 at his own frequency (1640 cps) and 100 each at 540 and 1540 cps. In these tests, however, the intensity of the field was increased to 15 gauss. The results were the same; the S would not avoid the field when paired with shock, but tended to approach under all conditions. This interesting development led to the final and most important experiment in the present study, wherein the preference of the S's for the magnetic field was more fully explored.

Table 6. Conditioning with frequencies from 540 - 1540 cps at 5 gauss.

Frequency (cps)	No. of trials	Results
1540	100	negative
1440	100	negative
1340	100	negative
1240	100	negative
1140	100	negativ <b>e</b>
1040 (S's own frequency)	100	negative
940	100	negativ <b>e</b>
840	100	negative
740	100	negative
640	100	negative
540	100	negative

# 3. Approach response to pulsed fields with frequency and intensity varied.

Up until this point, the evidence was somewhat contradictory and it was not sufficiently clear that the subjects were sensitive and responsive to magnetic fields. Therefore, on the basis of the positive evidence in the last experiment, it was decided to conduct a more comprehensive study of the fish's preference for or approach tendency to the magnetic field.

The T maze was used as before, with the magnets positioned on either side of one arm (Figure 5). Two series of trials were run, one at 10 gauss and the other at 20 gauss. Each of the four specimens of Sternarchus albifrons was put in the maze, and the frequency was adjusted to the subject's own discharge rate, which, in these fish, was 700, 885, 935, and 1,040 cps respectively. In subsequent trials the frequency was raised and lowered 100 and 200 cps above and below each subject's normal discharge rate at 26.8°C. Thus, the experimental design involved changes along two continua, frequency and intensity (Table 7). Under each condition, the fish was placed into the maze, and the number of times it entered the experimental area in the arm between the magnetic coils during a period of 15 minutes with the field off and 15 minutes with the field on was recorded on a counter. Each fish was tested for its tendency to approach the field at five frequency levels ranging from 200 cps below to 200 cps above its own frequency and at two intensity levels. A summary of the results are presented in Tables 8 and 9 and illustrated in Figure 9.

Table 7. Experimental conditions for the approach-response experiment with a pulsed magnetic field.

		10 gauss	20 gauss
+200 cps	S.A.1:1085 S.A.2:900 S.A.3:1240 S.A.4:1135	15 min on, 15 min off	15 min on, 15 min off
+100 cps	S.A.1:985 S.A.2:800 S.A.3:1140 S.A.4:1035		
normal rate	S.A.1:885 S.A.2:700 S.A.3:1040 S.A.4:935		
-100 cps	S.A.1:785 S.A.2:600 S.A.3:940 S.A.4:835	TO THE COMMISSION TO THE PROPERTY OF THE PROPERTY OF THE COMMISSION OF THE COMMISSIO	
-200 cps	S.A.1:685 S.A.2:500 S.A.3:840 S.A.4:735	•	-

Table 8. Summary of results for the approach experiment, showing the number of times the subjects entered the experimental area with the field on and off.

		s.	A.1	S.A.2		S.A.3		S.A.4		_	
		10 gauss	20 gauss	10 gauss	20 gauss	10 gauss	20 gauss	10 gauss	20 gauss	total	
	on	36	41	69	56	92	87	27	81	489	
+200cps	off	44	44	35	49	50	54	6	45	327	
	on	34	44	. 49	36	59	74	53	78	427	
+100cps	off	21	17	33	29	42	42	53	52	289	
norm.	on	38	38	34	43	27	14	19	23	236	
freq.	off	36	28	26	21	29	17	11	16	184	
	on	38	46	44	61	52	50	60	59	410	
-100cps	off	25	34	28	32	46	27	39	39	270	
•	on	33	57	52	72	45 ·	49	54	57	419	
-200cps	off	44	44	41	41	54	36	40	39	339	

As we can see in the total column, there was a very definite tendency for the Ss to enter the area between the magnets significantly more times with the field on than with the field off. For all fish and under all conditions, the experimental area was entered 1,981 times with the field on, and 1,409 times with the field off. Means were calculated for the average number of times the fish entered the area with the field on and off under all frequencies and at the 10 and 20 gauss

levels. The results are shown in Table 9. To test the significance of the difference between the combined means, a test was done with the following results:

$$\overline{X}$$
=49.53 (field on mean)  
 $\overline{Y}$ =35.23 (field off mean)  
D=14.30 (difference)  
ED_i=562  
ED_i²=14,956  
N=40  
 $\overline{D}$ _i=14.30  
Sd=10.35  $S^2 = \frac{E(x-\overline{x})^2}{N} = \frac{4288}{40} = 107.20$   
 $S = \sqrt{107.20} = 10.35$   
 $\overline{O}$ _D =  $\frac{Sd}{\sqrt{N-1}} = \frac{10.35}{6.25} = 1.66$ .  
 $t = \frac{\overline{D}}{\overline{O}} = 14.30 = 8.61$ 

We can thus reject the null hypothesis that the results occurred by chance at the .01 level, i.e., we can be 99% confident that the observed difference was not due to chance.

Table 9. Mean number of times the Ss entered the experimental area with the field on and off at 10 and 20 gauss and overall for all frequencies combined.

	10 gauss	20 gauss	combined
Field on	45.75	53.30	49,53
Field off	35.15	35.30	35.23

In Figure 9, average difference scores were determined by finding the difference between the number of times the Ss entered the experimental area with the field on and with it off, and dividing this number by 4 (the number of Ss). This was then plotted against the various frequencies tested. It can be seen that there are two definite peaks in the approach tendency of the Ss to the field, at -100cps and in the region between +100 to +200 cps. Surprisingly, there was a sharp drop at the subjects' own frequency, which is contrary to what we had expected. Previous reports had indicated that these fish are most sensitive at their own discharge frequency.

After this analysis of the data, it was apparent that the fish were not responding to a pulsed magnetic field in the expected manner, i.e., responses at the frequency of the fish at maze temperature were not the maximal responses observed, nor were the frequencies at which maximal responses were seen related in a periodic manner to the base (26.8°C) frequency of the fish.

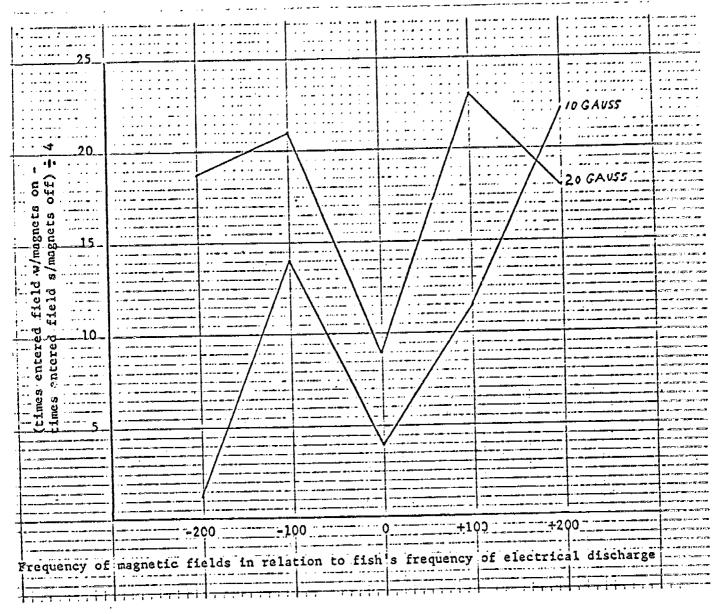
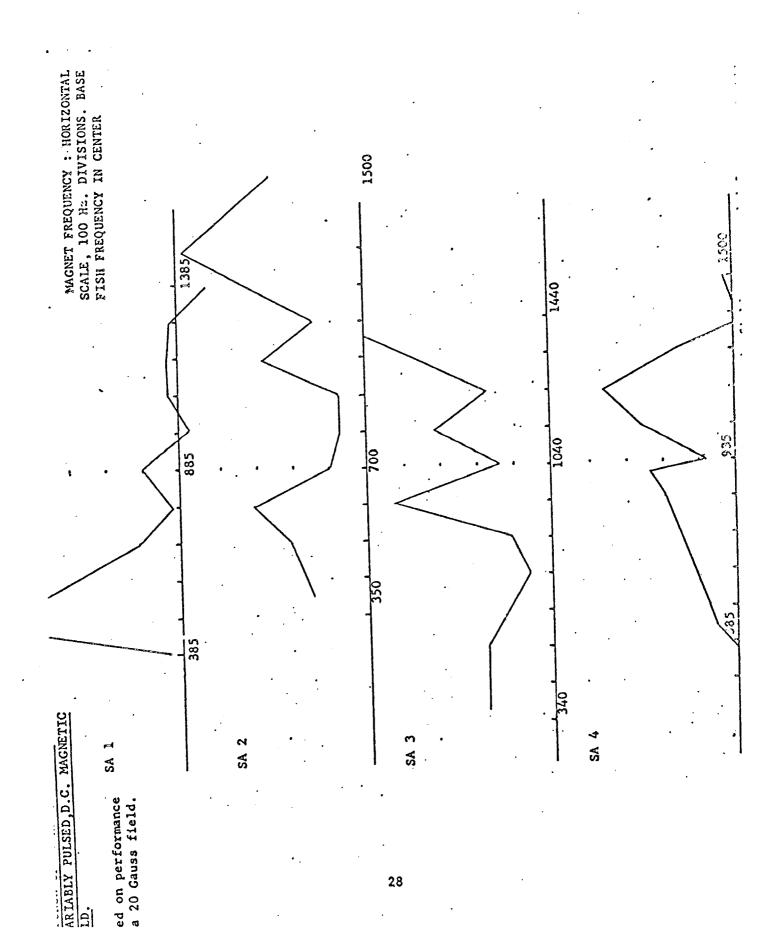


Figure 9. Changes in average difference scores with magnetic field frequency.

Therefore, an additional series of trials were run extending the frequency range of the magnets. A field strength of 20 gauss was used throughout to maximize responses.

The procedure was the same as before. The experimental fish was placed in the maze, the lights were extinguished, and two minutes allowed to elapse before counting began. The number of times in a 15-minute period that the fish entered between the magnetic coils with the magnets off was then recorded. With the electrical input to the magnet and to the switch adjusted to produce 20 gauss and the desired frequency with the standardized pulse as shown in Figure 5 for the magnet longitudinal axis, the entries into the area between the magnets



in 15 minutes with the magnets on and off were counted. After each series of half hour trials, the fish was returned to his home tank, the magnets readjusted if necessary to accommodate the frequency of the next subject, and the process started again. In any given day, one fish would have a maximum of two half-hour trials, separated by at least one hour.

The results are shown in Figure 10. These performance curves were drawn by subtracting the number of entries during each control run from the number of entries during the companion experimental run at each magnet frequency level. In actual numbers, the entries under control conditions ranged from 16 to 90 and under experimental conditions ranged from 14 to 87 in a 15-minute period.

Limitations in the equipment prevented the testing of performance at frequency levels of half and double that of the base frequency of each fish. However, the range tested was adequate to show that sensitivity to a magnetic field in Sternarchus albifrons is vastly different from that to an electric current.

All of the data in previous reports with regard to response to magnets have been discussed in terms of the current generated in the fish by the magnetic field. This may be true, but these performance curves clearly indicate that the sensitivity to magnetism is more complex. The literature is in agreement that maximum sensitivity to applied current occurs at the fish's own frequency (Granath, 1967, Figure 11). The results reported here indicate that maximum sensitivity to a magnetic field occurs at a point or points one to three hundred Hertz above and/or below the base frequency. What is most certainly indicated is that maximum sensitivity does not occur at the fish's own frequency with the magnetic field.

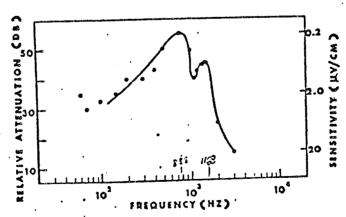


Figure 11. Response spectrum to a uniform AC field. (After Granath, 1967).

If, as our data indicate, the fish respond to more than induced current in a pulsing magnetic field, there is still the problem of defining more clearly the stimuli to which they are responding. A crude model of a fish was achieved by moving an induction coil through the maze. Results are reproduced in part in Figure 5. These wave

forms were induced with the axis of the test coil parallel to the axis of the nagnetic coils. With the axis of the induction coil perpendicular to the axis of the magnetic coils, results were similar from the distal end of the test arm to the point 15 cm from the magnet center, but induced currents were weaker, 2 - 50 mV as opposed to the 5 - 80 mV shown on the diagram. However, from 15 cm, on toward the magnet center, the induced pulses became more rounded and diminished in strength to about 1 gauss at the center of the magnetic coil. A behavior pattern observed in the fish indicated that the first model, though extremely crude, was better than the second. The fish, in moving from the distal end of the test arm would hesitate at about this 15 - 18 cm area, and then frequently continue to the magnet center in a rush, working their jaws and moving in an excited manner. Interestingly, the induced current pulse in the test coil assumes a wave form that is very like the fish's own discharge at this 15 - 18 cm point in our test apparatus.

One other aspect of observed behavior toward the magnetic field is unexplained. When the fish chose the leg of the T at a point 0 to 10 cm from the intersection, they were observed to sometimes execute a forward roll, frequently two or three in succession with some degree of force. As can be seen from the diagram, there appears to be no individuality in this area of the field. This response was seen to some degree at all frequencies and at 10 and 20 gauss, but seemed to be most common at those frequencies of maximum response to the magnet. A crude three-dimensional plot of the field shows it is cigar shaped. The fish were restricted to an area ± 5 cm above and below the edge of the cigar-shaped field (23 cm in diameter). At this 10 cm point, the lines of equal force would be essentially parallel to the long axis of the arm in the vertical plane, and curving toward the magnet center line in the horizontal plane. Perhaps it is this gradient to which the fish respond in this manner.

### F. Summary of results.

- (a) The rate of discharge in the electric field of Sternarchus albifrons is a positive function of temperature. In three subjects (S.A.1, 3, and 4) the change was ± 50 cps for 1 degree C. The other specimen, (S.A.2) varied ± 15 cps per 1 degree C.
- (b) The fish showed no significant approach or avoidance behavior toward a static (non-pulsed) magnetic field of 9 - 10 gauss in a Y maze.
- (c) A conditioning procedure in which electric shock was paired with a static magnetic field of 9 10 gauss and  $3\frac{1}{2}$  gauss in a Y maze in order to establish an avoidance response was not successful.
- (d) In a study of the effects of drugs, Nembutal and levodopa (L-dopa) failed to alter the discharge patterns of the subjects' field, although L-dopa produced a more variable temperature-frequency relationship

and some abnormal behavior. Pontocaine, however, modified the discharge frequency by depressing the rate severely.

- (e) Conditioning trials were attempted with a 60-cycle AC magnetic field of 1 42 gauss paired with electric shock in a T maze. The fish learned to avoid the field at intensities of 34, 26, and 18 gauss, but the results were inconsistent at 9 and 1 gauss.
- (f) Additional conditioning trials were run in the T maze with a pulsed, unidirectional field at frequencies ranging from 540 to 1540 cps at 5 and 15 gauss in which the field was paired with shock, but the subject failed to learn to avoid the field. Instead, the fish showed a tendency to stay in the field regardless of the shock it received.
- (g) Each subject was tested for an approach tendency to the field in a preference study. The pulsed field was varied in intensity from 10 to 20 gauss, and in frequency from 200 cps above the fish's own frequency to 200 cps below it by decrements of 100 cps. The subjects showed a significant preference at the .01 level for the area between the magnetic coils with the field on as compared with trials with the field off, indicating clearly that they are sensitive to the magnetic stimuli. The preference study showed maximal responses at frequency rates other than those of the fish, in a pattern totally dissimilar to imposed current stimuli.

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#### V. WHERE - LABORATORY INDEX.

The following is a list of laboratories, uuniversities, and institutes where work is in progress.

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University of Connecticut Graduate School Storrs, Connecticut 06268 (Principal investigator: A.W. Wachtel)

University of Maryland
School of Medicine
Baltimore, Maryland
(Principal investigator: L. Holdman)

Pennsylvania Hospital Philadelphia, Pennsylvania (Principal investigator: Summer I. Zacks)

#### Electric Fish Study

Investigations have been in progress on the species of electric fish, Sternarchus albifrons, and S. leptorhynchus, for 7 months. Now, having sufficient equipment, and with techniques developed over some months, we see good prospects for success in several lines of investigation.

Our initial work was directed at the responses of these fish to magnetic fields. Investigators using other species of electric fish have observed strong, overt responses to extremely weak magnetic fields. It seems likely that such fish, with proven ability to perceive extremely weak electric fields, must be responsive to current induced in them by changing magnetic fields. However, our investigations indicate that for Sternarchus at least, there is no response to strong (100 gauss), steady fields. Investigations with progressively weaker fields continues in effort to eliminate the possibility of the blanking effect of too powerful stimulus. The case with the magnet may well be analagous to that reported for applied current on these fish: the smaller the applied stimulus; the greater the relative response.

A concurrent study will proceed using a pulsed magnetic field. Sternarchus is reported to respond to applied A.C. currents and fields far more readily than to stimulation by currents and fields of D.C.

Also in progress is a study of threshold perception for A.C. and D.C. current. There are several reports in the literature already on this topic. However, the data is reported in such a way as to render the work of questionable usefulness to us. The threshold values are reported in Volts/distance. Data on resistance of the syster must be obtained before such figures are useful.

The above experiments have a possible practical application in that electric fish may find use as or as a model for energy detection in the water. The electric field navigation system may also be practical and further baseline studies of its natural originators, the electric fish, will be invaluable.

The electric field of the electric fish is easily monitored by means of an amplifier and oscilloscope. As such, the fish provides what amounts to a living nerve preparation. We feel that monitoring the free swimming animal provides a "window" on nervous activity. As such, this animal could provide a useful model for drug study. With the current emphasis on the breakthrough in the treatment of Parkinson's disease with dopamine, we saw an opportunity to test this theory. Investigations are preliminary, but electrical activity and physical behavior have been observed to be altered after several hours in L-EOPA solution.

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# ELECTRIC CURRENT AS AN AGENT FOR PERSONNEL INCAPACITATION

Prepared by:

22 October 1971

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# ELECTRIC CURRENT . AS AN AGENT FOR PERSONNEL INCAPACITATION

#### PROBLEM

To evaluate, especially from the physiologic point of view, electric current as an agent for personnel incapacitation.

#### DISCUSSION

#### I. Potential Applications for Incapacitation

Electric current possesses a number of possible advantages when compared to other proposed agents for personnel incapacitation. Controlled electric shock offers, not necessarily simultaneously, the following possibilities:

Broad spectrum of incapacitation: annoyance, fear, intimidation, pain, muscle spasm, minor burns, paralysis, suffocation, unconsciousness, severe burns, death.

Relative predictability of physiologic effect: reliable relationship between dose and responses.

Controllability: of dose and on/off times.

<u>Directivity:</u> with respect to person to be incapacitated and body part(s) to be affected.

Effectiveness on a wide range of subjects: regardless of determination or level of consciousness.

Rapidity of incapacitation: onset of action within a second.

Rapidity of recovery: only a few seconds for the milder effects.

Safety: for both the operator and the subject, * if desired.

^{*} Throughout trus report, subjects are assumed to be healthy, adult humans in the 45 to 90 kilogram weight range.

Covertness: quiet and unobtrusive, can be camouflaged.

Aside from technical details of the delivery system, the only broad limitations to use of electric current as an incapacitation agent have to do with the number of subjects and the duration of incapacitation. It is difficult to conceive of realistic circumstances that would permit a safe and uniform dose to be administered to a number of subjects at one time, although current would be as effective for the entire group as it is for an individual. In this report, current is considered as an incapacitating agent for individuals only. Electric current can be quite safe for periods of incapacitation of a few seconds only; hazards become much greater if current is used to maintain incapacitation for a minute or longer, unless special techniques and precautions are used.

Within these limitations, current could be used as an incapacitating agent under virtually any circumstances. Power can be supplied from permanent supply lines, temporary generators and lines, or portable supplies (including pocket-sized battery packs in some cases). Delivery systems might be permanent installations, temporary traps, hand-held instruments or long-range projectile devices. Automatic controls would suffice for systems designed for brief incapacitations, but systems maintaining incapacitation for more than a few seconds should be controlled by an operator who has some training in the methods of safeguarding the health of the subject.

#### II. Physical Variables of Electric Current

The performance and suitability of electric shock for personnel incapacitation may be affected by several variables which characterize the incapacitating current. The more important electrical parameters are voltage, current, power (or energy) and frequency. For familiarity, these and other terms used in this study are briefly defined in Table I.

TABLE I
DEFINITION OF BASIC ELECTRICITY TERMS

Characteristic	Brief Definition	Symbol	Unit	
Voltage	Electrical pressure or the electromotive force tending to move electrons, potential	E	volt	
Current	Volume of electron flow	I	ampere	
Direct Current	Current that does not vary in direction or magnitude with time	DC	ampere	
Alternating Current	Current that has continuous sinusoidal variation in direction and magnitude with time	AC	ampere	
Frequency	Rate of alteration of an AC current	f (c	Hertz ycles/sec)	
Resistance	Opposition to the flow of di- rect or alternating current	R	ohm	
Impedance	Opposition to the flow of alternating current	Z	ohm	
Pulsed Current Current that flows inter- mittantly, but repeatedly				
Energy	Capacity to do work		joule	
Power	Rate of delivery of energy, the product of voltage and current	P	watt	

Electric currents are most often supplied from batteries (direct current) or from rotating generators (either alternating or direct current). The current is usually carried from one locale to another by low resistance conductors, such as non-ferrous metals, or by ionized liquids or gases, and is prevented from leaving the desired path by high resistance insulators. The application of current or voltage to basic electrical devices, including resistors, coils, and capacitors, permits a wide range of functions to be performed by electricity. These basic electrical devices coupled with more complicated devices, such as vacuum tubes and transistors, form the working components of all electrical and electronic systems which generate, transmit, store, amplify, modulate or otherwise control electric current.

Purposeful control of the variables of electricity can be accomplished through the use of these basic devices. For example, a coil or inductor will tend to conduct direct current and low frequency alternating current, while impeding high frequency alternating current. Similarly, a capacitor or condenser acts as a conductor for high frequency alternating current, but impedes direct current and low frequency alternating current.

The spectrum of physical and physiological effects produced by the variations of voltage, current and frequency is probably familiar to many readers: the tingle of a mild electric shock of low amperage, the appearance of a high voltage arc discharge, the accidental burn from 110 volt, 60-Hertz "house current" or the painful shock from the high voltage of an automobile ignition system.

In terms of incapacitation and biological effects on living systems, current not voltage - is the most important variable of electricity. The frequency
of the current may also be a factor in determining the deleterious effects of
electric current, especially with regard to the sensitivity of the human
heart.

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III. Physiological Considerations

#### A. Effects of Electrical Current on Humans

With the exception of inconsequential effects such as the feeling of hair-standing-on-end, high voltages without current flow have no known effect on human well-being or performance. Polarity of a direct current or brief discharge makes no apparent difference with regard to the incapacitating effects of flowing current.

As it relates to the incapacitation problem, electric current has only three significant effects on human tissues:

- I. Depolarization of nerve and muscle tissue, causing the "firing" of nerve or brain cells and contraction of muscle fibers. Depolarization causes the subjective tingle, involuntary muscular contractions and several other side-effects of an electric shock.
- 2. Change in sensitivity of certain irritable tissues, such as increased heart irritability and sensiti ity to fibrillation. † Fibrillation is an uncoordinated "bag-of-worms" contractile activity of the heart, and is a major threat to life which may ensue when moderate electrical currents pass through the heart. Death can follow because a fibrillating heart cannot pump blood.
- 3. Heating, to the point of coagulation and burning if current flow is large enough or concentrated in a small area.

All three of the above effects could contribute to the pain of a severe shock, although a large part may be pain due to muscle spasm.

In this report, fibrillation means ventricular fibrillation.

Unless otherwise attributed, the material presented in this section is derived from Reference 1, which also provides a bibliography of the basic publications on the physiologic effects of electric current.

Detailed effects can be predicted if the amperage, route through the body, duration of current flow and frequency of the power supply are known. Deliberate execution in an electric chair is an extreme example in which approximately 10 amperes of 50 to 60 Hertz current are passed from head to both feet for longer than a minute. Such a lethal current causes immediate unconsciousness; immediate and continuous "tetanic" contraction of all major muscles including the heart, thereby arresting respiration and all useful heart activity, and severe heating effects most pronounced where the special electrodes make contact with the skin. The colloquial phrase "frying in the chair" seems apt.

