INTRODUCTION

The Research Study Group of the United States Public Health Service received numerous applications for funds to prosecute research on prefrontal lobotomy, lobectomy and topectomy. The Chairman appointed a sub-committee in Spring, 1947 to consider the subject and report conclusions on which could be based intelligent allocation of funds. This sub-committee garnered local information but was unable to convene for thorough consideration of the problem. Therefore, the Research Committee of the Group for the Advancement of Psychiatry was requested to undertake the task. This it did at its Autumn meeting in 1947 following which a detailed report was written and circulated to the entire GAP membership for criticism and suggestions. The modified document was submitted to and approved by the Research Study Group in April, 1948 and referred to the National Mental Health Council. The Council accepted the recommendation for a lobotomy commission but deferred final action pending more specific statements on possible organization, constitution, procedures of the commission and its potential need for funds.

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Research on Prefrontal Lobotomy, Lobectomy and Topectomy

Since 1936 approximately 5,000 patients have undergone the operation of pre-frontal lobotomy or leucotomy. Most of these patients are still alive and available for study. However, from this extensive material studied over such a long period of time very few conclusive answers to any questions have been derived. Instead there is considerable aggressive propagandizing for the operation by those who perform it or use it as an essential therapeutic technique. Their statements as to the therapeutic effects and the non-existence of deleterious results are not sufficiently supported by convincing evidence. On the other hand, others who are equally biased, but against the operation, state that its effectiveness is minimal and its damaging effects great. There are a few groups of serious and scientific workers in this country who attempt to ask themselves definite and unanswerable questions from the available material and the techniques which can be applied. From them preliminary data, not sufficient to make definite conclusions, have been presented.

The literature on lobotomy has been growing steadily, but consists largely in repetitive reiterations of similar statements by the few individuals who are performing the operation in great quantity. From our discussions and reading we are not convinced that lobotomy research is anywhere at the present time implemented with the best methods and directed by the most careful thinking.

It is remarkable that the best material has come from the clinic of a Swedish investigator, Dr. Rylander, who thoroughly studied thirty-two cases after lobectomy. He states that for the purpose of obtaining adequate data one cannot use most psychotic patients and that he uses for his experiments only those individuals who give hope of reliability in their response to his tests. For this purpose he considers the chronic compulsive-obsessive neurotics the best. He warns against using for experimentation individuals who are suffering from fluctuating or episodic psychoses. Rylander points out that after the operation the patients are shallow and show no depth of feeling; in fact their relatives frequently state to him, “He has lost his soul.” Many patients after lobotomy lose a sense of value for money, everything seems all right, they forget and lose interest in everyday happenings and at night do not dream. They show no evidence of real happiness or real sorrow. They seem to have little fun and always maintain a very concrete and matter-of-fact attitude toward things that happen around them. These individuals have a tendency to perseverate, and in response to problems they seem to have only one solution. They are incapable of associating mentally freely and intelligence quotients are not quite up to the pre-operative level. Rylander suggests that eventually a partial lobectomy may be devised to avoid the above-mentioned defects and at present is reluctant to operate on non-psychotic patients. Finally, he states that on the foundation of insuffi-
cient facts huge skyscraper theories have been built and he cautions against accepting these theoretical conclusions without much further study.

Lately, the lobotomy has been performed on numerous patients for the relief of intractable pain. Individuals with suffering due to phantom limbs, generalized carcinoma, severe and intractable neuralgias and thalamic syndromes have been lobotomized with considerable reported benefit. Surgeons resort to this operation after attempting to block various pain-bearing peripheral nerve pathways without success. The results in cases of intractable pain consist not in the diminution of pain itself, but a relief of the feeling of suffering. If it is true that suffering is an individual psychobiological response, why are only surgical procedures done before resorting to lobotomy? In the cases reported no attempt to deal with the suffering by psychological means was made. Nevertheless, for the purpose of research on the effect of frontal lobotomy in man, these non-psychotic cases, without the complication of mental disturbances, are extremely valuable for determining the specific defects or release phenomena occasioned by the operation.

Recently several new operations have been utilized for the same purposes as lobotomy. Some surgeons now do a lobectomy, amputating the prefrontal areas. Topectomy removes the cortical areas giving rise to fronto-thalamic radiations and thalamectomy destroys the medial thalamic nuclei which are the end stations for these radiations. The results of the latter procedures, designed to relieve anxiety without the great defects following lobotomy, are still to be formulated.

When we ask ourselves, why are we so interested in lobotomy and allied procedures and why is there so much emotional conflict about it, we must realize that it is more than an experimental procedure to determine the function of the deep white bands of fibers which course to and from the frontal lobes. It is an operation, performed in the name of therapy, steadily advised with greater frequency not only for intractable psychoses, but also for a wide variety of psychological disturbances. It is now being used for neuroses and in some clinics even for the treatment of war neuroses. It is often done hastily, without adequate previous study, without the previous use of rational therapeutic measures and it is performed before an opportunity is afforded for possibility of spontaneous remissions. It represents a mechanistic attitude toward psychiatry which is a throwback to our pre