A less drastic but equally dramatic . . . of electric current is in electroconvulsive therapy or "shock treatment" for mental illness. In this case, 50 to 60 hertz currents on the order of 1 ampere are passed from one side of the head to the other for one-half second or less. 2 The patient immediately loses consciousness and has a generalized convulsion that appears to last longer than the duration of current application. The patient usually regains consciousness within a few minutes and may be physically able to walk promptly. There is likely to be residual muscular soreness and a confusional state may persist for any period of time from seconds to days. The patient retains permanert amnesia for the time of the shock and usually makes no serious objection to repeat treatments. Therapy personnel take great care to make large-area, low-resistance electrical contact on both sides of the head to prevent current burns on the patient's scalp. It must be emphasized that current flow, and hence all direct effect, of electroconvulsive therapy, is confined to the head. The depolarizing action of the current on the brain causes convulsive stimuli to flow out to the muscles through the normal channels of the nervous system; there is no significant current flow through the trunk or extremities although they move violently. Only organs in the path of the current flow can be affected directly. This is why there is no risk of direct electrical interference with heart action during properly conducted electro-convulsive therapy.

Currents passing through the torso can cause spassic paralysis of the respiratory, back and abdominal muscles. Continuous paralysis of the respiratory muscles for several minutes can lead to suffocation regardless of other consequences. The most immediate and potentially lethal threat posed by a current passing through the chest, however, is electrical interference with heart activity. Table II outlines the hazards of currents applied externally to the chest for several seconds.

Inspection of Table II reveals several key points. For a given current level in the 0 to 3,000 milliampere range, alternating current has greater physiologic effect and is more hazardous than direct current. Fibrillation of the heart is rarely caused by direct current regardless of amperage. Ventricular fibrillation is almost always fatal unless given special treatment within minutes, but hearts that have been completely paralyzed for short periods usually resume normal activity spontaneously after the current stops. This difference accounts for the apparent paradox in the doseresponse relationships shown for alternating currents: other factors being equal, a current greater than 3 amperes is less likely to be immediately fatal than currents in the 80 milliampere to 3 ampere range. It must be emphasized that the approximations indicated by Table II are valid only for current applied externally across the chest and for the indicated durations. The voltage required to produce a given current, of course, is highly dependent on the nature of the electrodes, skin resistance, and other factors.

The fibrillation threshold rises for current durations shorter than one second, at least for non-repetitive pulses of current. Figure 1 indicates an approximate "worst case" threshold for fibrillation hazard in terms of the current-time factor for brief exposures to any type of current, including 60 Hz AC and capacitor discharges. For shocks lasting less than one second, the threshold shown by Figure 1 is for constant energy pulses of 1.6 joule

The standard method of "closed" defibrillation is to apply about 300 joules of electrical energy in 0.2 seconds or less through large electrodes held firmly on the skin of the anterior chest. One joule is one watt-second.

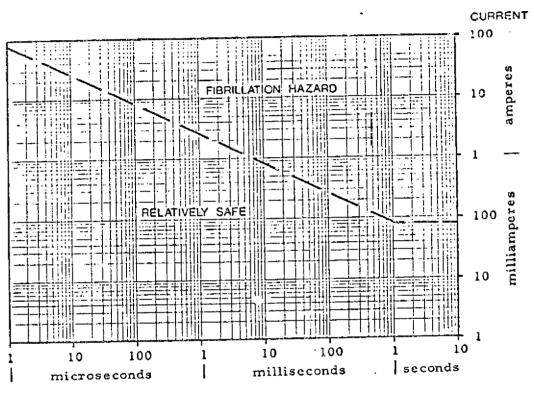
# TABLE II SENSATION AND EFFECTS ON HEART AND RESPIRATORY MUSCLES OF CURRENTS * LASTING 1 TO 30 SECONDS I (THRESHOLDS APPROXIMATE)

Current (ma)	Sens AC [†]	ation DC	Hea AC [†]	rt DC	Respirator AC [†]	y Muscles DC
0-1	none	none	попе	none	none	none
1-5	tingle	none	noné	none .	none	none ·
5- 25	pain	tingle	none	none	slight contraction	non€
25-80	pain	pain	none	none .	paralysis	slight contraction
80-300	pain	pain	fibrillation	none	paralysis	paralysis
300-3,000	pain	pain	fibrillation	paralysis	paralysis	paralysis
over 3,000	pain, burns	pain, burns	paralysis	paralysis	paralysis	paralysis

^{*} For currents applied externally to the chest; currents smaller than 0.1 milliampers can cause fibrillation if applied directly to the heart. 3

^{† 10-1,000} Hertz

Exposure longer than 30 seconds may cause fibrillation



DURATION OF CURRENT (Continuous, Non-Repetitive Flow)

Figure 1. Approximate Threshold of Heart Fibrillation Hazard for Single, Brief Current Surges (AC or DC)

each. Several authorities suggest that hazard threshold might well be at energy levels an order of magnitude higher than that shown; thus the threshold shown by Figure 1 may be quite conservative.

Currents of sufficient magnitude will cause painful involuntary contraction of muscles as the currents pass through an extremity. The motion made by the extremity as the muscles contract will depend upon: (1) the muscle groups stimulated, and (2) the relative strengths of contraction of the various muscle groups. A person "thrown" or "knocked down" by electric shock has been moved by his own muscle contractions rather than any direct propulsive effect of the current. Relatively weak movements caused by small currents can be overcome by voluntary muscle control, especially in large powerful people. A "no-let-go" current threshold can be determined by measuring progressively larger currents flowing through a person's arm from an electrode grasped in his hand, up to the current at which he can no longer voluntarily release the electrode with the current flowing. The no-let-go threshold for adults is in the 6 to 30 milliampere range for 60 Hz AC. Current values will be similar for other AC frequencies in the 10 to 1,000 Hz range, but DC currents would have to be about five times as large for similar effect.

#### B. The Human Body as an Electrical Conductor

From the standpoint of electrical shock, the normal human body can be considered as a bony framework encased in a protein gel with some lipids, all of which is permeated with an aqueous salt solution and encased in a water-proof skin. The electrical resistance of organs generally varies inversely with water content. Tissues such as blood and muscle display resistances in the order of 1,000 ohms per cubic centimeter while dense bone, fat and nervous tissues have resistances several times higher. Whole body resistance, exclusive of skin, is on the order of 200-1,000 ohms. The trunk has a lower resistance than the extremities with their smaller cross section and high proportion of bone. Current inside the body appears to spread in a

fairly uniform manner through the available volume between the point of entrance and the point of exit rather than being noticeably concentrated along any special low-resistance path.

The skin usually presents the major resistive barrier to electric current flow. Most of the skin resistance is in the epidermis, the dry, horny outer layer without blood vessels. Thickness of the epidermis, and hence the resistance of the skin, may vary widely between different parts of the body. Thin skin behind the knee or in the axilla may offer less than a thousand ohms resistance, especially if moist. At the other extreme, a thick, dry callous may offer resistance approaching a million ohms. Skin that is relatively moist, such as on the palms, soles or axillae, will be more conductive than drier skin of the same thickness elsewhere on the body. During sound sleep, all skin resistance rises greatly.

#### C. Skin Resistance

4

The major factors in electrode-to-body resistance through the skin are:1

- 1. Thickness and intrinsic moisture of the skin, as noted above. Range: about 1,000 1,000,000 ohms (dry contact).
- 2. "Wet" or dry contact. Presence or absence of an electrolyte solution providing a conductive pathway between electrode and skin. "Wet" contact can be proveded by special preparations such as electrode paste or fluids such as sweat, blood, saline solution or even tapwater. Conversion from a dry contact to a "wet" one usually drops the resistance one or two orders of magnitude.
- 3. Intact or damaged skin. Any thinning, scratching or penetration of the epidermis can drastically reduce skin resistance. In addition to any reduction due to a wet contact, painless, gentle sandpapering of the skin can also reduce the resistance one or two orders of magnitude. Even a tiny penetrating burn, such as that caused by a small area of contact with high voltage, will cause a near-instantaneous drop in skin resistance to a

few hundred ohms or less.

- 4. Area of contact. Other factors being equal, resistance is inversely proportional to the area of contact. A large area of uniform dry contact is difficult to achieve in practice. Significant and predictable reduction in resistance by large area contact is ordinarily achieved only with wet contact such as immersion of a body part or wet clothing.
- 5. Pressure of contact. Increased pressure on a dry contact with intact skin can reduce resistance, but the effect is usually not pronounced enough to cause dry electrode-to-skin resistances lower than 10,000 ohms until the contact pressure exceeds 10 kilograms per square centimeter.
- 6. Frequency of the electric power. Skin impedence, or total tendency to obstruct the flow of electric current, is inversely proportional to increases in the frequency of the applied electric power. The relationship is not sufficient to lower the effective skin impedance two orders of magnitude until the power supply frequency approaches 100 kHz. This report is not concerned with such radio frequency currents because "skin effect" keeps most of the current on the body surface where it is ineffective as an incapacitating agent.
- 7. Skin covering. Dry hair and most dry clothing can increase the electrode-to-body resistance by millions of ohms.

#### D. Burns and Other Thermal Injuries

The heating effects of electric current are dependent upon the amount of electrical energy being dissipated per unit time in a given volume of conductor. About four joules of electrical energy must be dissipated in a gram of water in order to heat the water one degree centigrade. In general, the temperature rise of tissue being heated by electric current varies:

- 1) directly with the square of the current
- 2) directly with the resistance of the tissue
- 3) directly with the time of current flow
- 4) inversely with the effective volume or cross-section of the conductor

Consideration of these facts leads to the conclusion that the highest temperature rises in most cases of electrical shock will occur in the skin at one or both points of electrical contact with the body. For significant current flows, skin burns of some degree will remain a hazard unless special precautions are taken to avoid high skin resistance and small effective cross-sections of electrical contact with the skin.

Conversely, the large effective cross-section and low resistance of the body beneath the skin means that many amperes of current flowing for prolonged periods would usually be required to "cook" organs other than the skin.

An electric arc in air at one atmosphere has a temperature of 2500° to 3000° C and can cause local heat effects other than those due to current passing through skin resistance.

#### E. Pulsed Current

Repeated brief pulses would seem to offer several decided advantages as a form of delivering electrical energy for incapacitation purposes. At a pulse repetition rate of one per second or faster, pulsed currents should be able to cause as much pain, paralysis and incoordination as continuous current, perhaps even more than continuous direct current. Very brief pulses and a small duty cycle would mean low average power levels, resulting in: (1) reduced burn hazard to the subject; and (2) reduced drain on the power supply system. For example, a one ampere pulse lasting one millisecond (0.25 joule of energy, assuming internal body resistance of 250 ohms) could be repeated at 10 pulses per second with a time-average power of only 2.5 watts, one hundred times less than a continuous current of one ampere. If such pulses passed through major portions of a man's body, they should be completely incapacitating with only minor burn hazard and low drain on the power supply. Figure 1 might be misconstrued to suggest that such a pulsed current is known to be safe as far as the heart is concerned. It must be emphasized that the figure relates to a single

barrier to delivery of electric current for incapacitation purposes. Methods of overcoming the skin resistance problem may be summarized as follows:

Avoid the skin. Make contact with moist mucosal surfaces such as mouth and rectum.

Use wet skin. Make contact with skin surfaces that are already wet, or deliberately moisten the electrode placement sites.

Use damaged skin. Make wet contact with skin previously or deliberately scratched or abraded, as with an abrasive electrode paste.

Penetrate epidermis with electrodes. Make direct contact with structures beneath the epidermis by means of electrodes in such forms as needles, splinters, burrs and slivers.

Use high voltage. Sufficiently high voltages will force any required current through the skin regardless of high skin resistance. High voltage cannot be considered a simple all-purposed solution to the skin resistance problem because high voltage is likely to cause extremely rapid changes in skin characteristics. A voltage high enough to force an incapacitating current through two high resistance dry skin contacts may well cause small burns that result in a drastic fall in skin resistance; if high voltage is maintained in the face of rapidly declining resistance, an enormous and hazardous current flow develops. Various electrical techniques are available to limit current flow in such cases. Use of high voltages also requires that special precautions be taken to avoid short circuits that bypass the subject's body.

#### G. Path of Current Flow Through the Body

The complete loop of current flow must be considered in every case of electric shock, and any changes taking place during the shocking process must be borne in mind. The locations of effective current entry and exit from the body are all important with regard to physiologic effect, considering that current has direct effects on only those organs through which it flows.

Two electrodes closely spaced. Current entry and exit points within a few centimeters of each other on the body surface can cause local pain, muscle spasm and burns only. The only significant exception would be electrodes on the front of the chest where part of the current could flow through the heart. Closely spaced electrodes could be used to cause limited incapacitation by pain and, if properly used, could be quite safe.

Two electrodes widely spaced. Widely spaced electrodes on the body surface offer a great variety of possible physiologic consequences, depending on full details of the method used. In all cases, there will be local effects near the electrodes as noted above. Large currents passing between electrodes on opposite sides of the head may have effects similar to electroconvulsive therapy, at the risk of severe scalp burns unless the electrodes provide large areas of good contact; similar effects, along with others, might be expected with current flowing from the top of the head to another electrode at neck level or lower on the body. Current flowing only in one extremity can have direct effects on that extremity only. There are many possibilities for widely spaced electrodes to cause significant current flow through the chest with resultant possibility of interference with cardiac and/ or respiratory activity. Figure 2 illustrates the possibilities of placement of contacts that cause a significant proportion of the current to flow through the chest. Electrode pairs offer such a possibility if they: (1) are on opposite sides of the plane AU; (2) are on opposite sides of the plane BC; cr (3) are on the front and back of the chest or upper abdomen. Figure 2 shows that the only path from one extremity to another, not threatening chest activities, is from one lower extremity to another.

One electrode and "ground". This situation must be considered as two electrodes, the second electrode being whatever is considered "ground" in contact with both the subject's body and the other part of the essential closed circuit for current. The single electrode problem may be one thing if the subject is standing barefoot in a rice paddy, and entirely different if he is standing in dry she as on a dry wooden floor. Any change in the subject's body contact with "ground," such as falling onto or away from "ground," can radically alter the current flow situation.

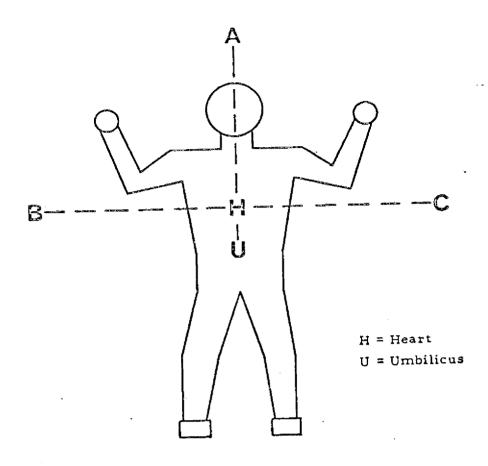


Figure 2. Diagram of Body Area Combinations for Current Flow Through Chest. (See Text)

### H. Physiological Conclusions

It is possible to use electrical current as an agent to cause a whole spectrum of human incapacitation from minor distraction through muscle spasm. pain, contortion, minor burns, respiratory arrest and perhaps vocal paralysis, cardiac arrest, unconsciousness with convulsion, severe burns and death.

The approximate degree and duration of incapacitation can, within limits, be predetermined by appropriate selection of current type, amount, duration, and path in the body. In general, electrical techniques tend to be time-limited if safety is a consideration; prolonged use of electric current to maintain incapacitation may present grave hazards to the subject in the form of burns, inadequate heart output or inadequate respiration. On the other hand, a brief "knock-down" incapacitation can be achieved with relative safety by almost any large current flowing for an extremely short period of time (less than a millisecond).

Several techniques can be used to increase the safety factor of current being used to incapacitate for longer than the "knock-down." A current large enough to cause extremely painful paralysis of the extremities presents no danger more serious than burns if it does not pass through the chest. In this respect, optimum safety with severely incapacitating currents could be achieved with the current flowing: (1) from one lower extremity to the other; or (2) from a distal point to a proximal point on the same extremity. Over such paths continuous AC current of more than 25 milliamperes or DC current of more than 80 milliamperes should keep at least one extremity of a man painfully paralyzed for the duration of current flow; currents larger than an ampere could cause severe burns, especially if the current flows continuously for many seconds.

If the current path is through the chest, the use of direct current will virtually obviate the hazard of heart fibrillation although the likelihood of respiratory and cardiac arrest remains with direct currents in the effective range. Cardiac arrest causes unconsciousness within a few seconds and death after several minutes. Complete respiratory arrest usually causes unconsciousness in less than four minutes and death in about ten minutes. Both kinds of arrest would be likely with direct currents larger than 300 milliamperes passing through the chest, so incapacitating direct current would usually have to be kept in the 80 to 300 milliampere range if it is to be used for prolonged periods.

The safety margin for incapacitating levels of alternating current flowing through the chest is narrow for periods as short as a few seconds and there is no margin of safety if the current flows for more than 30 seconds. All such shocks should be considered potentially lethal.

Carefully chosen pulsed currents, perhaps brief surges of one joule or less delivered once or twice per second, may offer effective and relatively safe incapacitation when flowing between any two widely spaced points on the body. Several key questions regarding the safety and effectiveness remain to be answered by direct investigation, but indirect evidence suggests that such pulses would offer the following advantages: (1) no direct threat to a normal heart for any duration of incapacitation; (2) only minor skin burns at worst; and (3) low average current requirement for the power supply. The facts remain to be verified, but such pulses passing from any point on the upper extremities or the upper body to any point below the waist may well be capable of preventing respiration and effective speech in addition to causing complete immobilization by muscle spasm and pain. If this is the case, an operator could be equipped with a system enabling him to: (1) knock a subject down rapidly; (2) keep the subject incapacitated and unable to make an effective outcry for perhaps a minute; (3) turn the pulses off for long enough to allow the subject to take a breath or two: (4) turn the pulses back on until the subject becomes blue or passes out; and (5) repeat steps 3 and 4 for a reasonable length of time. Properly handled, the subject should recover promptly after the pulses have been turned off for several seconds, and have no permanent ill effects aside from probable smallarea skin burns.

Electrical currents are not likely to cause the immediate coma and convulsion of electro-convulsive therapy without: (1) severe burns about the head or (2) the use of techniques very similar to those used in ECT.

reliable with regard to open-circuit and short-circuit possibilities under a variety of field conditions.

Electrodes. Electrode design and placement will have to allow for all the variables to be presented by the subject and the environment in the field. The subject variables are likely to include location in space, body posture, motion before receiving current, motion and posture after receiving current, clothing, moisture of skin and clothing, nature of surrounding objects, proximity and actions of companions. Subject variability is likely to determine the path of current flow in the body of a subject who moves himself into contact with previously placed electrodes. Again, hand placement should be easy, but swift long-range placement of adequate electrodes will require expert design in order to be reliable under a variety of field conditions. Electrodes are subject to open-circuit and short-circuit failure modes, in addition to dangers or ineffectiveness which might result from inappropriate current pathways through the body.

#### B. Operator Risk

Standard electrical safety precautions, built into the system, should be adequate for operator safety so long as the operator avoids electrical contact with the electrodes or the subject while current is flowing. The operator could handle the subject if he: (1) turned off the current; or (2) wore insulating gloves of an appropriate thickness.

#### C. Covertness

Aside from the actions of the subject, electrical current system activity should be inapparent to an observer except for the possible faint snapping noise, smell of ozone or burning and dim light of small high-voltage arcs. As discussed previously, the subject may or may not be able to scream, shout or signal. A severely incapacitated subject is likely to fall down, and might thrash about or jerk under some circumstances.

#### D. Courtermeasures

Only limited countermeasures would be available to protect a subject from a properly designed electrical incapacitation system. In general, countermeasures would fall into the following categories:

Avoidance. Stay away from the electrodes.

Minimize current flow. Current penetration of the body can be effectively reduced by: (1) interposing an insulating layer between the electrode and the body: or (2) providing a low resistance short-circuit path between electrodes so most of the current flow remains outside the body. Insulating footwear could often be a reliable countermeasure to any system using a single electrode with "ground." Insulating gloves might enable a subject to remove electrodes delivering currents above the "no-let-go" threshold if initial electrode placement does not provide a completely incapacitating path of current flow through the body. Protective clothing could have a low resistance (short-circuiting) outer layer and a high resistance (insulating) inner layer.

Interrupt current flow. Once a truly incapacitating current flow has been established in the subject's body, deliberate interruption of the current could be accomplished only by the operator or a third party coming to the aid of the subject.

#### V. Equipment State-of-the-Art

which the authors of this report have detailed information. The concept may be summarized as a self-contained, hand-carried, battery-powered unit designed to project one or two insulated delivery wires at high velocity to a subject who may be at ranges up to 100 meters; delivery wire(s) may terminate at electrode(s) that may be bare wire, net, dart, barb, burr, adhesive or some other form; current is passed through the subject in brief 0.1 to 3 joule pulses at about 30,000 volts repeated 2 to 20 times per second. Data are presented from tests involving a small number of experimental animals and human volunteers. During these tests, incapacitation periods were limited to four seconds or less.

In view of the information presented in this report, the appears basically sound provided that a reliable wire delivery and electrode emplacement system can be proved satisfactory under field conditions. From the physiological standpoint, safer and more rapid incapacitation might have been achieved with larger energy pulses repeated more slowly than the ten per second indicated in most of the tests. Available test information is not conclusive with regard to: (1) incidence of skin burns; (2) respiratory and vocal status during shocks; (3) whether or not personnel knew that they were "pacing" the hearts of the subjects; (4) effects of prolonged exposure to the pulses; and (5) results when electrodes are projected to the subjects rather than carefully taped in position.

Incomplete descriptions of other systems for incapacitation by electric current are also available. One is a patent application for a pistol that would produce "artificial epilepsy" by firing a small projectile with two trailing wires, the projectile to be equipped with two forward-facing needle electrodes

to penetrate the skin of the subject. The only way for such a device to cause a true generalized convulsion would be for the needles to penetrate the subject's <u>brain!</u> Closely spaced electrodes can cause only local direct effects. Elsewhere on the body, such a device could cause annoyance, pain and possibly burns before the subject removed the projectile.

Streams of conductive fluid, such as impure water, have been suggested as alternatives to conventional metallic conducting wires and electrodes. Such suggestions have merit so long as practical considerations of range, time, and open-circuit and short-circuit problems are kept in mind.

#### VI. Recommendations

- Arrange to have necessary experimental work done in order to establish appropriate thresholds of effectiveness and safety for pulsed currents. The physiologic effects and hazards of selected pulsed currents could be substantially proved by appropriate observations with a small series of experimental animals. Common domestic animals, such as pigs, sheep, and calves that weigh about 70 kilograms, provide good models for adult men as far as electrical effects are concerned. Audio-cinematographic, electrocardiographic and pneumographic recording should be carried out with emphasis on the time of onset of apparently incapacitating muscular contraction, cardiac and respiratory status during incapacity, the recovery phase, and examination of the sites of electrode placement. Time-toincapacity, ability to make an outcry and time-to-recover would have to be investigated with a small series of unanesthetized animals; other phases could use animals breathing spontaneously under light anesthesia. Judicious increases in duration of the incapacitation period and the energy and frequency of the pulses should yield useful approximations of the desired thresholds for humans. Other studies on the operation of electrodes and power supply could be conducted at the same time. Once burn thresholds have been established, the "no-let-go" threshold could be documented with a brief study using a palm-to-shoulder current path in human volunteers.
- 2. Encourage development of systems to fit specific needs. Any single electrical system is unlikely to prove optimum for all situations in which incapacitation is desired, especially with regard to making two appropriate electrical contacts with the subject's body and maintaining them if prolonged incapacitation is required.
- 3. High voltage is likely to prove the most practical way to overcome the skin resistance problem in many situations; if high voltage is used, the

likelihood of small-area third degree skin burns must be accepted. High voltage systems will need special provisions to avoid: (1) delivering excessive current to the subject after a fall in skin resistance; (2) shocking the operator; or (3) short circuits that could destroy effectiveness of the system before or after the start of incapacitation.

- 4. A short-range (arm's length) electrical current incapacitation device could be operational in a few months. The device could be a "pain dispenser" carried in the hand, and could consist of a modified surgical towel clip with battery-powered electronics to provide painful shocks.
- 5. Proposed systems should be examined critically, especially with regard to the resistance problem and the location of the entry and exit points for current flowing through the body. Unless a system has a reliable method of preventing current flow through the subject's chest, it should be assumed that current will flow through the chest in some cases. A single electrode with "ground" system is likely to be dependable in special situations only.
- 6. All systems intended to maintain incapacitation for more than a few seconds should deliver currents well above the "no-let-go" threshold in order to insure that the subject will not be able to break contact manually.
- 7. Operators should be aware that a subject's gun is likely to be fired if the subject has a finger on the trigger at the moment electrical incapacitation starts.

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## QUARTERLY TECHNICAL PROGRESS REPORT 1 August - 31 October 1971

The first substantive report entitled "Electric Current as an Agent for Personnel Incapacitation," was completed in October. An outline of the substantive portion of this report is appended. Electric current appears to be a promising means of delivering a wide spectrum of incapacitation to a single individual (or a few individuals). Application of the agent can be well controlled and is reasonably safe under appropriate conditions.

The next subject area to be reviewed will be impact and its application as an incapacitating agent.

#### Administrative Aspects

1. A six-months no-cost extension of the project was granted on 20 September 1971. The new completion date is 30 April 1972. This time extension, along with an acceleration of the substantive work of the program will allow completion of the project within the extended time limit.

#### OUTLINE

## ELECTRIC CURRENT AS AN AGENT FOR PERSONNEL INCAPACITATION

- I. Potential Applications
- II. Physical Variables of Electric Current
- III. Physiological Considerations
  - A. Effects of Electrical Current on Humans
  - B. The Human Body as an Electrical Conductor
  - C. Skin Resistance
  - D. Burns and Other Thermal Injuries
  - E. Pulsed Current
  - · F. Overcoming Skin Resistance
    - G. Path of Current Flow Through the Body
    - H. Physiological Conclusions
- IV. Other System Factors
- V. Equipment State of the Art
- VI. Recommendations

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OF _3 COPIES.

AS A VEHICLE
FOR INCAPACITATING AGENTS

Prepared by:

24 December 1971

(247)

This report has been prepared by
as a part of a Government Contract. The views expressed
are those of personnel and not necessarily those
of the United States Government.

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# AS A VEHICLE FOR INCAPACITATING AGENTS

#### PROBLEM

To evaluate, especially from the physiologic point of view, as a vehicle for personnel incapacitating agents.

## DISCUSSION

## I. Potential Applications For Incapacitation

is a chemical with the rather extraordinary property of penetrating skin rapidly. The skin, long thought of as a virtually impenetrable barrier or as an only slightly, slowly permeable one, is easily, quickly, and reversibly breached | Furthermore, many chemicals, when dissolved | can cross the barrier along with

Such a property lends to consideration as a possible means of delivering an incapacitating chemical agent via the skin. Those drugs which interfere with a person's state of consciousness -- inducing loss of consciousness, panic, disorientation or hallucination -- could conceivably be administered, as well as drugs which incapacitate by causing motor cysfunction or muscular paralysis, or those which incapacitate by producing somatic preoccupation such as itching or burning. Since many incapacitating drugs require fairly critical dosage, the usefulness of a incapacitating agent mixture would

probably be limited to individuals, where the dosage could be more carefully controlled as to quantity and site of application. In a crowd situation, uniform dosage would be quite hard to obtain.

II.

^{*} The lowest temperature at which vapors will ignite in air.

## III. Physiological Considerations

## A. Introduction -- Nature of the Skin.

A primary function of the skin is protection of the body. One way in which it does this is by serving as a barrier to penetration of chemicals -- harmful or otherwise -- into the body through its surface. It is a formidable barrier to such penetration. For example, the epidermis retards the diffusion of low molecular weight, water soluble nonelectrolytes (among the most diffusible of substances) by a factor of over one thousand times. 7

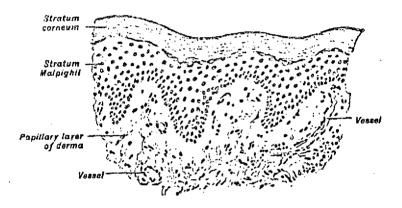


Figure 1. Section through the skin of the human shoulder

To get from the surface of the skin to the circulatory system, a substance must first penetrate the stratum corneum, or horny layer of the epidermis. This is a thin layer of dead, keratinized epithelial cells approximately  $10\,\mu$  thick. Once this is passed, the stratum Malpighii, or living part of the epidermis ( $100\,\mu$  or so thick), then the papillary part of the dermis ( $100\, 200\,\mu$  thick in most places) must be traversed before the capillaries in the dermal papillae are reached. The stratum corneum constitutes by far the major part of the skin barrier insofar as resistance to diffusion is concerned. If it can be breached, drugs can gain entrance to the body via

the skin -- eliminating the need to administer them orally, by injection, or by other routes.

## B. Theories of Penetration.

is largely The actual mechanism of penetration of the human skin unknown, although several theories have been advanced. There is little or no evidence in support of any of the theories, however. According to the replace molecules of most widely held hypothesis, the molecules bonds are less tight bound water in the stratum corneum. than HOH - HOH bonds and, therefore, temporary dissociation, allowing chemicals to pass through, would be easier.  7  In order other substances to penetrate the stratum corneum, saturation of the intersays, "It is almost as molecular spaces may be necessary. As if the penetrant is conducted through the horny-layer barrier by remaining which occupies interdissolved in a continuous channel molecular spaces. " This "opening up" of a pathway through the stratum |leaves the corneum occurs for a limited time only; stratum corneum open to penetration by other chemicals for 1-1/2 to 3 hours only. It is suggested that by the end of this time the saturating quantity of /has either diffused away from the stratum corneum or beer absorbed into the circulation.

High concentrations | are needed for effective penetration. | 7 This may be a result of the 1:2 or 1:3 associational complex formed with water.

A 75% or greater | has space remaining available for association with tissue water molecules -- they can be removed from the stratum corneum and replaced

#### C. Substances "Carried"

Various investigators have conducted experiments

in conjunction

with a wide variety of chemicals in hopes of getting them through the skin barrier. As a general rule, low molecular weight, nonionized chemicals pass through the most quickly, those which are ionized and/or of higher molecular weight pass through more slowly, if at all, and substances of high molecular weight such as insulin and ragweed allergen do not pass through at all.

Some substances which have been tried and which do penstrate the stratum corneum

It should be stressed that nearly all of these studies measured penetration only through the stratum corneum or into the skin. They do not imply penetration into the bloodstream. Indeed, many of these substances, including have been found to penetrate only through the stratum corneum into the epidermis and dermis, where they may form a reservoir. Some, such as may remain in the stratum corneum for the most part.

### D. Penetration Studies.

#### 1. Stratum Corneum.

There are two main factors to consider in the penetration {through the skin barrier -- the speed of penetration and the quantitative amount of penetration. Neither has been established with any degree of precision, but some figures are available.

on the back and spread it with a glass rod. They noted signs of reaction (whealing, especially around the hair follicles) in 5 to 15 minutes. The differences in whealing times between work may indicate that the absorption time is a function of the amount thin layer.

just like any other skin area) sufficient to allow rainless myringotomy (cutting of the eardrum) within one minute after wiping the eardrum with

In another study, penetrated to the base of the horny layer in 20 minutes. In the time was 55 minutes, and in 120 minutes was the time for penetration. These results emphasize the need to use high concentrations for rapid, maximum, penetration.

Published studies on the quantitative penetration have been almost nil. in gel form on the elbow and let it stand for 30 minutes. By then wiping off and weighing what remained at the

end of that time, they calculated that 25-40% of had been absorbed. This was obviously a rough determination only.

tion, that 20% of the applied dose was still in the epidermis. He did not mention where or how the remaining 80% was distributed.

These two studies demostrate that dermal application | \is no assurance that all of the compound will penetrate the skin. Furthermore, of that portion which does penetrate, some may remain in the epidermis for a considerable length of time. These studies were | alone; chemicals "carried" | may or may not behave in like manner. At present, it would be almost impossible to predict what the behavior of a given chemical agent | would be with regard to percent absorption or penetration rate without actually running tests on that particular chemical.

The constrated. It is known that, with regard to such things as water diffusibility, certain areas of the body are considerably more permeable than others. For example, scrotal skin is considerably more permeable than abdominal skin. There are several variables which may be at work. The skin itself (epidermis and dermis) varies in thickness, and the stratum corneum itself may vary in either thickness or structure. Other than on the soles of the feet and the palms of the hands, where the stratum corneum is considerably thicker, but has a higher diffusivity, the stratum corneum varies little in thickness. It may vary in nature, however, as in the forehead, where there is a less orderly, more open arrangement of the cells. There may also be some difference in the thickness and composition of the stratum corneum among various peoples -- for example, Negroes vis-a-vis Caucasians.

## 2. To the Bloodstream.

Most of the previously discussed studies of time and rate of penetration considered the stratum corneum and epidermis only. If the site of action of the "carried" drug is the epidermis -- fine, all of the major factors have been considered. But drugs which have the brain or body organs other than the skin as sites of action must go not only through the stratum corneum, but also through the remainder of the epidermis and then a portion of the dermis before they reach the bloodstream which can transport them.

This is where may fall down.

studied the influence on dermal clearance (the time required for the circulation to remove injected substances from the dermis). Fluorescein, a fluorescent dye, was injected intradermally -- 0.1 ml in saline, and in 25%, 50% and 75% solutions. The clearance time for the control (in saline) was 1.8 hours and the times for the solutions were 3, 5.5 and 18 hours, respectively.

The effects on dermal permeability were studied by measuring the penetration rate of 1% aqueous fluorescein through abdominal skin which had been stripped of its epidermis. The results are summarized in the table below.

## TABLE I DERMAL PENETRATION RATES OF VARIOUS

# Penetration rate, in µg/cm²/hr. 79.6 17.5 1.3 0.6

In the case of seems to inhibit or retard passage through the dermis. offers no theory or hypothesis to account for this, stating simply that "the diffusivity of connective tissue was probably being depressed One qualification, however, is applied to the intact skin would probably not attain such high concentrations in the dermis as were used in these experiments, so that dermal clearance

and permeability probably would not be retarded as much in normal use as was observed under the experimental conditions.

For incapacitating agents which act on the brain, the most important consideration is not how fast penetrates the horny layer, but how quickly it, or a drug administered reaches the bloodstream.

using tagged given dermally, found traces of radioactivity in blood drawn as early as five minutes was applied, but the level did not reach a maximum until 4-6 hours later, reaching a plateau where it remained for some time.

One other published experiment, which gives times and blood concentrations for humans, showed one hour after admintistration, but the peak level (approximately twice the one hour level) was not attained until four to eight hours after administration.

These two experiments

| It can be seen that a measurable may penetrate to the bloodstream in as little as five minutes.

Whether or not chemicals "carried" by | can enter as rapidly would have to be determined experimentally. Other substances may or may not reach the bloodstream this quickly, depending on several factors such as molecular weight, configuration, solubility in tissue water and lipids, and reactivity to tissue components. The | in blood keeps building up to a peak which is only reached after several hours; such behavior would not be acceptable for most brain-active incapacitating agents, for a dose powerful enough to incapacitate in five minutes would continue to increase for several hours, with serious and quite possibly fatal results. Unless the therapeutic ratio * of the drug is quite high, safety could not be insured. This, however,

^{*} Ratio between the lethal dose and an effective dose.

which may not be the case. There is a possibility, but only a slight one, that a peak concentration of an incapacitating agent could be reached quickly. In this case, maximum effect of the drug would appear soon after administration and a lower, safer dose could be used; the initial incapacitating dose would be the maximum dose received.

One report, showed apparent worthwhile results in feeding through the skin Such things as glucose, carotene (vitamin A), vitamin B₁₂, and some amino acids were absorbed in fairly significant amounts, as signified by blood levels and weight gain. The blood glucose level was 165% of the initial value within 30 minutes application. The net elevation at that time, which does not account for any glucose which may have already entered the bloodstream and then been metabolized, accounted for about 3% of the dose administered to the skin.

## E. Fate and Metabolism

The metabolic pathways | takes in the body are still relatively unknown:

Gas chromatographic and radioactive tagging techniques | show that

it is excreted as unchanged | and as two metabolic byproducts -- dimethyl

| are excreted |
| in the urine; | leaves the body via the lungs. Fecal elimination is negli-

gible. Urinary excretion accounts for most of the removal as the lungs eliminate only 1-3%.

Most subjects by the dermal or any other route have a characteristic "bad breath" said to resemble

This is caused by the presence of the which appears in the

^{*} A rather special case,

breath soon after administration

and continues for 24 hours

## F. Local Reactions and Toxicity.

applied dermally in the concentration typically is accompanied by transient burning, itching, and erythema (reddening).

Its exothermic reaction with water causes an increase in skin temperature.

In a significant number of cases, may cause whealing. This is assumed to be a result of histamine liberation.

Cerman patients who were given dermally for a 15-minute period per application yielded the following data on skin reactions:

6 - 8% showed no local reaction;

33% had a slight reaction (warmth, itching and erythems);

56% had the "typical" reaction (burning, itching, erythema for

3 - 4 hours, and occasional local urticaria);

2 - 5% had a more severe reaction (dermatitis, urticaria, and occasional vesiculation).

In only about 3.5% was it necessary to discontinue therapy. This was due to the local skin reactions which disappeared upon discontinuation of the treatment. There were sometimes complaints of transient nausea and headache among those | but no serious complications. | The "bad breath" was noticed in most subjects, and 50% or so reported they could "taste" the

In all of the studies done on humans (including over 4000 individuals in one of the studies). In o serious side effects have been noted. The temporary effects were those noted above, and no permanent changes or damage have been reported.

tested sensitivity of the conjunctiva * to drops of

Two drops caused only temporary stinging and burning, and, in some cases,

^{*} The membrane covering the anterior eye and the inner surface of the eyelids.

mild injection (congestion) of the conjunctival vessels. These effects soon disappeared.

if dropped onto the eardrum, may be painful, but will cause no long-lasting or permanent damage.

was withdrawn as a clinical drug in the United States in 1965 by the Food and Drug Administration because of reported lens changes in dogs which had been given up to 5 grams per kilogram

The FDA has subsequently allowed resumption of clinical testing.

There was fairly extensive in humans in this country before the FDA ban, has been available as a prescription drug

No evidence of any human eye toxicity due to has been observed even in the highest experimental doses given (1 g/kg per day for 12 weeks in one study, 30 g per day for up to 21 months in another). Rhesus monkeys have been given 1 - 3 ml of per kg orally or 1, 3, or 9 ml/kg dermally daily for periods of up to 18 months and no toxicologic or pathologic changes have been seen, other than skin reactions. Monkeys have been given intravenous dos as high as 4g/kg with no deaths.

No estimates of an  ${\rm LD}_{50}^{-*}$  have been made for monkey or man, but in view of the high experimental doses that have been given already, the  ${\rm LD}_{50}$  would be far higher than any dose which would be given for purposes of "carrying" an incapacitant.

Substances given in combination however, may result in an altered toxicity. reported an interaction between alcohol in 1967. He claims to have found increased rates of mortality in rats given

^{*} The dose lethal to 50% of those to whom it is administered.

high doses after previously having been injected with alcohol.

He also said he found more psychomotor impairment in humans given alcohol (orally) and (via the skin) than would be expected from alcohol alone. This interaction should be investigated further is to be considered for use in incapacitation since there could be complications if the were used on drunken subjects.

Interactions between various drugs other than alcohol | should also be investigated further. One group of investigators found that | increased the toxicity (as reflected by a change in the LD₅₀) | administered orally to rats by a factor of up to six times.

Thus, there is a possibility | could facilitate the body's absorption of drugs from such sites as the gastrointestinal tract. Such facilitated absorption could conceivably cause an otherwise safe dose of a drug to become a serious or possibly fatal dose when given }

It can be seen, on the basis of the fairly extensive work which has been done, applied externally in small quantities can be expected to have temporary, local effects causing some annoyance and discomfort, but no long-term or permanent damage. Whether or not this would be true of

mixed with a given chemical agent would depend upon the nature of the chemical and how it acts in conjunction

| Such knowledge would have to be established by experimentation, using the specific chemical agents to be considered. It would be quite desirable to have further data on the interaction of alcohol

| as well as any other drugs which potential subjects might take before or /administration.

## G. Physiological Conclusions.

For use as a "carrying" agent for incapacitants, would have to be used in fairly high concentrations, probably To assure useful speed of penetration and to ensure penetration it would have to be applied in volume, perhaps one ml or more, as shown by various investigators.

can fairly well be ruled out as a means of quick delivery for psychotropic agents, or any other agent with the internal organs as a target. The chances are very good that any agent delivered would not reach peak blood levels for several hours. For a drug to be effective quickly (say, reaching the blood in significant amounts in five minutes) it would have to be administered as quite a large dose. This is because, so far as is known, only a small percentage of the administered dose will reach the circulation in that initial five minute period.

There are too many variables to be certain of the fraction of the delivered dose which is likely to reach the target organ. This is especially critical for dosages of the psychotropic drugs. Whether all the material lands on the skin, how much remains in contact with the skin, how calloused or "tender" the subject's skin may be -- all may affect dosage and absorption. Such possible factors as individual variation \ \"penetrability" and possible insensitivity to the "carried" agent also enter in. All these factors would tend to eliminate most "brain-active" agents from consideration because of their relatively low therapeutic ratio.

Incapacitation by somatic preoccupation is a major remaining area. Intense itching or burning can be quite incapacitating. Applied in the conventional manner, skin irritants such as itching powder can be removed by washing.

could cause the skin irritant to penetrate into the skin, where a reservoir could be formed. Once within the skin, washing and rinsing could not remove them and might actually increase the irritation. Several hours of intense itching or other irritation could ensue. Quite possibly agents could be found which would penetrate the stratum corneum and go no further, eliminating the danger of overdosage which is such a distinct possiblity when psychotropic agents are used.

## IV. Other System Factors

One factor to be considered is the relatively

For use at cool temperatures, this would either have to be changed to a lower value by some means or would have to be heated prior to use.

Delivery could be made fairly simple. Used against individuals at close range, the could be delivered by a simple water pistol type device. For longer ranges, the mixture could be loaded into capsules that would break on contact after being thrown or fired from a gun.

The person who receives

of it. | itself has a noticeable odor, which could be masked with perfumes, but probably not removed. Soon after administration

| local reactions would appear -- burning, itching, and the like. Finally, subjects would be aware of having been sprayed or squirted with a liquid. For these reasons, it is highly doubtful | could be administered surreptitiously.

Ordinarily, when an individual is squirted or sprayed with a liquid, the usual reaction is to wipe it off his skin. Since the takes a finite time to penetrate -- several minutes at least -- much of the administered material would probably be removed well before it had any time to penetrate. This is a fairly strong argument against applying

to exposed skin areas, although wiping may have some effect of "rubbing it in" and spreading it.

These objections can be overcome by applying the to the clothing. The person receiving this solution on his clothing would be aware of it, but clothing removal would normally be too drastic an evasive measure to take, unless the nature of the liquid and the consequences of non-removal were known to the subject. If the liquid were applied to the

pants (or skirt), clothing removal would be especially unlikely, for psychological reasons. | wetting the clothing would be in contact with the skin, possibly for a long enough period of time to allow penetration or partial penetration before the reaction to the burning and itching would be strong enough to motivate clothing removal. By then, such evasive tactics could be too late.

were sprayed on the clothing, the genital area would be an ideal target, since the scrotal and genital skin is likely to be more "permeable" to than skin in most other areas of the body. Various psychological factors would enter in here also.

to the clothing would probably not work in situations where the clothing was already wet, as by rain, by firehoses, etc. This could be a potential countermeasure -- hosing oneself down. Use of rain gear could also serve to protect the subjects

The problems of storage and shelflife could be important; these factors would have to be investigated for the various incapacitating agents both individually and in conjunction

#### V. Recommendations

	V. Rec	Ollinications
A. The		sychotropic or other incapacitants which
		them to their target organs can, in all
		capacitation is desired. There is a
chance that an en		d be found which would penetrate the
stratum corneun	a and th	nen go into the bloodstream faster than
buts	uch a chance seem	s remote.
В.	should be c	onsidered as a possible vehicle for "implan
tation" of skin in	ritants. Studies s	hould be made with various irritants, chec
		of action and effectiveness.
C. con	nes into active con	sideration as a vehicle for skin irritants,
several other op	erational characte	ristics should be determined by direct
investigation.		
1. Studies	absorptio	on through different types of clothing .
	*	erials cotton, leather, synthetics
		effects of several layers of clothing, loose
ys. tightfitting g		
	•	
2. Investig	ation of the suspec	ted interaction
		o to be considered are possible interac-
tions		gs which a subject may have taken prior
to or subsequent	` 7	
the are a measurable and a service	, 1	
3. Storage	and shelflife	and various agents should be inves-
tigated.		11
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APPRAISAL OF TWO REPORTS ON MATHEMATICAL ANALYSES
OF HEAD INJURY

31 January 1972

(193)

## APPRAISAL OF TWO REPORTS ON MATHEMATICAL ANALYSES OF HEAD INJURY

Two papers concerned with mathematical modeling of head injury dynamics have been submitted for biomedical appraisal. 1, 2 Both reports define mathematical models of pressure-acceleration dynamics inside the skull during impact events by assuming that:

- (I) The skull is a thin, isotropic, homogenous, elastic, spherical shell.
  - (2) The brain is an ideal compressible fluid.
  - (3) All impact loading is axisymmetric.

Reference I considers the cavitation hypothesis of brain damage for head impact, and assumes a specific impacting load in addition to appropriate constants to define the primary assumptions noted above. The evolved model uses extensional shell theory and coupled differential equations solved by finite difference techniques to define the time-variable pressure field inside the shell. The authors feel that their model supports the cavitation hypothesis because the model indicates transient zones of negative pressure at the impact pole and the opposite (contrecoup) pole at different times after the start of impact. The authors acknowledge that their work does not verify the cavitation hypothesis and does not rule out other mechanisms of brain damage from non-penetrating impact.

Reference 2 considers the pressure effects of various impacting force waveforms in relation to the previously proposed General Motors' Severity Index. The Severity Index is an nth power of impact acceleration, or force, integrated with respect to time for the duration of impact. Brief positive pulses of impact force in square, triangular, half sine and eccentric waveforms were defined so as to have identical Severity Index values, indicating that all the pulses had roughly similar products of average amplitude times duration.

The four pulses were used as inputs to the mathematic model described above, and the model showed that the pressure dynamics of the physical system would be "nearly the same" for all pulses tested. From this finding, the authors conclude, "These results indicate that the General Motors' Severity Index is a useful means of determining the severity of vastly different pulses applied to linear systems." The authors go on to caution, however, that "these results do not necessarily indicate that the Severity Index is a valid means of predicting the hazard or injury potential of different pulses. An evaluation such as that must be accomplished by further experimentation and clinical investigations . . ."

### Comments

- 1. The two papers appear to be ingenious examples of analytical modeling technique applied to the complex dynamics of fluid filled spherical shells subjected to impact.
- 2. Reference 1 shows that, under the assumed conditions, transient negative pressures will occur at both the impact and contrecoup poles of the impacted shell.
- 3. Reference 2 shows that, under the assumed conditions, similar impact forces (differing mainly in waveform) selected to have identical General Motors' Severity Indices will cause similar dynamic pressure patterns.
- 4. It is unfortunate that neither report mentions the detailed results of Lindgren who measured the dynamic pressure patterns of fluid filled spheres and human cadaver heads subjected to impact. Lindgren recorded negative pressures at both the contrecoup and impact poles, as well as similar pressure patterns arising from similar impact forces.
- 5. With regard to the concussion threshold problem, it would be extremely interesting to see the powerful analytic techniques of Reference 1 and 2 used in a retrospective search for a useful common denominator in a large number of the published investigations on experimental concussion.

#### REFERENCES

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- Benedict, J. V. and Lin, D. J., "Analytical Investigation of the General Motors' Severity Index," ASME Publication 71-WA/ BHF-6, American Society of Mechanical Engineers, New York, 1971. (UNCL)
- 3. Gadd, C. W., "Use of a Weighted-Impulse Criterion for Estimating Injury Hazard," in Proceedings of the Tenth Stapp Car Crash Conference, Society of Automotive Engineers, New York, 1966, pp 95-100. (UNCL)
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## ACCOMPLISHMENTS

#### MINOR

## (Primarily in a support capacity)

- 1. Advised of a method for tagging to permit tracing clandestine transport routes. Method now operational.
- 2. In cooperation with \obtained \hardware and electronic gear from derelict \hardware initiated analysis in agency
- 3. Discovered portable water filtration units effective to 10 microns in cooperation with ... Units now being evaluated by \(\) for field use.
- 4. Participated in development of whose function does not deteriorate upon direct exposure to water, salt water, silt, mud, aquatic vegetation, etc., for use by / personnel.
- 5. Assistance given to Division in helping establish biological parameters and limitations on exposure of man to microwaves in air.
- 6. Discovered a material completely impervious to water, saline, and body fluids. This material has been brought to the attention of electronics groups.
- 7. Assisted in identification of analogue data from
- 8. Identified a compound which in contact with air which has potential utility in signalling devices of interest to
- 9. Have identified specific drugs ) for elements of
- 10. Participated in evaluation of eye damage from exposure to supplied facilities and personnel to perform this evaluation.
- 11. Participated in development of a guidance system with personnel of utilizing a

During the period 1963-1968, numerous research and development programs were undertaken in support of the Agency's interest and requirements. The diversity of programs reflected the multi-discipline character of biological sciences as well as the "common use" application of the research and development product. The following program briefs represent the major programs and achievements of the R&D effort during the 1963-1968 era.

## ANIMAL STUDIES

The state-of-the-art of remotely controlling animal behavior resided within the animal behavior studies was funded by the Division. The feasibility for remote guidance of animals in the free environment was demonstrated in 1965 using a as the guidance cue. This as the subject and an. achievement prompted a more intensive investigation of other animal guidance system was species. In the period 1966 to 1968, techniques. In late 1968, the program developed using was advanced to the operational and engineering development phase. One of the more notable achievements of the animal studies was the demonstration in 1968 that the homing behavior of environment. Coupled to controlled and maintained in an all animal guidance programs was the successful training of behavior necessary to emplace, deliver and/or retrieve as well as the development of the hardware and logistics subsystems phase. necessary to support the



## SUMMARY

BIOMOD is an operational system specifically designed to make it convenient for unsophisticated computer users to study models of dynamic systems. The system features a high degree of interaction, user-oriented model-definition languages, and flexible, in-depth model structuring. It employs a graphics console comprising a television screen, a data tablet, and a keyboard.

A BIOMOD user may represent a model by drawing block diagrams and handprinting or typing text; he receives immediate feedback about the system's interpretation of his actions. Each component of a model block diagram may be defined by another block diagram; this facilitates organizing models into meaningful substructures. A user ultimately defines each component block by analog-computer-like elements, algebraic, differential, or chemical equations, and/or Fortran statements. A modeler may thus define his model in whatever terminology is meaningful to him. Displayed curves are continually and automatically updated during model simulation. A user may stop the simulation and plot different variables, change scales, or alter parameter values, and then either continue simulating or revise the description of his model.

This report demonstrates BIOMOD by presenting a scenario of how a user might describe and simulate a drug-effect model, briefly describes the system implementation, and discusses experience with users.

## II. A MODEL FOR EVALUATING DRUG ADMINISTRATION POLICIES

Medications and their prescribed dosages are designed to maintain a critical amount of drug in the blood for a specified period of time. The conventional method for determining optimal dosages involves numerous laboratory experiments. If the drug effects can be modeled, however, a more efficient method is to experiment by running computer simulations.

One technique for maintaining the prescribed amount of drug is to use a capsule containing a large number of differently coated pellets. The pellets dissolve at different times, so that, as drug leaves the blood, it is replaced by drug released by newly dissolved pellets. Garrett and Lambert [8] have proposed the following model to describe this situation. A capsule comprises a number of pellet populations with different mean times of release. The rate of drug release for each population is assumed to be normally distributed (with the same standard deviation for each population) about the mean time of release for that population. The rate of adding drug to the body is therefore specified by a sum of normal distributions. The transfer of drug through the body is described by

$$\operatorname{drug} \longrightarrow \operatorname{GI} \xrightarrow{k_{\operatorname{GI}}, B} \operatorname{B} \xrightarrow{k_{\operatorname{B}}, U} \operatorname{U}$$

where GI refers to the gastrointestinal tract, B to the blood, and U to the urine and other excretory parts of the body; this means that drug flows from GI to B at rate  $k_{GI,B}$  and from B to U at rate  $k_{B,U}$ . Thus, for example,

$$dD_B/dt = k_{GI,B} D_{GI} - k_{B,U} D_B$$

where D_B is the amount of drug in B, and D_{GI} the amount of drug in GI.

Given this description together with the requisite parameter

values, BIOMOD can be used to simulate the model. Note that the following dialogue describes only one of many possible ways of reaching the same goal, and that BIOMOD does not force the user to take action in

When using BIOMOD, we communicate via a data tablet pen and a keyboard. The pen's location on the tablet is always indicated by a dot displayed in the corresponding location on the television screen. BIOMOD's interpretation of user pen actions depends on where the pen is placed and on what is currently displayed on the screen. We may handprint characters in most areas. As we write, a displayed "ink" track appears to flow from the pen; each time we complete a character, its track is replaced by a stylized character. We can change a character by writing another over it. Some symbols are used for editing; for example, we may use a caret to insert text, or we may scrub with the pen to delete text. Some areas displayed on the screen act as pushbuttons; if we "push" one of these (by touching the pen down), the system performs the indicated action. If we push a displayed arrow, a continuous action takes place, such as the rescaling of a set of curves. Some figures can be "dragged"; if we "touch" one of these and move the pen, the displayed figure follows the pen's motion. We may type (with the keyboard) in any area where writing is possible. The keyboard cursor may be positioned either with the pen or with keyboard control keys.

To create our model, we enter our identification, name our model DRUGS, then begin constructing the model. Because it has two major components, we first draw two rectangles; these are replaced by stylized function boxes. We write CAPSULE in one box and names of parts of the body in the other box, and then draw a flowline to connect them. This diagram (Fig. 2) provides not only a picture of our model, but also a means of defining the two components of the model separately.

To define the capsule component, we first push the DEFN button on its box. The system replaces the block diagram with a list of languages that we may choose from to define the component. The languages are block diagrams, mathematical equations, chemical equations, and Fortran statements. We choose block diagrams so that we can define the capsule as a set of boxes, each representing a pellet population. This ability to define a box by another block diagram enables us to organize a model as a hierarchical collection of a number of components at different levels. We draw four boxes and write PILL on the top line

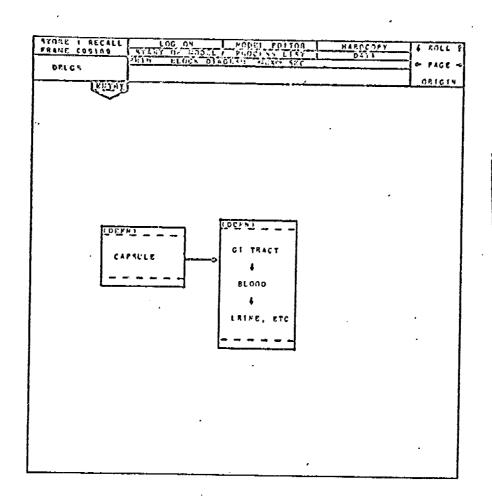


Fig. 2 - The DRUGS model block diagram

of each to represent four pellet populations. We name a function box in this way whenever we anticipate using the same function repeatedly.

Because each population is defined by a normal distribution, we indicate that we want to define the PILL function with mathematical equations. BIOMOD responds by displaying a form for writing algebraic and differential equations. We assume that the probability of a pellet dissolving in an interval about time t is given by the probability density function

$$p = \frac{1}{\sigma \sqrt{2\pi}} e^{-(t-m)^2/2\sigma^2}$$

Using this function to approximate the drug release rate by a deterministic variable, we write

$$P = 1/(SIGMA*SQRT(2*PI))*EXP(-(TIME-MEAN)**2/(2*SIGMA**2)$$

The system analyzes this statement and immediately responds with the message

### UNBALANCED PARENTHESES

We then add a closing parenthesis to correct the statement. We also realize that we should parameterize the amount of drug released by each pellet population, so we insert DOSAGE after the equals sign and scrub the 1. The display now appears as in Fig. 3.

BIOMOD has generated separate lists of the defined and undefined variables; TIME does not appear because it is always the simulation independent variable. These lists enable us to indicate which variables have different meanings or values each time we use the function. We indicate that the names (and therefore the values) of PI, SIGMA, and DOSAGE are the same each time we use the PILL function. This is because PI is a constant, and because we assume that the standard deviation and dosage amount are the same for each population. On the other hand, we indicate that MEAN may have a different value for each pellet population.

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Fig. 3 — The definition of a pellet population

Now that we have defined the PILL function, we are ready to use it to define the individual populations. We push a button to get back to our diagram of the four PILL boxes, then push the DEFN button on one of these. Because PILL is now defined, BIOMOD displays

P +

MEAN +

PI + PI

SIGMA + SIGMA

DOSAGE + DOSAGE

for us to provide the names of the output and mean of this particular population. We write Pl next to P $\rightarrow$ , to name this output Pl, and write Ml next to MEAN  $\leftarrow$ , to name this mean time of release Ml. We similarly establish the correspondence between the names of variables in the other three pellet populations and the names (P and MEAN) used when defining the function PILL.

We can describe the flow of the drug through the body by chemical equations because these are mathematically equivalent to mass transport equations. When we push the DEFN button on the box that describes the body, and select chemical equations, BIOMOD presents an appropriate form. According to our original model description, we would like to write

$$D_{GI} \xrightarrow{k_{GI,B}} D_B \xrightarrow{k_{B,U}} D_U$$

or

$$D_{GI} \stackrel{k_{GI,B}}{\lessdot} D_{B}$$

$$D_{B} = \frac{k_{B,U}}{\sqrt{2}} > D_{U}$$

where 0. indicates that there is no backward flow. BIOMOD requires that we linearize each equation, and write the rate coefficients and equatic.s

S KGIB 0. DGI = DB S KBU 0. DB = DU

Here S (for slow reaction) means that BIOMOD should derive integral equations from our equation. Since the pellets release drug into the gastrointestinal tract, we also write

G

This statement (with G for gain) indicates that the gain of DGI, i.e., the increased rate of change of DGI due to drug entering the body from outside, is equal to the sum of the rates of drug release from the four pellet populations.

The model is now defined except for parameter values. When we indicate that we are ready to provide these values, BIOMOD displays the names of model variables and parameters in two separate lists (Fig. 4). Names such as DGIO indicate initial values; they are derived from the chemical equations by BIOMOD. We enter the values given or implied by Garrett and Lambert. We assume that some drug is immediately released into the gastrointestinal tract and therefore set DGIO to 5; the other drug amounts are initially zero. In order to minimize storage requirements, BIOMOD limits the number of variables whose values are saved during simulation and the number of parameters whose values can be modified during simulation. Since this model is small, we indicate that we want to save values of (and possibly plot) all the variables, and that we might want to modify values of all parameters except PI.

It has taken us less than half an hour to completely describe our model. We now indicate that we would like to simulate it. BIOMOD first produces a CSMP/360 [2] program that describes our model and provides for graphic display of the results. CSMP, in turn, generates a Fortran program, which is compiled and linked with other programs required to run the simulation. If an error is detected at one of these steps, program listings and error messages are displayed on the screen; otherwise, our easy minerages of the insermificte steps is via displayed

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Fig. 4—The model variables and parameters

messages. The time required for the translation depends on the load on the (multiprogrammed) computer; generally it is about three minutes.

Our DRUGS model translates successfully, so the form shown in Fig. 5 is displayed on the screen. As in the other forms, software pushbuttons appear across the top. The central area is for selecting numerical integration methods, modifying parameter values, examining variable names and values, or plotting graphs. The areas to the left and below the central area are for specifying the y and x axes of the graphs.

We expect the values of our model variables to change smoothly and over several units to TIME, so we choose a simple integration method--Simpson's method with step-size = 0.1. This is a fixed step-size method, so the information regarding variable step-sizes disappears. Before studying how to use a multi-pellet capsule, we want to ensure proper model behavior when there is initially some drug in the gastrointestinal tract, but no capsule. To eliminate the capsule drug we push the PARAMETERS button to display the list of modifiable parameters in the central area, then overwrite the value of DOSAGE, changing it to 0. Next we display the list of plottable variables. Because we are most interested in the amount of drug in the gastrointestinal tract, blood, and urine, we drag the names DGI, DB, and DU to the y axis. We want to watch the model for several simulated hours, so we change the upper range of TIME (in the small box at the lower right of the central area) from 1. to 7. We push PLUT; now we are ready to plot DGI, DB, and DU from 0. to 1. against TIME from 0. to 7. hours.

We push RESTART and the simulation begins running. We see (from the curves) that DB, and later DU, are being generated; the "NOW X = "number changes continuously to indicate the current value of simulated TIME. Because EGI is plotted off scale along the upper boundary, we touch the pen down to stop the simulation. In order to determine the range of DGI, we return to the display that lists the variables along with their current, minimum, and maximum values. The maximum value of DGI is 5. (its initial value), so we write 5 over the 1 that specifies the upper y-axis value, then redisplay the curves. The curves are now nicely scaled. We continue the simulation, then stop it then we see that nearly all the drug has entered the upine, and values are changing

slowly. We assume, from the curve's reasonable appearance (Fig. 6), that we described at least the body component of the model correctly, and our choice of integration method is adequate. We see from the curve labeled D3 that, as expected, the drug remains in the blood for only a short time.

We reintroduce the capsule drug by changing DOSAGE back to 3., then restart the simulation and watch the curves being continuously updated as it runs. Once it becomes apparent that the capsule is not effective, i.e., that the value of DB drops too low, we stop the simulation. Apparently (Fig. 7), the drug is not released from the pellets in time to replace the drug that leaves the blood. To correct this, we change the mean times of release from 2., 4., 6., and 8. to 1., 2., 3., and 4. We then rerun the simulation and get much better results. The amount of drug in the blood should be greater than 2.5. In order to determine if this is achieved, we place the pen down in the central area to establish an x-y meter, then drag this meter to a place where Y (corresponding to DB-as well as DGI and DU) is equal to 2.5 (Fig. 8). Our choice of means was good, but they need to be adjusted to maximize the total duration of capsule effectiveness.

While changing the means for further trials we realize that rather than controlling four means, we would prefer to deal only with the first mean and the interval between mean times of release. To reformulate the model in this way, we return to its description and add another box to the definition of the capsule component. In this box we write

#### M2 = M1 + INTVAL

and similar equations for M3 and M4. This replaces the parameters M2, M3, and M4 with the single parameter INTVAL, which we set to 1. and mark modifiable. Once this is accomplished, we retranslate the model, then continue to resimulate it and change parameters until we have established a satisfactory drug formulation and administration policy.

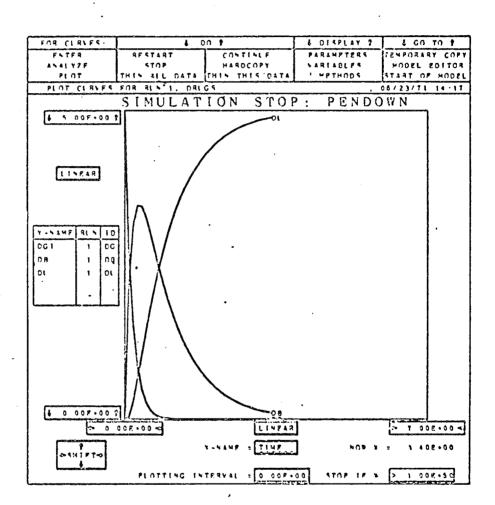


Fig. 6—The simulation run with no capsule drug

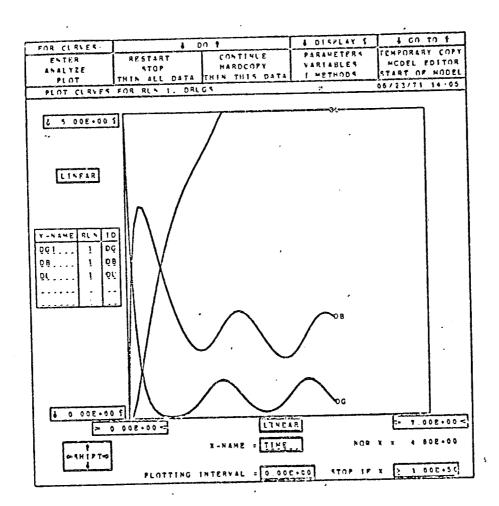


Fig.7—The simulation run with the parameter values shown in Fig.4

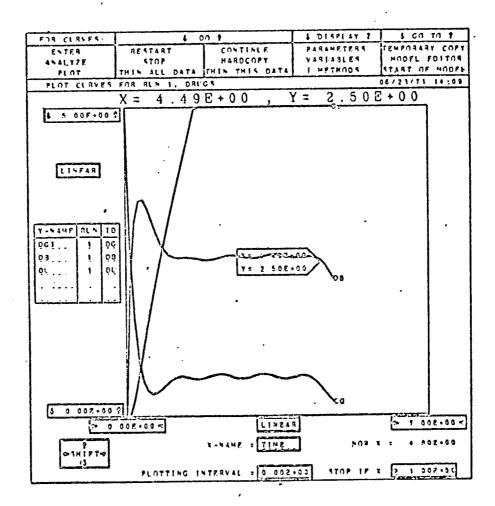


Fig. 8—The simulation run with means = 1., 2., 3., and 4.

### AUTICHORE

A-A Report of Trip by from 1 Harch to 11 Harch 1953

1518

I. The Proposal

The best method of financing the project, requirements for supplies and equipment and an overall estimate of costs were to be estimated.

II. Provious Investigation

on 13 and 19 December 1912, indicated that
the would furnish natural cover and that
was
willing to co-operate in such a project. The present trip was to
investigate theroughly the feasibility of such a research project.

for an AUTICUALE project.

is a fully-cleared consultant to the Agency so that possible programs and approaches could be fully discussed with him, but could not be discussed with other individuals who would be concerned if such a program were activated.

In order that the reader may get a letter picture of what possibilities for research exist in the area of the following outline is presented. Attached is a has been also been also be a letter picture of what the possibilities for research exist in the area of the following outline is presented.

dicated by an asterisk the individuals with whom he is well acquainted.

The various organizations which might be utilized as places for research will be reported giving the purpose of the organization, the population with which they are concerned, the staff organization, the minimum clearance requirements and the pros and cons of using the organization as a location for research.

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. <i>1</i> 9	these are rarely and voluntarily come to the for examination, it is unlikely they would be good subjects for this project. However, the space night be used for other types of Agency research.
CYB	There are full-time psychiatrists on the staff and part-time examining physician. There are psychologists and support staff members
$\mathcal{S}(\cdot)$	
B	it would be assential to clear the and the three members of the concerned with activities. Inastuch as the and cases are referred to the by all the it would be desirable and probably necessary to clear all ten able, if not necessary, to get individually from the either a blanket authority to administer drugs to all cases at the discretion of the or to receive individual authority from case to case. If this were not done, it is possible that the
	damages, etc. even though the subject volunteered for such a research procedure. If the under not previously advised, the entire program might be jeopardized.
••	For the personnel of the itself, is already cleared and it would be necessary to clear others the
•	<b>-3-</b>
•	

psychiatrist, and the doctor who administers the physical and neurological tests, It is not contemplated to use any of the psychologists. In addition, it would be desirable to obtain clearances on the secretary and the of the last would have access to some of the activities.

IV. Discussion of the Pros and Cons

The is ideally situated. It is next to the The clients of the process of the pool subjects for ARTICHOR experimentation. The Director of the pool subjects for worked in the for the last pears, is well-acquainted with all of the officials of connected with the and dealing with lie is also a cleared consultant of the Agency and is willing and even enthusiastic to participate in such a research project.

There is ample space in the ______ to conduct such a research project. ______ can be easily wired for sound recording and the large ______ could be used for the administration of drugs. Teds and toilet facilities would be available if recessary.

On the other hand, there are some difficulties. The conduction of such an experiment would not fit easily into the routine of the - I am assuming that the administration of drugs and subsequent interrogation would require from four to six hours. This would probably have to be done in addition to the routine procedure of the and would probably now the individual would have to be called back for the second visit. Tilmvise, it seems to me escential that a medical man be present during the entire amount of this time. If something untaxard occurred, it possibly would be necessary to hospitaline the individual at and in this event the admitting officer or the admitting physician would have to be told what led up to the existing physical condition. It is possible that someone at the hopital could be cleared but inasmuch as there is a great deal of variation in duty hours for the medies at the Mospital, the situation would be almost impossible to control. Other possible difficulties are that an hearing of such a research project might try to take advantage of it as a means of obtaining ". Again it must be borne in sind that the

and as such ruight be prome to stimulate publicity if they thought it was favorable to or themselves. Should permission be required from the for individual cases, the administration of the project would be difficult. Finally there is the possibility that some might disapprove of the project and though they might not be able to stop the project they might well create difficulties. There are t tof the Which might be useful in conducting ARTICHONN research projects. The is headed by whose title is Issides the there are a fulltime medical officers, one pharmacist and two There are four full-time medical officers who operate entirely outside of the office making home calls on police personnel. The an outpatient clinic in the Police Department "milding, is opinped to perform minor surgery and hendle all types of minor complaints. There is a fully stocked pharmacy. Then haspitalination is necessary, the uses the where they have beds assigned to them. of these are for margery and fifer illness. In the past year they filled an average of thed. these rooms night be utilized for research purposes. bnother department is the is 1.15 arolate in the second assigned including Tolonista am' variona emporta in ' science. The laboratory itself is F and equipped with various apparatus. Taxt to one of the rooms is an excellent In addition, there are in a central root in the of three Thave been with the for over [

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the the library control of these divisions cores under the the three divisions cores under the three three three three three three again, any expenditure of funds would have to be approved by the three and

A research project might be set up with the co-operation of these two departments. The subjects would be who are being For example, over a year ago in the over three hundred were run on the alone in a notice of a few weeks. Currently, there is another case being investigated and any number of the will be the property In certain instances, have been given drugs although this is not publicly admitted. It would be possible to set up a project whereby could be with the use of drugs, drugs and hypnosis or the use of drugs and the . In the event that hospitalization was required, they could be sent to the and use the bods assigned to the perhaps without further clearance with the Mospital. Most cases could sleep evernight if necessary in some of the rooms. The number of cases thus furnished would be variable depending on the number of investigated. Honomor, in thoro are some a month so that pronumably a fairly substantial number of cases could be built up.

`_

and perhaps the _____, but probably would be the only others who would require elemance. The other nonlers of the department would not likely question a research project, particularly if it would assist them in their activities.

it would

If a project were initiated in the

be necessary to secure the permission of the

Wi. Discussion of Pros and Gons

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The advantages of the are that they have adequate space, they have medical men attached to the staff and could conduct experimentation under controlled conditions. Foth are very much interested in the field of and would probably led interested in participating in such a research project as it would assist them in their day to day activities. They have the advantage of being able to sleep people evernight if this is necessary and have a current arrangement with the for admitting which could be utilized in handling some cases which might be required.

if for no other reason. The conduction of the experiments would be secure and there would be no necessity for publicity. Any nevers physical reactions could be treated in the hospital and even if a death occurred, it is not likely that it would create a perious crisis. Experimentation with different drugs and various desages of drugs could be tried out here as physicians are always available and the time of the subjects is . Namy of the of this have passed through the in consequently, information about the subjects would be available from an independent source.

After sufficient experience is gained from the use of a drug, it might then be used in a more open situation and perhaps administered surreptitiously. Experiments using hypnosis and drugs could also be more readily conducted in the

IX.

This Hospital, located in , is a mental institution for the insone and in recent years has house non-psychotic, psychopatha. is about The Hospital has bods a ron and woman. Of these, bods and the current population in == are psychotics psychopaths. There are full-time psychiatrists including the superintendent. There are no other full-time physicians or interns on the staff. Local physicians are available on a contract basis for medical and surgical use. The superintendent, who is well known by Administratively, the Hospital comes unlar the direction of the , who is appointed by the ATTY work conducted in this institution would probably require the clearance of the

#### The Pros and Cons

The advantages of doing work in this institution is that a conbination of psychotic and non-psychotic patients would be available. psychopaths have passed through Practically all of the and independent information usuald be available 7 et the T on them. Some of the other patients will have likewise gone through The staff of this hospital is very small the and it is likely that they would welcome such an experiment inasanch as they are able to do practically nothing with the psychiopaths and psychopaths would make good subjects for our purposes. (With the psychotics and psychopaths, it is likely the authorities would be more willing to permit experimentation with drugs.)

The disadvantages of this institution are that any work conducted there would probably have to be done by personnel furnished by the would make difficult the project. Again, the distances from participation of consultants there. It may be felt that the number of non-psychotics will not furnish enough material for our purposes.

which was converted is a nouro-psychiatric hospital. was one of the; men to start this institution and he still retains one work with possibly to done here. This has the men to start this institution and he still retains advantage of being a granization where no other approval would be required. The difficulty in this instance would be obtaining subjects. They would probably have to be volunteers who could come to the and perhaps stay overnight.

## XII. Other Institutions

Other institutions were considered as possible locations for research programs but were rejected after therough discussion. the These included the of the the tho

and several hospitals.

and in particular the smuch be considered because if any work is done in in the the facilities of the will likely be required. operated under the administration of the. which controls all It likwise has charge of ಇಕಿರ. is responsible to the Tarki the of the Foard appointed by the same There is also a riade un of prominent citizens who are appointed without pay and serve in an advisory capacity. is in charge of Medical Corvices and has administrative of the Penro-Psychiatric Drauch of the Pospital. If the facilities are used, it may be necessary to obtain as well as in the Hosclearances of someone in the nital.

Considerable thought was given to the problem of cover and to the method of financing such a research project. The following or spanizations and institutions are mentioned because they might be involved in the arranging of the financing of such experimentation:

The is a organisation founded by the late the owner of the well known, presently heads the possible to use this organisation for the granting of a fund for the project. The actual advance of money might be from the -10-

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Agency but directed Urrough this . It may be possible that would make a direct grant ofter booting of such a project. If this organization were used, it would be necessary to clear end originally suggested that a remarch (reject might be initiated Wrom of the organization. Tre 💄 ກາວ 🖰 of the L'io of the Tor <u>Psychiatry</u>, who is likeof the Usychiatric barvior at the Todayisa of the responsibilities -Mirestor of the Fours-Chyclatetic Drimeh of the he has bed close relations with the suggested as a possible consoring agency for the reservoir eroject behas recoloud mants from many ordinations to e migrijes - filogy T carry on remark projects and is on the charge time they nor all a combact truy anomated restaired two prais, it furnishos a very cont cover for rich a program of the Also, has someth comboding the the the thought very wall. Franciably, much a progressional care under department and other participants selected by the Account would work with him. The The , is adject to the - 'ccordingly, a recovely rroject unler. I in the would be ideally loomied for Amendy consultants. There are several disadvantages in alterating to set up a research program through or any other. The administration of funds would reconstrain no through the usual channels. It would be difficult to obtain " it control of the conduct of the emericantation. Throrous intividuals in the University would have to be given at least some inferiotion about the nature of the recented. Were to always the receivedity of some numbers of the lengthing interested in the project who night not be -11-

# M. Pirect Nothods of Chonsorship

It is possible that a research program could be conducted directly by personnel recruited by the Agency. For example, it might be feasible and plausible that receive a grant to conduct research in the field of in which they are all interested. They in turn could use their departments to conduct research and convince their superiors that it would not interfere with their usual routine. This method has the advantage of the Agency retaining also dute control over the direction and supervision of the project. It is also possible that the above named individuals or others might be given grants singly and carry on simultaneous projects at different locations.

### XII. General Discussion

For ARTICHORS research purposes, a place is needed for extensive experimentation with various drugs to determine effectiveness, desages, possible side effects, methods of administration, etc.

The best place in for such experimentation would be would be the second choice.

After certain drigs are selected for effectiveness, ease of administration and patient acceptability, the offers good research possibilities. In exactning actual field conditions are approached. Tost will have unsavory backgrounds, one or more will be and the others will be and the discovered, the must find acceptable independently of the for presentation in . If are selected, there will be little conplaint on the part of the citizenry if it becomes known drugs were given.

罗马马德兰 医牙孔囊 建物层外部线线线线线线线

facilities could best be utilized for research using drugs and the or perhaps drigs and hypnosis. Progs that could be given surreptitionally would be preferable. The would not be ideal for more extensive use of drugs because of the number of people who would have to be cleared, because all of the subjects (we thist after t side effects could not be easily newled, etc. respla coming into the , not for the furnise of determining I but as a mothed of probing their continual conplaces. He does not require any additional additional to de Ude and in some instances be'is even directed by the line attinister Simila for the purpose of determining is known as concentrat of our "export" in the recent field it would be nore natural for the to do reserved in that Rield. Takewise, he could do this without all of the "cut in". Setting up any research project involving will require long and complicated procedures, particularly if there are deminds of clearance on some individuals who may be only incidental to the program. In fact, anthoigated difficulties in some of the implibutions are so great that their usefulness teconer quantionally. Tottley and such a project Unough the margines of jeluo offers many obstacles. In light of bais, I recommend that if possible a direct and simila natival of sponsorable to utilized. I believe that it is plausille that a fire our Dund organization such as the could grant research namey to on i dividual or a group of individuals to do reserved in the concret field off cluding the use of drugs. If singly or as a troup, were given such funds, they in turn could obtain permission from their superiors to engled percent in their departments morely using the cover story and not discussing the intorest of the Vymey in such a program. Is producet citizens, id whitfied with the field of I holiove that tray could approach the officials of the lin i'm sam nann r ad obtain the facilities of) - " factitations without discussing their ultilate purposes. I undoughout, clorumous has been inquisted for ! I reconvered that the elements of the he the held in With food and are cleared, a conference could be arranged

cither in or in deshington to get their definite reactions to such a proposal. If they concurred in such a plan, then steps could be initiated to obtain clearances for proposal if this fund organization is to be used, and any others considered necessary. If this plan is followed, it will be possible to actually determine whether a research program can be conducted at the or other inject should be set up so that it will furnish the Arency as much central as possible, require the clearance of a finitum number of people and occasion little or no publicity.

# EXII. Costs

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Determination of cost could not be made as this would vary greatly depending on where or what research projects were set up. A cursory investigation and discussion on the subject of cost, however indicates the greatest expense will be fees to be paid to consultants co-operating in the program. Fest of the equipment is available at the various suggested installations. Other equipment and supplies could be furnished by the Agency. More a definite program is accepted, a more exact determination of cost can be acceptained.

# Office Memorandum · UNITED STATES GOVERNMENT

то : .4 from :	Chinf, Technical Franch	DATE:	17 April 1	.953
•	Recommendation Regarding Experimental Prog	ram in 🚾 🍌		

B

1. Following the meeting of 16 April 1993 on the ARTICHORE project, the following recommendations are submitted on the experimental program in

(1) After the clearance of

is obtained, contact

definitely ascertain whether they are interested in working on a project in which the Agency is interested if mutually satisfactory terms of definite research objectives and payment, etc. are arranged. I am morally certain that these two individuals will be interested in such a project as their general interests have been determined and they are definitely interested in this particular area.

- (3) After this discussion, a meeting should be held in abshington to determine whether the agency approved the proposals and recommendations made by the undersigned and the three prospective consultants. If this approval is forthcoming as I assume it will.
- (b) then the next steps can be believe to make these weemle Agency consultants.
- (h) Assuming that the three aforementioned people become consultants of the Arency, a most include authorise of the Arency, a most include the authorised either in a paramington to set up tentalized research plans. At this time, decisions can be made

as to what draws will be initially investigated, what institution will be authorized for subjects, what other procedures will be undertaken, etc. Also at this time a more definite determination will be made as to what future number of individuals will have to be cleared or will be involved in the research project for the following six months. At this meeting too both short-term and long-range research plans can be definitely agreed upon.

(5) Following the meeting in Mashington or — of all the parties who will initially institute research activities, the necessary people carrying on the work in Mashington and the initial phases of the research begins, the undersigned can assist and stimulate in starting the research procedures and lay plans and take action for future activities.

ς.

R/10, 7, 77, 1

16 February 1953

DATE:

Debuty Security Officer :AIV Chiof, Security Research Staff, IAS VIA: Chief, Technical Pranch, SRS, I&S FROII: . Summary of. Report on ARTICHOKE by SUPJECT: dated 2 February 1953) The writer has made a very careful study and analysis of the report on the ARTICHOKE problem. In general, the writer agrees group but wishes to in the overall statements set out by the report that are subject to point out certain elements in the dispute and tend to indicate that the group has not been totally informed as to the nature of ARTICHOKE or the present status of the ARTI-CHOKE work insofar as one Tochnical Evanch is concerned. group continually stresses long-range emperi-(1)The mentation, particularly of a psychological and psychiatric nature. The writer agrees with this as a general premise but while conducting this long-range research it appears absolutely essential that we develop, and have ready for instant use, techniques, etc. that will or at least well assist in obtaining information in vital cases. The writer believes that involved, complex, and cumbersome research such as carried on at ___ will not be productive (cortainly in the immediate ... future) and is unrealistic and will not be of use to the

operations people when it is needed.

Security Officer

TO:

discusses the use of various chemical agents.

While in a general sense is accurate, it does not specifically tet to the core of the problem. The writer assumes that the group is familiar with most of the techniques but

it is possible that has never considered or possibly never heard of it some. The writer believes that the

individual talk at great length on pertinent matters while there is nothing in their report to indicate the extreme value of a chemical agent if it will produce only one small bit of verifiable information. The comments that individuals when they realize they are drugged tend to become taciturn is not accurate. Individuals may become taciturned under certain circumstances if they feel that they have been drugged or attempted to be drugged surrepticiously, but one of the established ARTICHOKE techniques is to conceal the fact of the drugging behind a medical cover and then use drugs as a nedical cover treatment in special ceases.

damaging processes and calls them elaborate, impractical, and unnecessary without, it appears, going into specific reasons why these processes might be used. They comment that equivalent results could be accomplished by experts using simple techniques of interrogation. The writer does not agree with this at all and -can cite instances where absolutely new information was turned up using chemicals that was unabailable before the chemicals were

used and where "expert" interrogators had attempted to obtain

- dividuals under hypnosis will not act against their will in repugnant acts of violence and acts of disloyalty. This is a very most question and the writer wishes to point out that there are no tests made that can be regarded as definative in this matter.

  The writer wishes to point out that experts in the field of hypnosis are not agreed on this point and return professors and not does feel that there is a good chance that these things can be accomplished through hypnosis.
- (5) The group comments on methods of combating the ...

  technique and their recommendations in general appear to the writer to be fairly should sound although again tests to support these recommendations would take a great deal of time, money, and effort before anything definative could come of it.
  - made in psychological effects, human behavior, studies of seduction, persuasion, and persistence are, undoubtedly, worthy projects but would be time consuming and results would not be forthcoming for extremely long periods of time.

### RECOID ENDATIONS

2. That is and when the group ever meets as a unit that APTICHOKE Team members be permitted to talk personally to the group members and lay before them specific examples and certain items which possibly the members can give pertinent advice. The writer

(purpositely specifical work) froup has never been thoroughly briefed or feels that the indocrinated in ARTICHOKE'AND THAT their report quite clearly reflects that. 3. The writer cannot agree with the opinion that "little." threat, if any, to National Security exists because of special interrogation techniques or agents." The writer wishes to point out that the only requires one break for the successful compromising of one individual to cause extreme damage to a nation. There are numerous recent classic examples of itals not brush up m the only of ways a men of making individues 1. ies officient, land, lafty a 2. Engine, money permitty

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4. Reninfation - or re-acquition Chank (and particularly action

or alived frame worshing "-) ..

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TO:
VIA: Deputy Ecourity Officer Staff, Ed.
FROM: Chiof, Tochnical Branch, SRS, Lis
Appendix a Report on ARTICIONS by Amendry of State of the Articions by
Cated 2 February 1953)
on the general ANTIONNE problem which was received by this
Office on 9 February 1953. William to 1951 The State of t
2. The roport is broken dan into three parts. The
Tirst covering existing techniques and agents of ell types; the second con-
- ''N' taining communic on existing programs that are in some way related to the ''
AMICIONS Project; and the third section containing contain recommendations.  A made by the group. The report itself also contains Appendices
made by the group. The report itself also contains appointed a restor of the list some projects of interest to
group, and a schodule of mostlings.
group first discusses various known techniques
3. The group first discusses various ducknic techniques and agents. They point out that all individuals can be broken under montal.
which and physical expanite and by such techniques as conving sleep, exception,
permunion, starvation, pain, buniliation, sickness, otc. They state that
The state of t
group than points out that bethou at beauthous
and permusion as contrasted to the punitive methods can be very effective
in obtaining information from an individual.
5. The third technique talma up is the most laces of various chami-
definition and assume. They state in semeral terms that there agents up, in some that
ways, facilitate the obtaining of information from individuals but they do not also point out that these techniques and not perfect and that they do not
and the recognitive recognitive or withhold information and they also state that
when individuals realize they are drugged, they tend to become doubly sus-
fill the property a few of the openial charicals and selected
that others will be found to hauten and facilitate the process of persuasion
The transfer of the second of the second
。  * 到了我们,一点只要一点一点精神。在我们的智能是是一个"特别"。这种"有的"的事情,我都是他们的"特别",这种"大人",这一个说话,我就是他们自己

- 6. The fourth major section takes up the fact that individuals under interrogation do often have ammesias or an unawareness for information they have given out. Briefly, they discuss the following points:
  - A. A person may say something unknowingly which is of value.

    They comment in this connection that certain chamical agents increase talking.
    - B. Secret information may be told outright and forgotton by the teller through the psychological process of repression.

      again points out that chemical agents will often make it easier to forget that one has revealed information.
      - discusses the "subtlo" means of making an individual "say or do things against his will" by the use of
        secret drugs, "Black Psychiatry", hypnosis and brain-damaging
        processes.

        feels that these processes may be
        tried but they are "claborate, impractical and unnecessary."
        They comment in this connection that probably equivalent results
        could be achieved by experts using simple techniques of interrogation as previously mentioned.
    - The group at this point in the report took up the matter of hypnosis and whether or not individuals will perform acts against their will and thereafter have no semony of the act.

      points out that making one act segment one's will, particularly in such matters as physically repugnant acts, acts of violence, acts of disloyalty, etc., could be produced only in instances of extreme rarrity.

      The group obviously feels that results from hypnosis either to produce amosis or to produce acts of disloyalty by loyal and patriotic individuals would be regligible.
- 7. After considering the above techniques and nothods in general terms, the group discusses the possible uses of damaging the person. In general, does not feel that the damaging of the individual, either through poisoning or by surgical or other means, is of great value in that such damaging may destroy other valuable capacities of the individual and results are at present unpredictable.
- 8. The basic report concludes with a section in which they hold that the best methods for combating these techniques are:
  - 1. Careful screening of individuals and studying their past activities.
  - 2. A very careful safeguarding of secret information. (limit the amount of information to each person and prevent those who must know much from coming under the influence of the enemy.)

- 3. Propor indocrination in security matters.
- 9. In the second main section of this report, the group deals with a number of existing projects which are of interest to AMICHORE. Now of their communication connection with such programs as the

will be such gained from these efforts, at least in the immediate futureprimarily because extensive psychological and psychiatric, as well as other
types of research, is required.

10. The group states that "although the present state of brealedge indicates little threat, if any, to National Security through special 'interrogation' techniques or agents, it is the considered epinion of the study group that the existing progress offer little hope of establishing the existence of, or of developing effective and practical techniques are agents.

dations may be briefly succertained as follows:

- wros use of skilled airl experienced interrogators and those expessed to energ interrogation to analyze and study the techniques and formulate procedures for instruction and protection.
- B. The group recommends that enhancing studies to be poor accurity risks.
  - recommends that field study, particularly in whore measures prisoners are available, should be carried out to improve rathods of interrogation with resourch teams having freedom of action in this connection.
- D. That research be carried out involving current polygraph residuals and these methods be that into the psychological-psychiatric approach to the overall program.
- E. Egain strasses the importance of developing procedures for the utmost care in screening and selecting and parsons.

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intelligent indecrination, including familiarity with

persuasive acthods, is vital.

proup also recursates broad studies, particularly studies at pay
abological effects of chemicals, studies of the underlying principles of human behavior, studies of persuasion, seduction, and resistance, and studies directly on the affects of chemical agents with psychotic-type individuals.

It has basic report recursands that the group hereafter not arrange any regular schedule of meetings but be called together when portioent information is developed or special work is necessary. They esti
pents in this connection that two meetings a year will be sufficient.

12. The appendices attached are neverly technical.

-(1-

Office Memorandum • United States Government

TO	:	Deputy Assit.	Deputy	(Admin.)	for	Security	DATE:	26 July 1952

FROM : Chief, Operations Staff/SI

SUBJECT: Study Group

1. In connection with our various conversations regarding the downgrading of a Top Secret document which forms the basis for the establishment of the Study Group under Project Artichoke, I am sending you herewith a copy of a memorandum from ______ of ____ which gives the current status of proposed membership in this group.

> 2. is very anxious to have a decision as soon as possible as to whether the draft paper which has been submitted to you can be classified simply as Secret. I would appreciate it if you would advise me as soon as possible on this latter aspect of the matter.

Attachment: (1)

Thermocopy of 16 July 52 memo fri

Distribution:

Orig. & 1 - Addressee ..

1 - Subject File

1 - Chrono

1 - Daily Reading File

AM, I, 77, 4 11 July 1952

The problem exists of ascertaining whether effective and practical techniques exist, or could be developed, which could be utilized to render an individual subservient to an imposed will or control, thereby posing a potential threat to National Security. Complete effectiveness of such techniques would require the individual to be subsequently unaware of their use. Degree of effectiveness and practicality of utilization and protection and possibility of devising more effective means for utilizing and counteracting existing techniques should be explored.

It is believed essential that a study be made of the problem outlined above and that a report be prepared indicating:

- (a) All techniques and agents which may be applicable to this problem
  . together with comment on degree of feasibility of utilization
  and protection.
- (b) In the case of techniques and agents which pose a potential threat which cannot be completely evaluated on the basis of present knowledge, recommendations be made relative to further promising rosearch. Such recommendations should include the scope and nature of required research and indicate research groups where such investigations could be expeditiously undertaken. An estimate of the effort (man years and/or dollars) required is desirable for each project.

Office Memoran	ndum	UNITED CO	ATES COL	
Children of the Control of the Contr	The second second	THE STATE	ALES GUV	EKNMENT
C14				Ly 1952
STUDY STUDY	CROUP			
1. In response to you	the feet the state of the state of	wost of 14 Jul	r 1962 the fa	llowing
information is provided.	元表的			
2. As of 15 July 1962	ojest group es 🖰	<ul> <li>oonsultante</li> </ul>	All have a	ephone (
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#### DRAFT

5 December 1952

MEMORAND	UM FOR	THE RECORD	•	•	-	. •	
SUBJECT:	Ď	Memorandum or	· · · · · · · · · · · · · · · · · · ·	<b>}</b> }			

TASK:

The task of the Committee as defined by the Chairman,

was to indicate the following:

- techniques and agents and degree of feasibility.
   of application to the problem of interrogation;
   recommendations for research for potential
   agents and measures;
  - a) the area or nature of investigation;
  - b), scope;
  - c) recommendations for research groups to execute;
  - d) estimation of effort now expended and to be expended;
  - e) comment on the accomplishments of research to date.

ACTION

First Meeting: The first meeting was held on 19 August
1952. List of those present and notes on the meeting are
attached as Enclosure I (with original only). The membership of the committee is attached as Enclosure II (with

original only).

Second Meeting: The second meeting was held on 1 October 1952. In addition to the committee and the undersigned, the following were present:

Proceedings follow:

- 1) The Chairman read a prepared statement of the state of the art. (This was later modified).
- joint interrogation center at overseas. Discussion was limited to straight interrogation.
  - discussed selection of PW's for interrogation.
- 4) reviewed orthodox methods of handling selecting and interrogating PW's.

	<u> </u>	5) discuss	ed interrogation in	
		general, the training of men	in resistance to interroga-	
	B	tion and reported very briefl	ly on the Books recent.	
		expedition. Since a	ill of the data was HiXX not	
		at hand, he did not comment	on the results achieved.	
C	Y	discussed his work	k of recent years with LSD 25	5.
	••	parahexyl and narcosis.		•
<u>_</u>	Y	7)	reported on experience	
		with a variety of agents.		
	C	eported or	n project	
		9) The remainder of the me	eeting was taken up with."	• •
• •		discussion.		•
	<u> </u>	Third Meeting: The third meeti	ng of the Committee was	. <b>-</b>
	h	neld on 11 November 1952. The	e entire meeting was occupie	d
	Ъ	by discussion and editing of a p	reliminary report of the	
	si) c	Committee XOINIX to the Chairn	man of and with discussi	.on

Fourth Meeting: The fourth meeting is to be held on 9 December 1952.

of the briefings of the previous meeting.

PROGRESS:

As of this date, a preliminary report has been prepared and generally agreed upon. This should be in final form at the completion of the next meeting.

# PROBABLE OUTCOME:

The Committee in its report will almost certainly recommend that no further regular meetings of the Committee be held, but called when fresh information requiring interpretation becomes available. It is also likely that the Committee will recommend that designate or assign an individual to act as clearing house for all information in the area of the Committee's interest and brief the Committee as indicated.

We will comment on the Committee's final report when it is completed.

# COMMENTS ON COMMITTEE:

1) Alk of the members of the Committee are largely without personal experience in this area with the exception of the Chairman, who carried out a number of studies for OSS in WW II. As a consequence, the statements in the final report will be largely ex cathedra and based upon the scientific outlook of the individuals as applied to interpretation of the very limited material offered in the briefings. The Committee is composed of competent scientists well able to evaluate finished work or to guide enterprises which have advanced sufficiently to provide quantitative data for discussion.

2) Attitudes: Both and are naturally anxious to pursue it.

<u> </u>	have, to my knowledge,
	no direct investigative interest in any type of research.
$C_{-}$	(Chairman) is convinced that little further can
	be accomplished by large expenditures in this field and
	has stated that it would be unwise to continue large-scale
A	studies. He is a friend of (formerly Deputy,
٠٠	CIA) and has told him repeatedly that little can come from
	investigations in this field.

Distribution:

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Attachments: (2)

Enclosure I - Minutes of Meeting 15 August 1952 Enclosure II - Membership of Committee

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12 March 1952

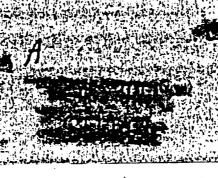
MEMORANDUM FOR THE RECORD

SUBJECT: CIA Facilities for Research Re Project Artichoke

- In October 1951. RDD and OSI agreed that limited laboratory facilities are essential to the development of certain specific items which will be available within six months. OSI agreed to take action, either to set up the facilities within CIA or to obtain appropriate facilities outside the agency. After discussion with the sensitive nature of the work involved made the establishment of laboratory facilities under our direct control advisable.
- 2. At a meeting of the AD's concerned with Project Artichore on A 30 November 1951, participated by brought up the problem of the establishment of a laboratory within CIA. The saked that the A matter be deferred in view of the many details which must be considered before we agree to set up such a facility. The saked that he considered fact that he was working with the Medical Department of the agency in connection with fartichoke work and would like to explore their interest on the subject.
- and the items under development are now ready for laboratory testing. It is essential, therefore, that the agency either establish a small facility for such testing, or eliminate this possibility in order that we may go shead with outside facilities and accept the security risks involved.
- the other offices concerned indicate that the personnel in I&S and the other offices concerned indicate that the personnel required for the laboratory testing involved are now available within the agency and the only problem is the obtaining of two or three rooms where we may go to work. The type of testing planned will not include any items which will endanger or seriously effect the subjects used and in fact, initially, we would do the testing on each other.

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explore the matter further. It is hoped that from this meeting we can come up with specific suggestions regarding the work involved and the facilities required in order that the laboratory question can be resolved.



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SA

Chief, Security Research Staff

17 Mebruary 1954

Chief, Technical Dranch

Conference, 13 February 1954-

H-B/3

Research Staff wand.

Of and discussed certain propisals in connection with the project known as In general, the project in an in and alsowhere there are large numbers of the are lecitizens. These for various reasons such as absence from their families, possibly anti-Communist, possibly pro-Communist reasons, possibly business reasons, wish to return to their native homes in In general, the project is concerned with the contacting of these people and sending them through covert channels back into to perform intelligence missions for this Agency.

- 2. Hore specifically, the project contemplates a mechanism within the United States which will be a ways and means of contacting alien in the United States (and elsewhere) and through agreements with the and the analysis as "undesirable aliens". By the use of these mechanisms, it is believed these alien. By the use of these mechanisms, it is believed these alien. Will be given legal entre into contemplates contacting these individuals, carefully acceening and testing them to see where their loyalties lie and indoctrinating these people so that they, when they return to will carry out missions for this Agency, regardless of Communist screening and "brain washing".
- 3. The exact technique of contacting these people has not been worked out but through sympathetic "committees" or "fake" left-wing organizations, it is believed these people can be a reached and contacted.
- h. The main problem in this case has been and always will be to determine A) where the exact sympathics of the individuals lie and B) how can we be sure the subject will perform the mission once he goes through the Iron Curtain and C) how can we train or indoctrinate these individuals so they can pass the "screening" or "brain washing" that probably will be given them by the

Communists upon their return to the Furthermore, in this connection, how can they be made to successfully resist this "brain washing" or "screening" so that they will be passed or accepted by them.

and yet will ultimately carry out their assigned missions:

Toward this end and his group designated to study this problem and to discover ways and means of assuring continuous loyalty of individuals dispatened to for this Agency. In carrying out this assignment, the studying indoctrination techniques and human psychology with addition, has apparently talked with others the have related interests along these lines. The writer and cannot establish exactly why these not referred to the ARTICHOKE work originally since it was devious that was to a certain extent aware of the ARTICHOKE work through contacts he had previously had with the so-called group of the ARTICHOKE with the so-called group of the ARTICHOKE was Chair-B and was responsible for report along ARTICHOKE times which this staff had B previously reviewed and found in many ways quite unsatisfactory and empty.

6. Apparently, after six or eight weeks of study with had come to the conclusion that the answer to this problem was through selection screening, indoctrination and ultimately, hypnosis. However, and and that also apparently come to the conclusion that no trats had been designed as yet to determine the sixty-four dollar question; i.e can individuals be commanded under hypnesis to do things that they would not otherwise do because of morals, training, éthics, etc.? This dead-end was revealed to the conference and sances? he Technical Branch and Messra. Land Again about three and one half years ago, this discovery was not regarded as unique. However, one important fact arose from the discussion and that is, and his group believe they have a ple money and they can supply bodies and areas where actual tests can be made to establish whether or not individuals will act against their morals, ethics, upbringing, etc. Euchhermore, under the cover of this loose project named this type of experimentation can be financed and carried out without much additional approval. or work within the Agency. It appeared obvious to all rembers at the conference that wredictions could not accurately be made in the behavior of the being sent back into unless certain very positive and definitive tests had been run and results very clearly established:

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B/3

would approve of the use of the prochamics for carrying out ARTICHORE experimentation. Bether and and also felt the project had great merit as certain fundamental facts could be demonstrated. It was also recognized that if and A his group could produce bodies and if certain very rough, primitive, and ultimate tests could be carried out then a more accurate prediction could be made in connection with the ultimate goal of which is the running of the process of the proc

B/3

8. This problem was discussed for several hours. All hands participated. It was agreed in general that this type of work had to be carried out A) with Security clearance and not as a free-lance show and B) that it should be carried out with the technical aspects under the ARTICHORN experimentation program.

ARTICHORE machinery could be brought to bear fully in this type of work; i.e. scientific support (chemicals, etc.), support in hypnosis, medical and psychiatric support and technical support (tape recordings, movie picture experss, regular cameras, etc.).

Furthermore, in this connection and pointed out that an ARTICHORE Tech was in the area and daid one of their basic assignments was the carrying out of tests to determine whether or not are and the individual in controlled missions and possibly over long distances and over considerable periods of time.

A BB

9. It was agreed at the conclusion of the conference that would return the and continue his training and on I tarch 195h, Monday, would return to Mashington and come up with a series of tests and ideas that could be submitted for ARTICHORE study and later their possible implementation. It was agreed by Messrs to convey the general details of this conference to and see that when the natter could be formally taken up, Security would be able to define its position and raise whatever phjections might appear. It was also agreed that the Technical Branch would consider the matter from an ARTICHORE point of view and be prepared to assist in the designed tests and working out ways and means of carrying out experimentation which yould be conclusive and would ultimately work to the success of the project.

H

problems involved in experimentation of this type and are of the opinion that whether or not this program can be set in motion



should be a decision for a very high level. Technically, however, this type of experimentation is essential to determine <u>finally</u> just how for human beings can be controlled (with or without their consent) using ARTICHORE techniques.

should take full advantage of the opportunity to act under this cover. The mission itself has merit, particularly if through ARTICHOKE we can "guarantee" successful accomplishment of missions by its use 'irrespective of the "brain washing" and "screening" that may be applied to the returning agents by the 'implication and the control mast not be of the scademic or clinical type and must be of a type that proves beyond any doubt certain premises that up to now have never been established. The Technical Branch recommends that we support this work but believes that the entire operation should be authorized by Security and the technical and rechanical operations be placed squarely in the jurisdiction of the ARTICHOKE program and directly under the control of the Security Officer.

that this type of work must not be overwhelmed and overburdened in a maze of statistics, technical reports and learned academic experimentation
since previous experiences along these lines
clearly indicate that when this appears the end
results are almost always negative.

Office Memorandum · UNITED STATES GOVERNMENT

ATE: 19 February 1754

TO : Director of Security

Chief, Security Research Staff

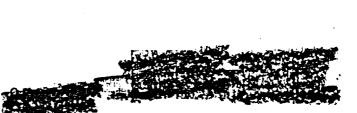
FROM : Deputy Director of Security

SUBJECT: Project

H- B/3

1. Reference is made to the attached report on proposed development of Project B/3

- 2. This project is an operational application of ARTICHOKE, and I feel that we should clearly be in the picture from start to finish exercising control features on actual experimentation.
- 3. As stated in the report, the principal question is whether or not an individual can be controlled into the future by the application of "H" techniques. I further feel that this cannot be done in the United States on a clinical basis, and the only answer is to concentrate on field applications. To this end we could supplement the ARTICHDKE team and possibly carry out these experimentations on where I understand we have some likely prospects who meet all the requirements and are not "friendly."
- the I recommend that we lay on this project with thand obtain a full working agreement and support this activity in every possible way.



3/3

- 1. TSS and TSS operations at any men who are TSS consultants, most of whom would be on the covert side and it is possible that we may have a flap on this because sooner or later TSS will probably find out about the project. In addition, it probably would be a good idea to cut TSS in or at least selected personnel since they may have some new chemicals for tests, possibly of interest to us.
- very valuable on research and is devoting almost all of his time now to psycho-chemicals. He is fully cut into ANTICHOKE and I believe we can control him completely.
- 3. If offices are established in they must be fully equipped for monitoring purposes. This is the type of work that we should do since we may want tapes on significant conversations.
- A B/3
- and I believe he would be definitely interested in the clinical psychiatrist assistment on the project at I believe we should push this since it will place In a key position where he can watch the situation from our point of view and he has a project natural cover.

- bably need a speaking individual in addition to on the Staff at the nt This is important for a great many reasons and might be very valuable if the "students" were not aware that the person in question spoke and understood. I believe this employee should be a staff employee of the Agency.
- 6. I am still somewhat concerned over the bringing together of agent candidates all at this may be a security hazard and unless our
  cover is extraordinarily good, it may blow the project. This needs a very
  careful study.

  told me that there are no bodies available
  now that he knows about in the area for tost purposes.
  - a bad idea and may possible drive out of the picture. Cortainly we should check this with as soon as possible. As you know, has a large contempt for the college instructor type hypnotist and his objections in many ways are valid. We must talk to about as soon as possible. Is completely inexperienced now and I wonder where he will get experience, particularly on and under what cover will this be attempted. As you know, arranged first-case a week or two ago and I am absolutely certain that gave a well-condition subject.
  - 8. Details concerning the trip into the for test purposes are still very, very vague. In my opinion, ARTICHOKE will have to have a fairly sizable representation at these tests. Exclusive of physical

security which probably will be handled by cut of though we have discussed this before, I feel that we should probably have on our team, in addition to you and I

9. We have not yet discussed technical tetails as you know. We are not at all certain as to whether or not knows anything about hypnotism or A for that matter, of course, has had no experience and we do not know if speaks enough to work II on subjects. At the present time, we do not yet know how et al. A propose to bring II to bear on the "students." How this will be done and what cover will be used is of vital concern to us for many reasons.

in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the would like to know what the views of the continuing etc. are on length of time required, techniques, covers, methods, etc., etc. We would also like to know would it be possible to test new chemicals under some pretext or other at the project in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the continuing process of the students in and the subjects in the continuing process of the students in the continuing process of the students in the subjects in the continuing process of the students in the subjects in the continuing process of the students in the subjects in the continuing process of the students in the subjects in the subject in

ll. Whereas I believe we should give all the technical equipment he needs, we certainly should have some say in the purchase of it and I personally would not be in favor of buying technical equipment for merely for non-pertinent experimental reasons.

12. We have not as yet been briefed by specifically what they intend to do, what they intend to look for in the

way of subjects and how he proposes to go about the conditioning process. Since we must be responsible for security in these matters, I feel we must have full knowledge for any work such as this. A flap in this matter might be very serious.

- 13. In connection with the special testing in the area this fall, what has been proposed to date. Does'nt yet make sense to me.
- A. says there are no bodies for testing
- B. suggested we would need 10 selected subjects.
- C. Selected by whom and would these subjects be witting, unwitting, prisoners, volunteers, or what?
- D. Who is going to choose them? It was proposed that choose these 10 subjects but how can we expect to correctly choose them. Or should we send to assist prior to the arrival of the A team?
- E. If time is short for the testing we are certainly going to have to use chemicals. We should discuss this in detail.
- F. Also this may be an opportunity to test a few new chemicals and this should be considered since the expense involved would not add anything more to the overall cost.

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H-B/3 COLJECT: Conference; Lartonoics, 24 Lerch 195h.

1. On 2h harch 195h tetween 6:30 and 12:30 P., and the writer visited and confermativities.

Attlume consultant in hydrosis, and expresentative in

2. In general, the conference was for two purposes: the first, to introduct and; the second, to obtain a very general idea of printions on certain matters concerning the use of hypnosis in confection with processed Attropy.

The fall of lath.

The feet of lath.

The process of the feet of the considered the possible dises of hypnosis for indoctrination, orientation, development of new personalities, central of activities, assume of individuals to be used in the future in connection with the fill lattice work.

nowered and discussed all questions at length with ave his views on the use of hypnosis in a project of this type. For the record, it may be said it closely parallels, the views previously set out by ARTICHORD. In certain cases, admitted the answers were not known since to his knowledge no one in the field of hyphotic work; had attempted such experiments:

| Very clearly indicated in his professional opinion that the overall is the fell that a large percentage of the discussed ideas could be carried out successfully.

indicated a willingness to co-operate in this work in any way be could and arrongements were made so that he and the end, possibly later.

Ould get together and discuss the problems further.

he and the writer are most desirous of talking with and setting up a series of conferences in which the more specific aspects and technical ramifications of the AdTICHORE work could be carefully examined.

assured and as seen as returned from a lecture tour, which he at this time was making, another conference would be arranged.

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B13₄

the hypnolic techniques and if they were properly laid on, repairedle shvides could be made in the use of this method in intelligence work. Stated he was certain could arrange and would arrange his work so that he could accompany a tead into the field for a test in support of the ARTICHORE work.

, at 1x:35 Pic and rence that he would leave a Tew manutes later. This had providely. then agreed upon as a sound security precaution by all hands.

عنار 26 harch 19 الم

8 December 1954

Technical Installation

On 29 November 195h, Messra. and proceed with automobile and began the installation and miscellandous physical security improvements requested by the above named project.

- 2. Hicrophones were installed in the second floor conference s office adjoining it, and an office on the third floor immediately above so office. The attached sketch will indicate and describe both location and rethod of installation. Please retain this sketch in our files for future reference.
- was well pleased with the installation and expressed his desire for personnel to be familiarized in its operation. and all clerical and stemographic personnel there were yery thoroughly instructed in the operation of the system. In particular (designated by custody) assured he that he understood the system thoroughly.

he and I departed on Wednesday evening, P

5. As you know, the Committee was advised at the last meeting of the completion of the assignment. As previously discussed, the installation was accomplished with full consideration being given to destruction of property, length of the lease and other minor considerations. Therefore, it should be noted that the installation made was considered adequate for immediate needs

17 June 1955

Tech. Br. PSD

Technical Equipment, Removal from

4-B/3

In connection with our telephone conversation recently, I have listed the Equipment that should be removed from the above mentioned premises. Also a brief description of the locations is given.

1 Microphone, and leads - located near left rear window and radiator/w lead wire to closet opposite side of room.

2

- 1 Microphone and load located beneath folding part of desk/w lead wire to cabinet right side of fireplace.
- 1 control unit located in cabinet right side of fireplace.

- 1 Microphone and lead Located in fireplace/w lead terminating at control unit
- 1 Microphone and lead Located at desk near front wall of Conference root. This microphone is detachable and may be secured elsewhere.

(On both conference and office space on second floor are control units in desks both terminating at control box in cabinets by fireplace.)

5 July 1955

was removed from a pocation on 29 June. He said that a tape recorder (not on your list) was left.

B/3

# Office Memorandum · united states government

Chief, Security Research Staff

DATE: 6 July 1955

Attention

Chief, Security Support Division

subject: PROJECT

H-B/3

1. Reference is made to your memorandum dated, 17 June 1955 requesting this office to remove cortain equipment from a covert site of interest to your Staff in 📆

2. Pursuant to your request, this equipment was removed on 29 June 1955 and stored at a Security Support Division int. It is the understanding of this office that you may wish to have it installed at another location in that city at a later date.

of your office 3. This will confirm advice furnished on 5 July 1955.

No further action is contemplated in this matter unless requested by you.

# · Office Memorandum • united states government

TO

DATE: 15 July 1954

FROM

SUBJECT:

A 4-B/3 1. Between 3:00 and 4:30 PM, Wednesday, 14 July 1954,

and the writer discussed immediate problems in connection with the situation in the primary discussion was concerned with the immediate necessity of obtaining a Headquarters House for After considerable discussion, the basic essentials as set forth by and and agreed to tentatively by the writer were as follows:

B.13

- a) The house should be located between to the and it should be somewhere between if possible.
- type having a basic area of no less than three floors or possibly four. The house should have two entrances, preferably one fore and aft. The house itself must not have janitor service, no doorman and no secretarization to accommodate at least two or three of the standard drawer-type safes together in any one given area.
- C) The house should be large enough to have internal area for the following rooms:
  - 1. Director and Assistant Director.

A

- 4. A secretary and receiptionist office (situated at the entrance to building)
- 5. Conference room
- 6. A special purpose operations room.
- d) In addition, the house should have living facilities, possibly at least one bedroom, living room, toilet and kitchen on top floor.
- e) House must have at least three toilets and refrigerating facilities other than mentioned immediately above or area suitable for this type of purpose.
- f) Telephone service for the house is not to run directly through the lines.
- sible from

  and preferably be abutted on each side by
  private dwellings. In this connection, and

  area be cleared by Security before any occupancy but
  by the project and coth requested
  Security to check out the house completely and make
  recommendations for any and all nexcessary safety
  precautions. This to include a device for burning
  and destroying classified papers and material.

h) Besires air-conditioning in the house on an

individual room basis, particularly the conference room and important rooms with wire screening or whatever necessary protective devices are on the windows.

- 2. The matter of 2h-hour protection was discussed and it was agreed that this would be important. In this connection, it was felt that if it could be arranged properly, would reside in the house in the apartment on the top floor. All present agreed that girls living in the house would not be a good idea and a suitable watchman who resided in was not sound.
- 3. In connection with the above, was to go to B/3 this date (15 July 1954) and make the initial payment to start the project and explore the real estate situation through the lift this was not us ccessful, asked if Security would offer support along these lines in an effort to find a proper location for these headquarters. The writer informed and in addition are our ce would assist in all ways possible including physical security measures.
  - 1954 and at this conference will be agreed upon.

. .

A

A/B, 210/96

Chief, Special Security Division

16 July 1954

Chief, Security Research Staff

Building for Use of H - B/3

B/3 a building available for rental purposes be located

It should be in the area between as close as possible to the Maximum rental \$5,000; per annum, subject to some flexi-

The building should preferably be of the "row" type, or what is popularly called "brownstone front" construction, with a basement and three other floors. The interior arrangement is not too important, as it is anticipated at least some alterations will be required in any event.

This information is desired by Wednesday, 21 July 1954. It is not anticipated that the assistance of your office will be required for the rental process.

A

Covert Headquarters,

1. On Friday, 16 July 1954, called and requested his staff to attempt to locate the headquarters building, along lines set out in memo of 16 July 1954. On Honday, 19 July 1954 ported that they had been able to locate only two places and in each instance the rent situation was way out of line with the proposed \$5,000 per annum.

2. The best of the two places located, a converted row house containing apparently four apartments was for rent at the price of .9,000 per annum clear to the owner, plus a five or ten-year contract. The other place, in poor condition, was for rent at #200 per month but the owner insisted upon a twenty-year least and the restoration of the property after the lease was over.

In view of the above, Wdiscussed the matter on honday afternoon, 19 July 1954 and it was aff extend the search agreed to request; o have his and to report the results or this search Monday, 20 July 1954.

It was also proposed that after we receive a report from he matter be taken up with a chief of Logistics, or one of assistants having knowledge of estate matter.

palked with I In addition, stated he believed that the administrative plan could be altered to increase the rental without a complete revision of the project to the extent of approximately \$15,000 per year and that he would proceed to start revision of the administrative plan, along those lines.

enged for the call Bonday, 19 July to extend the search and the above set out areas.



15 October 1954

MELDIANDUM FOR:

CHILF, SRS/SO

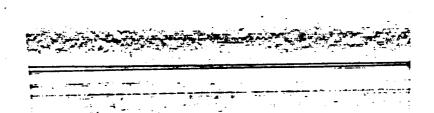
SUBJECT:

Persons Knowledgeable of H-B/3

The following persons have complete knowledge of

Allen Dulles Lt.Gen. C.P. Cabell

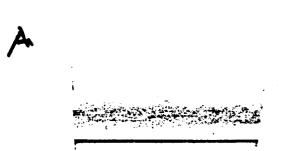




2. The following persons have knowledge only about the project as it affects their specific participation or support:

(continued)







22,







16 February 1952

MEMORALDUM FOR THE RECORD

SUBJECT: G-2 action in Artichoke Matter

1. On 24 January 1952, it was agreed at a meeting of the IAC designees for Project Artichoke that the problem should be submitted to the Committee on Medical Sciences, Research and Development Foard, for study and recommendation. Those present at the meeting were:

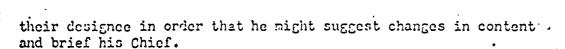
CIA

י עווויי ו

Navy

Air Force -

- '2. A draft of a memorandum from the DOI to the Secretary of Defense asking for the services of the Committee on Medical Sciences, Research and Development Board for this problem was circulated within CIA and concurred in by O/SI, O/PC, O/SO and I&SO.
- 3. On 30 January 1952, the draft was shown to the IAC designees noted above who concurred in principle but desired to study it further for minor changes and briefing of their Chiefs.
- 4. At the same time the draft was checked with the Office of Secretary of Defense (Lt. Col. and the Research and Development Board (Dr. They approved of the idea and indicated favorable action when the final memorandum was received.
- 5. On h February 1952, a second meeting was held at which time the G-2 representative asked for more time to do further checking in G-2. Subsequently, the Air Force and Navy concurred in principle subject to certain minor changes to be discussed when the Army was ready.
- 6. On 15 February 1952, the G-2 representative advised that he had been reversed and G-2 was conding the paper to the JIC for study by one of their subcommittees rather than the RDB.
- 7. The action of the Department of the Army is a violation of



- 8. The action of the Department of the Army disrupts a carefully planned and otherwise well-coordinated attempt to obtain badly needed technical advice and guidance for Project Artichoke.
- 9. Unless the Department of the Army is over-ruled in this matter, CIA will lose control of Project Artichoke and also will lose the respect and confidence of those in the Mavy, Air Force and Office of Secretary of Defense who are trying sincerely to help us in the project. The damage to the security of the Project because of its referral to individuals in JIC who have not been briefed on the matter cannot be over estimated.





FEB 1 8 1952

PEMORADUM FOR: Director of Central Intelligence

SUBJECT

Technical Assistance for Project Artichelia

1. THE PROBLEM:

To obtain technical assistance, cosmittal to the development of Project Articheka.

#### 2. FACTS REFRIND ON THE PROBLEM:

a. On 2 April 1951, Project / rtiphoke was discussed at an Executive Fession of the Intelligence Advisory Committee attended by the members representing 0-2, ONI, A-2, and the Fal. Except for the FFI which indicated no interest, the numbers agreed to assist and to appoint a representative to work with CIA on the project.

b. The designees have been necting with the CLA reprecentative as necessary, but all agencies have been hardisapped by the non-availability of competent technical sivice in contain highly specialized medical fields.

- c. In a mosting of the designess on 2h January 1952, it was agreed that the Committee on Posical Sciences, Research and Development Foard, is the only group with the requisits security clearance which has the technical commetence to advise on this problem. It was agreed further that the best way of obtaining the services of the Committee on Medical Sciences would be through a memorardum from the Director of Central Intelligence requesting their technical assistance.
- d. A draft of the proposed meroranium was prepared in O/SI; cleared with the appropriate offices shi staffs in CIA; and circulated to the IAC designees on 28 January 1952. The designees were to brief their Chiefs and submit comment and suggestions by h February 1952. The Navy and Air Force representatives concurred by the date indicated subject to some minor substantive changes to be taken up when the G-2 representative was ready. After several requests for nore time, the G-2 representative advised, on 15 February 1952, that his office had sent the CIA draft with slight modifications to the JIC for study by a

subscript too of that Agency, rather than by the Research and Development Ecard.

o. On checking with the ONI representative, CIA was advised that the Navy and Air Force do not concur in the G-2 action and that the Director of Naval Intelligence will raise objections when the matter comes up in the JIC.

### 3. CONCLUSIONS:

e. The Committee on Medical Sciences, Research and Development Reard is the only group with the requisite security clearances and the competence to provide technical assistance essential to Project Artichoka. This is consurred in by A-2, OHI and the G-2 designee for Project Artichoka.

#### h. RECOMMENDATIONS:

- a. That the Director sign the attached necessarium to the Chairman, Research and Development board, requesting the technical assistance of the Coumittee on Medical Sciences; and the memoranda to the Chiefs of the Military Intelligence /geneics advising them of the action taken.
- b. That the JIC to provided with a copy of the newprandum to the Chiefs of the Military Intelligence / geneies.
- c. That the Assistant for Special Security Programs, Office of Secretary of Defense be provided with a copy of the manorization to the Chairman, Research and Development Board.
- d. That all of the papers to hand delivered by the O/SI Project Coordinator, in view of the special security aspects of this problem.

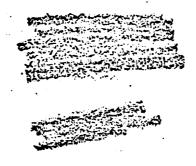
Assistant Pirector Scientific Intelligence

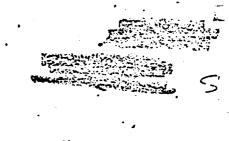
Attreh: Proposed DCI memo to PDB

CONCURRENCE:

Deputy Director (Intelligence

Data





MAR 5 1952

HEIDRAIDUM FOR: Chairman, Research & Development Board

SUBJECT : Request for Technical Assistance

1. I would appreciate the assistance of your Committee on Medical Sciences, in commention with a problem now under study in the intelligence community because of its possible concern to national security. The attached papers indicate the nature and scope of the problem and contain contain recommendations as to stope necessary before the full implications of the nature can be evaluated.

- 3. Feermse of the sensitive nature of this natter, all papers are being handled on an "EMES ONLA" basis. The code word "Artichoke" has been assigned and is "unclessified" then used in such a way that it does not reveal the nature and sample of the problem.

WALTER B. SMITH Director

#### Attrohment A

Distribution:

Addresses - ords & 1

Assit, Seedal Fourity

Programs, See Def. - 1

ACOSS, S-2 - 1

Dir. of May. Intell. - 1

Dir. Intell, US/F - 1

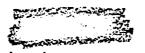
Dep. Dir. for Intell,

Joint Steff - 1

Signor - 2

AP/SI - 1





26 February 1952

MEIORAIDUM FOR: Deputy Director (Intelligence)

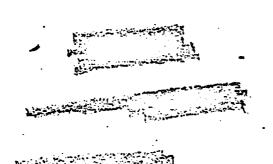
VIA

: Assistant Director for Scientific Intelligence

SUBJECT

: Transmittel of the "stelf Study"

- 1. The attached papers are returned with corrections in the "Staff Study" as you suggested.
- 2. Also in recordance with your suggestion, I have checked with the G-2 Liaison designee for the Project, Lt. Col. to determine what progress G-2 has nade in withdrawing its recommendation from the JEC.
- 3. Lt. Col. Sadvises that G-2 has not withdraw the natural from JIC. The subcommittee of which Col. is a member has made certain recommendations including the one that FDB undertake to provide technical assistance. These recommendations are to be considered by the JIC at its next mooting on 3 March 1952.
  - he This section is not consistent with the action agreed to between you and Col. . . namply, that the nation would be with-drawn from the JIC by G-2. Also it interpress indefinite delay in the project which is more than the "few days" we agreed upon. The RDB action will have been delayed three weeks as of 26 February, and this will extend to more than a month if we quait JIC action, all because of the unilateral and questionable G-2 tectios. The Mary designee has indicated again that it is imprepar for this matter to continue in the JIC when there are specifically designated ICC representatives to provide coordination and make recommendations as necessary.
  - 5. Under the circumstances, it is recommended that the Director be briefed on the matter and asked to sign the memoranda in order that the project any proceed without further unnecessary delays.



(131)

MEMORANDUM FOR: The Director

The lack of formal G-2 concurrence is, I believe, related to the existing confusion on all scientific intelligence matters on which you ; conferred with Gen. et'al., recently. The taking of the action here recommended is consistent with the "standstill" agreement i reached at that meeting, since RadB could act . for them it may concern when the final ellegation of responsibility is made. I empressed myself to this effect to Con. and was sabured ion his behalf that G-2's recommendation in the IJIC would be the same as that herein recommerded, inemaly, that the assistance of RaDB be sought, and Accordingly, I recommend proceeding without awaiting formal concurrence by G-2.

> Holid by Oil 5 March 1952 Schools and (DATE)

FORM NO. 10.101 JAN 1952

Section of the section of

147

:45-Ph 4 Mar 1/ 1/m hunch was night changes reflected to the comments . not general's - a skrime from necessity to keep proposes my such of B agreed Wit al REZ mig Propo Phan. 6/ menos of chaps of mit. Pat. · sent, of to do no men may mig &

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Aig = 2 lt t. RTIB. al that olde, model be considert, by anaugusts will or they AUCT à turbelje. Thank the corns all prints you rand. Mont let's tolk there of sec. while mistre. in violand-

(133)

Dept of any

Compile. 4 of

HENGRALDIN FOR: Assistant Chief of Staff, 6-2 MAR 7 1952
Department of the Army

SUBJECT Réquest for Technical Assistance from Research

- 1. Attached is a comp of a newbrandum which the Director for Control Director for Control Director in Control Director for Development Board, requesting technical assistance in connection with Project Articlicks.
- 2. As you will recall, Project Articheko was discussed at an Executive Session of the Intelligence Advisory Committee on 2 April 1951. At that time, it was agreed that each number present would designate a representative from his agency to work with the Assistant Phreeter for Scientific Intelligence on the matter. Subsequently, representatives were designated by G-2, Old, and A-2, and these designees have been necting with the CIA representative to facilitate coordination of the project.
- 3. On 24 January 1952, the CIA and Military representatives agreed that the presentatives indicated in the attached payors was essential to the project. Practs of the attachest were circulated for your information and for each comments and suggestions and suggestions was appropriated as you might wish to rake. The suggestions received are supposted and have been incorporated in the final amorganism.

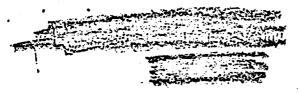
Assistant Director Scientific. Intolligence

Attachments IGI Mero to RD3

Distribution:

Addressed - Copies 1 and 2 Dir. of May. Intell. - Copy #3 Dir. Intell., USAF - Copy #4







MEMORANDUM FOR: Director of Central Intelligence

MAR 7 1952

VIV

: Deputy Director (Intelligence)

SUBJECT

Technical Assistance for Project Artichoke

### 1. THE PROBLEM:

To obtain technical assistance, essential to the development of Project Artichoke.

## 2. FACTS BEARING ON THE PROBLEM:

- a. On 2 April 1951, Project Artichoke was discussed at an Executive Session of the Intelligence Advisory Committee attended by the members representing G-2, ONI, A-2, and the FBI. Except for the FBI, which indicated no interest, the members agreed to assist and to appoint a representative to work with CIA on the project.
- b. The designees have been meeting with the CIA representative as necessary, but all agencies have been handicapped by the non-availability of competent technical advice in certain highly specialized medical fields.
- c. In a meeting of the designees on 24 January 1952, it was agreed that the Committee on Medical Sciences, Research and Development Board, is the only group with the requisite security clearance which has the technical competence to advise on this problem. It was agreed further that the best way of obtaining the services of the Committee on Medical Sciences would be through a memorandum from the Director of Central Intelligence requesting its technical assistance.
- d. The attached memorandum on the subject to the Chairman, Research and Development Board is concurred in by the interested components of CIA and by ONI and A-2. G-2 has delayed concurrence pending review of the matter by a subcommittee of the JIC. It is understood that the JIC subcommittee is recommending the same action as proposed herein, but that final JIC action will not be taken for at least two weeks.

# 3. RECOMMENDATIONS:

a. That the Director sign the attached memorandum to the Chairman, Research and Development Board, requesting the technical assistance

20 March-1952

MEMORATBUA FOR: Deputy Director for Central

THROUGH Director (Plans)

SUBJECT

1. In a series of meetings with representatives of the interested offices, it has been determined that there is a need for a small testing facility within CIA for use in connection with Project Artichoke. The establishment of this facility and the activities connected therewith have been assigned the unclassified code word the purpose of this facility is to enable us to conduct a series of tests to determine means of improving our ability to detect deception on the part of individuals.

2. The administration of the facility and the direction of testing will be the responsibility of TSS. The actual tests to be conducted and the naterials to be used will be reviewed and approved by I&S and the CIA Medical Officer prior to initiation of specific projects. Personnel required for the work will be drawn from the interested activities, initially, as follows:

Project Director: To be assigned to TSS on a loan basis, with individuals suggested for consideration as follows:

Staff, D/TR

Project Advisory Group: (To assist in planning projects, and to guide project along lines most fruitful for foperational purposes).

EDD CSO

I&S

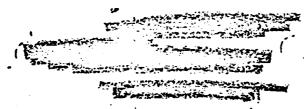
Project Assistants:

Medical Officer ) To be assigned by Medical Technician) Chief, CIA Medical Stoff. Polygraph Assistants) To be assigned by ILS

Additional support . as requested by:

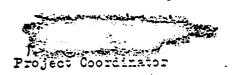
0/SI, TSS, I&S, etc.

3. Space in the amount of about 1500 square feet within the regardy is being arranged by I&S. Funds, equipment and materials are available or can be obtained from existing, approved projects.



4. All of the arrangements noted above are concurred in by the heads of the offices concerned, with full support and assistance guaranteed, subject to over-all approval of the project from a policy point of view by the Director, Central Intelligence. It is believed that these arrangements are adequate to insure full control of the project from the medical, scientific, and security point of view; with the direction of each aspect of the project under competent and experienced leadership.

5. Your approval, in principle, of this project is solicited in order that we may proceed with its implementation.



Concurrence:	
	·
AD/SO	. Chief, TSS
	• .
CIA Security Officer	DD(2)
Concurrence:	

Deputy Director for Central Intelligence

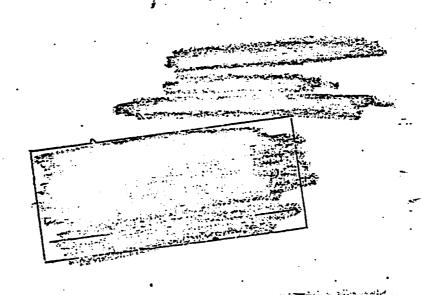


22 Earch 1952

IMMORATION FOR: ASSISTANT DIPUTY (INSTLCTION & GENURITY)
CHIEF OF MADICAL STAFF

SMBM:CT : Experiments on Interrogation Techniques

- 1. I have discussed with Mr. Fulles the proposed experiments to be consucted within the Agency on various interrogation techniques under the overall direction of GAT. I explained to Mr. Fulles that the Medical Staff and TAS would backatop these experiments but that before doing so the approval of the Biractor or Deputy Director had been requested.
- 2. Mr. Dulles agreed that these experiments should go sheed on a laboratory basis under medical and security controls which would insure that no damage was done to the individuals who volunteer for the experiments.
- 3. This memorandum will serve as your suthority to proceed with CCI and TSS in the carrying out of these experiences. It is the understanding of this office that TSS will actually run the experiments and that QSI will provide supervision, advice, and particular qualified personnel.



No. 4 or 6 copies

26 April 1952

TO: Assistant Director, Scientific Intelligence

FROM: Project Coordinator

excipitat topical saucus

1. PROBLEM.-To reexamine the CLA program for developing special techniques for interrogetions (Project Articiake), and to determine the most effective means for carrying out this program.

# 2. FACTS BEARING ON THE PROBLEM.--

- n. Despite the fact that on several occasions the operational offices have encountered situations where additional interrogation procedures were needed, field tests utilizing opecial tecimiques for interrogation have not been conducted as planned in the Project Artichole newerendum dated 13 March, 1951.
- b. The principle reason for the delay is a lack of confidence on the part of those responsible for the Project in the techniques presently available, and our inability to come up with any new techniques offering significant advantages over these.
- c. A major factor contributing to the lack of confidence in present techniques, as well as our inability to develop new ones, has been the difficulty in obtaining competent medical emport, both for the operational teams and for the research effort.
- d. The CIA Medical Steff, which was not included in the original program, has recently revised its planning in such a way that it is in a position to assist in an evaluation of presently known techniques.
- e. Escense this is primarily a medical problem, the CIA Fedical Etaff may be in a better position than any of the offices presently concerned in the Project to develop new and improved techniques.
- 3. DISCUSSION.—(See Tab A).
- 4. CONCLUSIONS .--
- e. The support of the CIA Medical Staff is essential to Project Artichola if field tests are to be conducted as originally planued.

CEOPET STEEL

COL OFFICE

LECOLUL MARIE MARIE

# SECRET.

b. Pecause this is primarily a medical problem, the CIA Medical Staff might well assume primary responsibility for the Project.

# 5. ACTION PECUNEEDED. -

e. That consideration be given to the facts and conclusions noted above, and if there are concurred in by the interested . agreey components, appropriate steps to be taken to correct the Project directive.

R. J. MILIANS
Project Coordinator

DIG th

Attached: Tab A

SECRET.

Copy No. 4 of 6

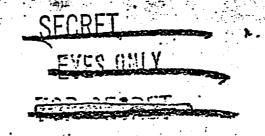
SECDET

TAB A

#### 3. DISCUSSION .-

- a. Project Artickalla is a special recomp program established for the development and application of special techniques in CIA interrogations and in other CIA covert activities where control of an individual is desired. Activities along the line of Project Artichake have been pursued by various components of CIA for at least four years, and previously spoundic efforts to develop and apply techniques of this nature were made by the Armod Services and OSS during Wall.
- b. A directive establishing OSI as the coordinator of an integrated CIA and inter-agency program in this field was approved on 13 March 1951. Since that date OSI has endeavored to evaluate known techniques and to uncover new ones using consultants. Armed Service contacts and whatever information may be available within CIA or through other CIA chample. At the same time, OSI has endeavoral to evaluate claims that the USER and/or its catellited may have developed new and significant techniques for this purpose.
  - c. Results of the program to date are mited as follows:
  - (1) Presently known techniques which have been used in one form or enother along the lines of interest to GIA:
    - barbituates in general. Typination: These techniques have been proven to be effective and they involve little risk to the subject if administered under competent medical direction. They will produce leads and some previously concerled information in a majority of cases.

      Requirements and Limited pedical facilities; experienced medical personnel; interrogation personnel with background and training in their application; preparatory medical personnel interview to determine intrengths, weaknesses and the most productive pattern of interrogation to follow. Subject usually has no knowledge of actual interrogation. Physiological after-effects might be samlyaced by a doctor as an indication that drugs of some kind had been used.

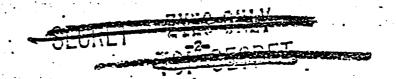




- (b) Remarks Evaluations Of come value in interrogations and in controlling individuals. Will not be 100% successful and requires cooperation from most subjects. Questions exist regarding extent of control that can be applied, particularly in acts against the normal will of the individual. Also several days pre-conditioning period necessary in nest cases. Requires experienced hypertist but no other supporting technical personnel. Subject usually has no account of the event but at present there is no way of determining that control is actually achieved (or that subject is faking submission).
- While psychiatric use of these techniques is widespread along the lines of interest, the severity of the treatment, possibility of injury and pormnent damage to the subject, and the highly experienced personnal required, rule these techniques out for the present.
- (2) Other items which are frequently used by police as well as intelligence officers on a routine basis are noted for the record as follows:
  - (a) Stimulanta Densedrine, caffaine, nicotine, etc. Evaluationi Usefulness, effectiveness and limitations are company known. Frinarily of value because they essist the interrogator in mining access to certain types of individuals. When combined with psychological exphysical stress, they increase the tension and ultimately the exhaustion of the subject.
  - (b) Almhol Evaluation: Commonly considered the most pasful presently known item for sloosening the tongue.
  - (c) Hobit forming drugs heroin, marijuona, etc.

    Evolution: These items can be useful in reverse because of the stresses produced when they are withdrawn from these addicted to their use. Also, some claims exist as to their usefulness in interrogations, but this has not been verified by research.
  - [2] Errot alkaloids lycergic soid, etc.

    Evaluation: While definite results have been achieved in producing confusion among subjects treated with minute quantities, these items have not yet shown usefulness for interrogation purposes.



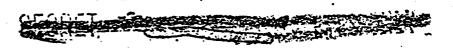


(a) Aidd to Actaction of According — Including the commonly used polygraph has a variety of usages but is besically of value when used on voluntary subjects endeavoring to prove that they have nothing to hide. Then used on this basis by a smilled operator, it is effective in producing useful leads.

# (3) Now items uncovered.

In new techniques or materials have been uncovered which show significant promise along the lines of Project Artichale. Primarily, such research as CIA and the other agencies concerned are sponcoring is directed toward providing a better evaluation or improved usage of the item noted above. Principle programs in this direction are:

- The T-nel. As agreed in the memoranism of 13 Merch 1951, OSI established a posel of professional personnel to oveluate nocalbilities and give direction in the field of research and experimentation for the development of this program. Fr. Coryl Healing was salected to head up the Panel and endemorate in comjunction with OEI, to emlist the cervices of other qualified profescional perconnel. We were largely unsaccessful in this offert and after four norths there still uses no personnel on the Panel or cleared for concultation with 1t who had experience and background in the colontific fields concerned. Furthermore, there vas no evidence at that time that such personnel could be available in the immediate future. Despite this handicap, the Fanol made every effort to be of service, although for the most part their assistance consisted of suggestions and advice of a rather general nature. In addition, the individuals who were serving on the Panel became more and more concerned with other matters were slong the lines of their background, and experience. In a memorantum to Dr. Chadrell deted 2 October 1951, Dr. Haskins indicated that the Fanel had contributed about as much as it could for the present and until resources were built up in the agency to undertake the staff and field work necessary, the Panel would hold itself rondy (as individual consultants) to be of any further advicery assistance. In conversations with Dr. Anakins, subsequent to the above, errengoments were made whoreby the Panel would cease to operate as such, and use would be rede of the members individually as needed and evailable. Little need or opportunity for further use of the members has occurred since that time.
  - (b) MB Styly. As an alternate making to provide the best possible professional savice for the project.



The Cold

the Research and Development Board, at the request of the DCI. has undertaken a study of the technical feasibility of Articholic-type techniques. Although the Study is designed estensibly to provide CIA with a better basis for evaluating Soviet espabilities in this field, it can be useful in evaluating and guiding our own program. The committee members have been selected, and, subject to their availability and clearance, should be positing on the subject in the near Suture.

research to develop techniques for improving our capabilities for detecting deception and to evaluate certain types of drugs having a potential for use in Project Artichoke. Research on the edeptability of hypnosis to the various aspects of the Project is being conducted within the agency. Limited facilities for tenting devices as they are developed have been approved and are being established.

## (d) Related IAC Programs.

On 2 April, 1951 the Deputy Director briefed the ItO in Exemptive Cassion on the project. Each Service intelligence chief agreed to assist the agency in the matter and subsequently, limited officers were nominated for the project. The limited officers have been nost cooperative but, except for the Navy designee, they have not been in a position to contribute to the project. It is hoped that the RRB Study noted above, which was plamed in coordination with the IAO designees. Will result in a better picture of Department of Defense research going on. In the meantime, information from the Department of Defense concerning new techniques or materials which might be adequable to CIA operational use has been largely negative.

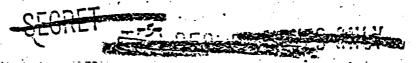
## A. Evaluation of Soviet capabilities?

(1) A complete evaluation of Soviet emphilities cannot be made until the RDB Study has established a solid matrix of fact regarding the technical feasibility of various artichake-type techniques. A preliminary evaluation of the rather fragmentary information available does not confirm the assertions in some quarters that the Soviets have a monder drugs or revolutionary technique for making individuals talk. Host of the cases examined have shown the age-old pattern of terture, exhaustion and ultimate mental and physical collapse of the subject. Euch use of drugs as may have been indicated, appeared to be along the lines of increasing the tension and thereby hastening the collapse of the subject.

- (2) We cannot accept this lack of evidence as proof that the Soviets have not developed has and effective techniques. One of the common characteristics of most paychiatric techniques we have considered has been a certain amount of amenda with respect to the event. It should be expected that perfection of these techniques would include perfecting the amenda characteristic to such an extent that the individual is totally uneverse that he has given anything at all.
- (3) Contributing to the Soviet capability in this field, whatever it may be, is their rather progressive and forward looking psychological and psychiatric research program. They are well versed in all of the techniques of which we have knowledge. While there have been inferences connecting this program with their interrogation personnel, no direct evidence of such connection has been found. A detailed study of their psychological and psychiatric research programs in now in process in the Medical Division, CSI, and it is hoped that this will produce some leads indicating whether or not they are applying special techniques in interrogations.
- (4) Of interest in connection with Boviet empablifties are two items which were found on two Soviet agents intorcepted in Cermany in the summer of 1951. These consisted of identical plactic cylinders containing hypodermic needles attached to collapsible metal tubes similar to, but about half as long as, shaving cream containers. One of the Rems was analyzed incompletely in the field and retained there. The other was shipped to Machington but, upon receipt by the Project Coordinates in late August, the contents of the Tube had been lost and the needle broken. Exhaustive chemical and spectroscopic analysis of the cylinder, the tube, the needle and prespings from these items revealed little information of significance.
- (5) The agents are quoted as stating that the needles, when emplied to any part of a victim would cause him to become anemable to the will of his captor. While this could mean any of a variety of things, conclusive evidence as to just what the devices can or cannot accomplish is lacking. Repeated efforts to obtain further information, either from the agents or on the material analyzed in Germany have been uncucessaful.

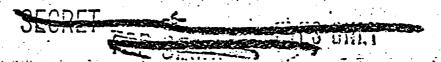
# e. CIA Operational Possibilities.

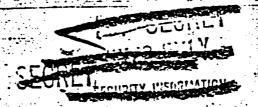
(1) Despite the fact that we have been unable to develop new tecimiques, there is sufficient potential in these evailable originally to justify consideration of their use in the field. Principle hardicap to such use has been our imposility to provide the medical competence for a final evaluation and for such field testing as the evaluation indicates. Repeated efforts



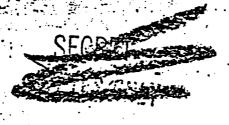
to recruit modical personnel have failed and until recently the CIA Medical Staff has not been in a position to assist.

- ... (2) . As the medical support situation become increasingly acuto, alternate nethods of obtaining applicance ware considered. Recently plans vere developed whoreby carbain elected contacts would undertake to train medical perconnel for CIA for the field testing program. The plan, in brief, contemplated establishing confracts through Dr. 2. H. Cuching, at that time Acoistant Medical Director of the Veterane Administration, for research and education, and through Dr. Hestings of the Unversity of Himmosota. Under these contincts, personnel would be trained in the use of drugs, electric whele end other potential fields, ostensibly for the purpose of doing rescarch in psychiatry. The contractor, who would be fully cleared and briefed, would evaluate those techniques he considered worthy of field testing and would sorcen the personnel in training for the physical and matel applicate for field work. The menes and Personal Eletory Statements of premising cardidates would be submitted to CIA for security screening. At the appropriate time the individuals nesting all requirements would take leave of absence from their resourch laboratory and be brought to CIA for infoctrination, efter which they would proceed with the field testing program. After suitable application of their techniques under field conditions, they would return to the U.S. where the results would be evaluated in conjunction with the contractor and further letoratory research work conducted.
- (3) This procedure was held in shoyance when it was learned that the CIA Medical Staff might now to in a position to provide the requisite evaluation and support. In fact, because of certain parallel programs which the CIA Medical Staff has recently undertaken, the entire organization and responsibility for the project might well be reviewed in the light of their new responsibilities and capabilities. Certainly this is basically a medical program requiring competent medical advice and direction. Even if it were necessary to use the alternate plan for providing medical support through the centract program noted above, this might be administered more effectively by the CIA Medical Staff than by OSI. Also it would probably be useful to the CIA Medical Staff in other programs they have established.
- (4) If the potential of special techniques for interrogations is to be exploited to the fullest extent by CIA, it is essential that a more direct line of command responsibility be established for the project. This was pointed out in a draft semmandum from AD/SI to DDCI deted 4 February, 1952. After discussions by DD(I) and Col. Taylor acting for DD(P) with AD/SI and the Project





Coordinator, it was decided not to send this memorandum forward. The principles expressed in this secondaries etill valid and the administrative problems occasioned by lack of acceptance of the principles are just as complex and pressing as they were at that time. Should it develop that the CIA Medical Staff is the agency component which can be given the responsibility and authority for pursuing expressively all aspects of this matter, the full potential of the program may yet be realized.



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#### PROBLEMS FOR DISCUSSION IN PROPOSED TO MARIP

#### 1. AREA

The cases should be handled in a completely safe area. This area should be near places of confinement of subjects or where suitable facilities are available for holding subjects until ready for Artichoke techniques.

#### 2. HOUSE

The safe house in which the actual operations will be carried out should, if possible, be fairly large -- possibly large enough to accommodate the entire Elusbird team for sleeping purposes and should be stocked with provisions so that the E team could live in during the Artichoke experimentation. In addition, the house should be of sufficient size to contain living quarters for guards.

#### 3. WORKING AREA

The working area for the actual application of the Artichoke techniques should be two rooms with bath adjoining or nearby. If possible, these rooms should be lit by indirect lighting and the floors should be covered with rugs. The main operation room should be quite large and more or less in the nature of a large bedroom. These rooms should be on the second floor of any house.

#### L. GUARDS

Guard duty must be on a 24-hour basis at least at all times when subjects are on the premises.

#### 5. CHEMICALS

Chemicals will be supplied by the B team unless the field is specifically requested to furnish some items. The chemicals will be the responsibility of the medical staff member of the B team.

#### 6. MEDICAL INSTRUMENTS

Medical instruments will be supplied by the E team. They will be the responsibility of the medical staff member of the B team.

NOTE: Medical instruments and chemicals will either be destroyed or given to the field offices prior to the B team's departure for Headquarters: The only possible exception to this will be standard medical instruments normally carried by a doctor.

#### 7. ELECTRONIC EQUIPMENT (Including Recorders)

All types of electronic equipment will be supplied by the B team unless the field offices are specifically requested to supply certain items. This equipment will be crated and shipped to the area prior to departure of the B team. In this connection, it is necessary that the B team know in advance the type of current used in the area and other technical details which will be requested prior to departure of the B team.

#### 8. PHOTOGRAPHIC EQUIPMENT AND SUPPLIES

Photographic equipment; and supplies will be furnished by the B team.

#### . 9. TEAM PERSONNEL

At the present time, the B team will probably consist of and an M.D. to be designated by Dr.

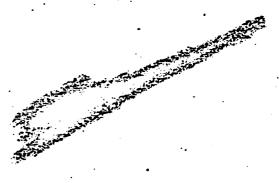
#### 10. REQUIRED TIME FOR THE OPERATION

It is estimated that any case will require a minimum of four days. This will include basic preparation, any necessary polygraph work, general testing, and the actual operation. Duration of cases depends upon many factors and chanct be easily estimated.

# (139)

#### 11. POLYGRAPH

It is proposed that area polygraph men should be assigned to the Artichoke problem. The experience will be valuable and quite possibly some results may require polygraph testing. Area polygraph operators will be thoroughly instructed in Artichoke methods during their association with the Artichoke team.





- (6) Knowledge of the arrival of the term and the location of the safe house and the proposed work of the term should be limited to only there personnel at headquarters and in the field who of necessity must have knowledge or this operation. Under no circulatiness should the mission of the term be circularized and become the subject of general discussion within the station.
- (7) The team will bring with them all measury equipment for the actual carrying out of the operation. The equipment referred to represents photographic, recording and other devices utilized by the team. The station will not be called upon to furnish any equipment in this like unless some unforced menorgonary develops.
  - (3) Required time for the operation. After arrival of the term, two or three days should be allowed for the term to cet up the safe house and cenfer with the case officers as to the techniques to be utilized. The term can then agree upon the time the subject should be colivered to the safe house. It is estimized that a minimum of four days will be necessary to conduct the precessing of the subject, with a possibility of extending three or four more additional days.

The team is desirous of running other subjects velected and approved by headquarters and the field station: If other subjects are provided, the team will continue to stay at the safe house and arrangements can be indo by the team and the chief of station for the briefing on each now case with the case officer and the establishing of time of delivery of the subject for processing purposes.

- (9) Pisposal. The behaiques applied by the team will be in direct consideration of the disposal facilities available to the chief of station, and in those cases as the same definite disposal facilities exist, the team can utilize many forms of techniques. In other cases that right be presented where the disposal facility is weak and the subject may have full or limited degree of freedom following the processing, the team techniques will be adapted to this situation. In each case, however, the team will discuss with the case officer and the chief of station, as recessary, the disposal factors prior to the running of a case.
- (10) Techniques. It is the full responsibility of the form officer in charge of the team as to the techniques to be employed in each care, and such techniques as have been stated are predicated on the security factors involved, disposal facilities available and the character of the subject.
- (11) Composition of the team. The team will be composed of a composition of the team, a professional consultant to specialist who will be in charge of the team, a professional consultant to professional a technician and a medical officer. A medical officer may be provided from headquarters or he may be assigned to the team from the field perconnel by headquarters.

(12). The team desires to use the services of actively Worlding on entering in the appropriate sutherization should be granted for the use of the agency the team during this period.

15 Ly 1952

MENORALIDUM FUR: Exercise Assistant Deputy (Administration)

for Security

Assistant Director/Special Operations

Assistant Birector/Policy Coordination

Attention:

Dr. Chief, CIA Medical Staff

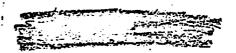
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: Assistant Director/Scientific Intelligence

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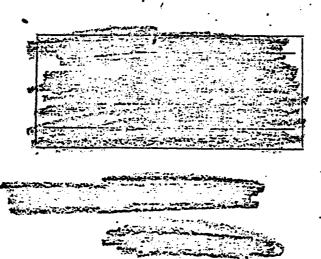
: Special Interrogations

Attached is a draft of a Staff Study proposing an interim field testing program for Project Artichoke. Since there is some urgancy about this matter, I would appreciate your making every effort possible to have your comments and suggestions in the hands of Fr. Room 15hl H, Extension and not later than noon, Tresday, 20 May 1952.



Attachments: Staff Study

Tab A



15 Kay 1952

IMPRANIEWIFER: Deputy Director of Central Intelligence

THE REAL PROPERTY.

TERCUCA : Reputy Director (Intelligence)

Deputy Director (Mans)
Deputy Director (Mainistration)

SUBJECT : Special Interrogations

REFERENCE: AD/SI Embranden to DD/P on Subject, dated
13 March 1951.

1. PROMEM.—To establish an interior field program using special techniques in interrogations.

#### 2. FACTS I WARRIED ON THE PROBLEM.-

a. The most practicable way of initiating field wange of special techniques in CIA interrogations is by assigning full authority and responsibility, on an interim basis, to the offices noted as follows:

### (1) Office of Inspection and Security:

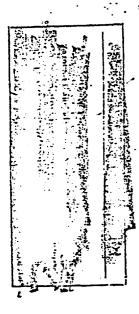
Over-all authority and responsibility for Project
Articholm with specific responsibility for training personnel
and assigning than to field operating units where subjects
are available and the field situation has been evaluated
by IMSO as compatible with CIA policy and security interests.

### (2) CIA Padical Staff:

Authority and responsibility for providing guidance and support, including the procurement and assignment of specially qualified medical personnel, to the Office of Inspection and Security.

### (3) Office of Special Operations:

Authority and responsibility for providing selected subjects and facilities in the field for use by IASO trained personnel, provided that personnel are under the command of the Chief of the field station concerned.



Policy Control of the 
The offices concurring in this proposal should, therefore, evaluate it after six menths with this factor in mind.

c. Paralleling this interim assignment of authority and responsibility, the research program will be nest effective if carried out as follows:

#### (1) CIA Medical Staff:

Authority and responsibility for evaluating presently known techniques; determining means whereby they may be improved; and spensoring research for development of new techniques.

### (2) Office of Inspection and Security:

Full responsibility for evaluating and developing aids to detection of decontion (polygraph, etc.) which will no longer be considered a part of Project Artichoke.

(In carrying out this responsibility, the ILSO would depend to the fullest extent practicable upon the Technical Services Staff for development of "gadgetry and hardware" as necessary).

### (3) Office of Scientific Intelligence:

- (a) Responsibility for monitoring the Study now being undertaken by the Research and Development Board, Department of Defense, as a basis for evaluating Soviet capabilities in the field of Special Interrogations.

  OSI to make available to the CIA Medical Staff and the other offices concerned results of the study.
- (b) Responsibility for assessing and evaluating Soviet capabilities in this field.
- (c) Responsibility for continuing the centret with the Department of Defense representatives established at the request of the Director in the LNC Discoutive Session of 2 April 1951.

- 3. DISCUSSION: -See Tab A.
- h. concusions:-
- a. Field usage of special techniques in CIA interrogations may should be initiated as soon as practicable, and their usage/co initiated in the most expeditions manner in accordance with the interim expresents outlined under "Facts" presented above.
- b. The offices concurring in this proposal should review the interim arrangements after they have been in effect for six months and usis recommendations regarding the best practicable permanent arrangement.

#### 5. ACTION RECOTEMENTS:-

a. That the interin arrangements outlined above to approved for invediate inglementation with provision for review after six months by the offices concurring in this proposal.

Assistant Director Scientific Intelligence

ANNEXES: Tob A

Assistant LivectorySpecial Operations . CIA Security Officer

Assistant Director/Policy Coordination Chief, CIA Redical Staff

ACTION BY APPROVING AUTHORIST:

Dato

Approved (disapproved), exceptions, if any.

Director or Deputy Director



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#### 3. DISCUSSION.

a. Project Articholo is a special agency program es- ... tablished for the development and application of appoint techniques in CIA interrogations and in other CIA covert activities where control of an individual is desired. Activities along the line of Project Artichoke have been pursued by various components of CIA for at loast four years, and previously sporadic offerts to develop and apply techniques of this nature mere made by the Armed Services and CES during WAII.

b. "A directive establishing OSI as the ecordinator of en integrated CIA and inter-agency program in this field was approved on 13 March 1951. Since that date OSI has endeavored to evaluate known techniques and to uncover new ones using consultants, Armed Service contacts and whatever information may be available within CIA or through other CIA channels. At the same time, CSI has endomored to evaluate claims that the USSR emi/or its Satellites may have developed new and significant techniques for wils purpose.

- c. Results of the program to date are noted as follows:
- (1) Presently incom techniques thich have been used in one form or another along the lines of interest to CLA:
  - (a) Narco-hypnosis: -- Sodium pentathol, codium anytal, barbituates in general. Fvaluation: These techniques have been proven to be effective and they involve little rick to the subject if administered under competent medical direction. They will produce lesds and some previously concealed information in a majority of cases. Requirements ave: Limited medical facilities; experienced medical personnel;

interrogation personnel with background and training in their application; preparatory radical examination to insure proper physical condition of subject; paychological interview to obtaining strengths, weak-nesses and the most productive pattern of interrogation to follow. Subject usually has no knowledge of actual interrogation. Physiological after-effects might be analyzed by a doctor as an indication that drugs of some kind had been used.

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- interrogations and in controlling individuals. Will not be 100% successful and requires cooperation from most subjects. Treations exist regarding extent of control that can be applied, particularly in cote against the normal will of the individual. Also several days pre-conditioning period necessary in most cases. Requires experienced hypothet but no other supporting technical personnel. Subject usually has no memory of the Arent but at precent there is no may of determining that control is notably cohieved (or that subject in faking submission).
  - Mile psychiatric use of these techniques is midespread along the lines of interest, the severity of the treatment, possibility of injury and permanent damage to the subject, and the highly experienced personnel required, make further research and evaluation of these techniques essential.
- (2) Other items which are frequently used by police as well as intelligence officers on a routine basis are noted for the record as follows:

with Dr. The publication to the above, arrangements were made whereby the Panel would cease to operate as such, and use would be made of the members individually as needed and available. Little need or emertanity for further use of the numbers has occurred since that time.

The second secon

- (b) ADD Study:—As an alternate noneme to provide the test possible professional advice for the project, the Research and Development Enard, at the request of the DCI, has undertaken a study of the technical feasibility of Artichoke-type techniques. Although the Study is designed estensibly to provide CIA with a better basis for evaluating Soviet emphilities in this field, it can be recful in evaluating and guiding our own program. The consistent members have been selected, and, subject to their availability and elemence, should be working on the subject in the near future.
- research to develop techniques for improving our capabilities for detecting deception and to evaluate certain types of drugs having a potential for use in Project Articheka. Research on the adaptability of hypnosis to the various aspects of the Project is being conducted at thin the agency. Limited facilities for testing devices as they are developed have been approved and are being cutablished.
- (d) Related IAS Promann:—On 2 April, 1951 the Deputy Director briefed the IAS in Describing Session

on the project. Each Service intelligence chief agreed to assist the agency in the natter and subsequently, liaison officers were nominated for the project. The liaison efficers have been most ecoperative but, except for the Many designes, they have not been in a position to contribute to the project. It is hoped that the RDB Study noted above, which was planted in coercination with the IAC designees, will result in a better picture of Department of Defense research going on. In the recenting new techniques or materials which night be adaptable to CIA operational use has been largely negative.

- d. Evaluation of Coviet capabilitics:-
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- (2) To carnot accept this lack of evidence as proof—
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  we have considered has been a certain amount of amount with
  respect to the event. It should be expected that perfection of

these techniques would include perfecting the amesia characteristic to such an extent that the individual is totally unaware that he has given anything at all.

- (3) Contributing to the Soviet capability in this field, whatever it may be, is their rather progressive and forward looking psychological and psychiatric research program. They are well versed in all of the techniques of which we have knowledge. While there have been inferences connecting this program with their interrogation personnel, no direct evidence of such connection has been found. A detailed study of their psychological and psychiatric research programs is now in process in the Medical Division, ONI, and it is hoped that this will produce some leads indicating whether or not they are applying special techniques in interrogations.
- (h) Of interest in connection with Soviet capabilities are two items which were found on two Soviet agents intercepted in the summer of 1951. These consisted of identical plastic cylinders containing hypoderale needles attached to collapsible metal tubes similar to, but about half as long as, shaving cream containers. One of the items was analyzed incompletely in the field and retained there. The other was shipped to Washington but, upon receipt by the Project Coordinator in late August, the contents of the tube had been lost and the needle broken. Exhaustive chemical and spectroscopic analysis of the cylinder, the tube, the needle and scrapings from these items revealed little information of significance.
- (5) The agents are quoted as stating that the meddles, when applied to any part of a wietin would cause him to become agenable to the will of his captor. While this could mean any of a variety of things, conclusive evidence as to just what the devices can or cannot accomplish is labiling. Repeated efforts

. (41)

to obtain further information, either from the agents or on .
the material analyzed the place been unsuccessful.

e. CIA Corrational Possibilities.

- (1) Despite the fact that we have been unable to develop new techniques, there is sufficient potential in those available originally to justify consideration of their use in the field. Principle handicap to such use has been our inability to provide the medical competence for a final evaluation and for such field testing as the evaluation indicates. Repeated efforts to recruit medical personnel have failed and until recently the CIA Medical Staff has not been in a position to assist.
- (2) As the medical support situation became increasingly acute, alternate methods of obtaining assistance were considered. Recently plans were developed whereby certain cleared contacts would undertake to train medical personnel for CIA for the field testing program. The plan, in brief, contemplated establishing contracts through the Veterans Administration, and through the University of Minnesota. . Under these contracts, personnel would be trained in the use of drugs, electric speck and other potential ifelds, ostensibly for the purpose of doing research in psychiatry. The contractor, who sould be fully cleared and bricked, would evaluate those techniques he considered worthy of field testing and would screen the personnel in training for the physical and mental aptitude for field work. The names and Personal History Statements of promising candidates would be submitted to CIA for security screening. At the appropriate time the individuals peeting all requirements would take leave of absence from their research laboratory and be brought to CIA for indoctrination, after which they would proceed with the field testing program.

After suitable application of their techniques under field conditions, they would return to the United States where the results would be evaluated in conjunction with the contractor and further laboratory research work conducted.

- learned that the CIA Medical Staff might now be in a position to provide the requisite evaluation and support. In fact, because of certain parallel programs which the CIA Medical Staff has recently undertaken, the entire organization and responsibility for the project might well be reviewed in the Hight of their new responsibilities and capabilities. Certainly this is basically a medical program requiring competent medical advice and direction. Even if it were necessary to use the alternate plan for providing medical support through the contract program noted above, this might be administered more effectively by the CIA Medical Staff than by CSI. Also it would probably be useful to the CIA Medical Staff in other programs they have established.
- (4) Under the circumstances, an interin arrangement appears to be the most practicable way of taking advantage of the potential which is believed to be available in the use of special techniques in CIA interrogations. This arrangement should provide the most direct line responsibilities for carrying out specific field usage of narco-hypnosis and such other techniques as the CIA Medical Staff may consider to be feasible at this time.
- (5) An interim arrangement is necessary during the initial stages in order to make full use of the resources available in the various CIA offices. Also there is a need at the beginning to provide full policy and security control in operations. At a later date a different arrangement may

prove to be more effective and also compatible with the necessary policy and security considerations.

- (6) Interin responsibilities can be assigned to the offices concerned as follows:
  - (a) Office of Inspection and Security: Authority and responsibility to train personnel and assign them to field operating units where subjects are available and the field situation has been evaluated by IMSO as compatible with CIA policy and security interests.
  - (b) <u>CIA Medical Staff</u>: Authority and responsibility for providing guidance and support, including the procurement and assignment of specially qualified medical personnel, to the Office of Inspection and Security.
  - (c) Office of Enerial Charations: Authority and responsibility for providing selected subjects and facilities in the field for use by IMMO trained personnel, provided that personnel are under the command of the Chief of the field station concerned.
- (7) A review of the effectiveness of this arrangement after six nonths and suitable recommendations for arrival at the best personent arrangement would be in order.

STARWARD FORM IN. CA

# Office Memorandium . United STATES GOVERNMENT

TO : Assistant Director/Scientific Intelligence

DATE: 19 May 1952

FROM:

Chief, Medical Staff

SUBJECT:

Special Interrogations

- 1. Reference is made to the attached draft, subject "Special Interrogations."
- 2. At the macting of 14 May 1952 the Madical Office outlined its position regarding the Artichoke Project and requested that the term "Marco-hypnosis" be used to define those responsibilities within the interim program that are basically medical. This was agreed, and it was with such understanding that further concepts of responsibilities were evolved.
- 3. The attached draft provides the delegation of authority in regard research to the Medical Office, and lists in its "description" varied techniques pertinent to such research. This would extend the scope of medical responsibilities beyond the previously agreed definition.
- 4. It was also agreed at the meeting of 14 May 1952 that field activities would be under the command of the chief of field station concerned, provided that instances of this agreement would be referred back to hardquarters for final decision. Paragraph 2a(3) does not provide for the qualifying phrase.
- 5. It is requested that the project draft more closely outline the concept of medical responsibility as originally defined and that Paragraph 2a(3) be changed to provide for the necessary qualifying phrase.

Attach .: 1

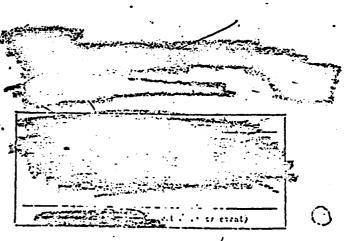
1. Project Draft

(19 lby 1952)

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#### REMARKS:

. Joe:

I have read the enclosed TS document and, as knows, am in consid erably disagreement with it. I t seems to me to be a belated attempt to make up for 2 or 3 years confusion and ineffectivness. I question the security in doing the study in this way, if it is to be done at all. If this is supposed to be covered up as a defensive feasibility study, it's pretty damn transparent. There is a in of obvious experimental work that needs to be done . The a study describe

FROM: begin to get it done.

ROOM NO.

EXTERSION

FORM NO. 36-8

# Office Memorandille DNITED STATES GOVERNMENT

TO: Assistant Director, Scientific Intelligence

DATE: 20 May 1952

PROM : Deputy Security Officer/CIA.

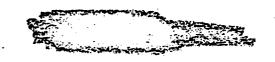
subject: Special Interrogations.

REFERENCE: 15 dated 15 May 1952, Staff Study on Special Interrogations

(Project ARTICHOKE).

1. This Office concurs in the Staff Study dated 15 May 1952 to the DD/CI on special interrogations, Project ARTICHOKE.

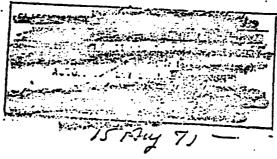
2. This Office will assume, upon appropriate approval, the responsibilities placed on it in the Staff Study and at the empiration of the six months period a meting will be called to determine the results achieved during the interim six months period and determination made as to whether I&SO or some other office should assume permanent responsibility for the conduct of this Project.



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(144)

21 May 1952

MELORALDUM FOR: ADPC

SUBJECT:

OSI Proposal for an Interim Field Program and for Organizational Changes With Respect to Project ARTICHOKE

- 1. Project ARTICHOKE is a research Project with the objective of developing special interrogation techniques such as narco-hypnosis. By a memorandum from ADSI to DD/P dated 13 March 1951 concurred in by ADSO, ADPC and the Security Officer, CIA, responsibility for initiating and coordinating activity in this field within CIA and for coordinating such activities with the IAC community was placed in OSI.
- 2. Enclosed is a nemorandum for your signature in response to a memorandum from ADSI requesting your comments on a proposed interim field program for special interrogations. This memorandum was addressed to ADSO, ADPC, Comments of CIA Medical Staff.
- 3. The OSI staff study proposes an interim field program and appears to place ultimate responsibility for Project ARTICHOME on I & SS. The organizational arrangements proposed appear to provide that I & SS will, with the help of medical personnel provided by CIA Medical Staff, conduct covert special interrogations in the field on personnel supplied by OSO all under the command of the OSO station chief. TSS is left out of the picture entirely.
- 4. In my opinion, the proposal is an effort to cover up the lack of accomplishment in this field by OSI and to block Tis from undertaking any program.
- 5. On 13 February I arranged for a meeting between and Subsequently, TSS has let some research contracts in this field with the prior concurrence of the second sec
- * 6. Because the objectives of Project ARTICHOKE are closely connected with "Operations" and because DD/P now has a research organization to support covert operations, I believe that TSS should have a primary interest in this field. The memorandum to ADSI recommends consultations between OSI and TSS to determine the future of this Project.
  - 7. I recommend that you sign the enclosed memorandum.

Encl. - 2



21 Hay 1952

MENORARDUM FOR: Assistant Director for Scientific Intelligence

FROM:

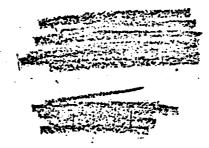
Chief, PLANS Staff/080

SUBJECT:

Special Interrogations

1. Reference is made to your memorandum dated 15 May 1952, TS-23 and to the Staff Study attached thereto proposing an interin field testing program for Project ARTICHOMS.

2. This Staff Study has been carefully reviewed by this Office and has been discussed with the ADSO. OSO concurs in the Staff Study as prepared by your Office.



22 MAY 1952

MEMORANDUM FOR: ASSISTANT DIRECTOR FOR SCIENTIFIC INTELLIGENCE

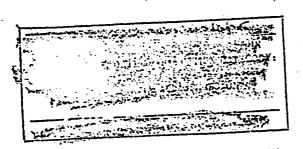
SUBJECT:

Special Interrogations

REFERMMES:

Monorandum from ADSI to managed, ADGO, ADFO, Dr. Porton Serie mubject, dated 15 May 1952,

- 1. This nemerandum is in response to your request for contents on the interin field program for Project ARTICHOME proposed in your staff study attached to the reference memorandum.
- 2. The Deputy Director (Plans) has recently established the Technical Services Staff with the general mission of providing devices and techniques required by operations to carry out its missions. Since the techniques in question are of direct application to operations, it would seem appropriate that that staff take part in the research and development aspects of this Project.
- 3. While still asserting our strong interest in Project ARTICECKE, I question the desirability of undertaking the field program with the organisational arrangements proposed in the staff study without a fuller understanding of the objectives sought in the proposed field program and in ARTICHOME itself as a major research project. I would recommend that you discuss the Project with Chief, TSS for the purpose of developing a line of collaboration.



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Assistant Director for Folicy Coordination

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If you desire further information, suggest you				
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MEMORALDUM YOR: Deputy Director (Intelligence)

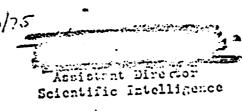
JUI! 6 1952

SUBJECT: Special Interrogations

1. The attached Staff Study (Tab A) was circulated to the other offices of the Agency interested in the subject of Special Interrogations (Project Artichoke). The purpose of the Study is to obtain concurrence in and approval of the initiation of field testing of special techniques for interrogations utilizing such resources and talents as exist within the Agency. The Study utilizing such resources and talents as exist within the Agency. The Study proposes, also, that research and development in this field sten from the office providing field medical support, the CIA Medical Staff.

# 2. Also attached are:

- a. A copy of the original memorandum charging OSI with the crer-all responsibility for this project (Tab B).
- b. Copies of Memoranda from Chief, Flans Staff, CSO, and Deput; Security Officer, IASO, indicating the concurrence of their respective offices, (Tab C and Tab D).
- c. A copy of a memorandum from the Chief, CIA Medical Staff, indicating partial concurrence, but requesting clarification of certain aspects (Tab E).
- d. A memorandum from AD/PC questioning the desirability of undertaking the field program until the research objectives are clarificias they relate to those of Technical Services Staff (Tab F).
- 3. It is evident from the question raised by AD/PC that there is a conflict in the responsibilities assigned by the memorandum of 23 March 1951 establishing Project Artichoke (Tab B) and the general mission of Technical Services Staff as stated by AD/PC in paragraph 2 of Tab F. This question services Staff as stated by AD/PC in paragraph 2 of Tab F. This question goes beyond the matter of collaboration with Technical Services Staff with whom lisison has been established in order that Project Artichoke may benefit by any developments they may run across.
- 4. Since the clarification requested by CIA Medical Staff (Tab E) has been discussed with Dr. The and a basis for agreement has been reached, we are prepared to undertake the field testing once the more fundamental question raised by AD/PC has been resolved. I suggest, therefore, that this cuestion raised by aprice to the Deputy Director (Flans) and Deputy Director (Administration) for the purpose of clarifying the responsibilities of the effices concerned.



(149)



11 June 1952

HEMORANDUM FOR: Deputy Director/Plans

FROM : Deputy Director/Intelligence

SUPJECT : Project "ARTICHOKE"

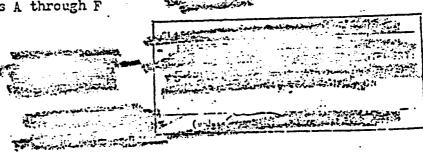
1. The attached memoranda are forwarded for your information and such action as may seem appropriate in the light of the following:

2. I not only agree with the statement in AD/FC's memorandum for AD/SI, dated 22 May 1952 (Tab F attached), to the effect that TSS should participate in the research and development aspects of this Project, but also feel that one of the basic purposes of the recently approved that one of the basic purposes of the recently approved direction, with competent scientific advice, for projects of this nature. Consequently, I feel that responsibility for this entire Project should be transferred from OSI to TSS, the latter to determine the need for medical and other support from other components of the Agency.

3. Accordingly, it is requested that TSS be directed to confer with CSI in order to prepare an appropriate directive transferring responsibility for this Project from OSI to TSS.

from OSI to TSS.

Attachments-Tabs A through F



13-43725>



17 Juno 1952

MENORANDUM FOR: Assistant Director of Scientific Intolligence

ATTENTION:

SUPJECT:

Project ARRICHME

- 1. Pursuant to today's conference attended by Kn. I. an inturning to you the file forwarded to the DD/P's office on the above subject.
- 2. After studying this material, I would like to bring the following summary of facts to your attention:
  - a. On the basis of basic paper dated 13 March 1951, Subject - Special Interrogations, OSI is charged with the responsibility of coordinating Project ARTICHERE.
  - b. Staff study dated 15 May 1952, Subject Special Interrogations, recommends that everall authority and responsibility for Project ARTICHNE new be placed with the Office of Inspection and Security.
  - c. Momorandum from ADPO to ADSI, dated 22 May 1952, recommends that Technical Services Staff (TSS) take part in the research and development aspects of Project ARMICHORE.
  - d. Memorandum from ADDI to DD/I, dated 6 June 1952, suggests that the clamification of responsibilities of the various offices concerned with Project ARTI-CDME be effectuated on the DD/I, DD/P, and DD/A level.
  - e. Memorandum from ED/I to DD/P, dated 11 June 1952, recommands that responsibility for the entire Project ABTICNOME should be transferred from OSI to ISS, the latter to determine the need for medical and other support from other components of the Agency.



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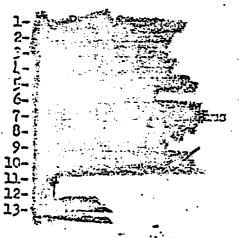
3. DD/P requests that you in your capacity of Coordinator of Project ARTICIDAL take the above under active consideration in cooperation with the components concerned, including TSS who have not heretofore had an opportunity to acquaint themselves with the various phases of development relative to this Project. It would be much appreciated if you would submit final recemmendations to DD/P in the light of the above at your carliest convenience.

15

Acting Chief of Plans Office of DD/P

hvT:mgd

Distribution:



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MEMORALDUM FOR RECORD

SUBJECT: Project

- 1. A meeting was held today in the office of Dr. Research and Development Board, to discuss Project with Dr. William, who is proposed as Chairman of the Committee to make the study requested in DCI Memorandum of 5 March 1952. Present were: Dr. This, Dr. and Mr. Dr. of RDB, and myself.
  - 2. Prior to the neeting, I had received word from Dr. that Dr. is cleared for Top Secret. Dr. I was shown the DCI Memorandum and Attachment A thereto. From subsequent discussions, I gathered that he was quite agreeable to carrying on a study of the defensive implications of the problem but suspect that he would have distinct reservations about getting into any offensive aspects.
- 3. Emmiples of the various fields of research which should to covered were given and it was emphasized that the factor of "control" was the important one rather than the subsidiary phase of interrogation.
- in reviewing this to come up with suggested nominations for his Committee. His nominations will be given to me by Dr. that I&SO can take a look at them.
  - 5. On the question of downgrading the Attachment to the DCI Memorandum of 5 March 1952, it was agreed that I would explore with I&SO the possibility of preparing a redraft for the use of the Committee that could be classified "Secret, Eyes Cnly".

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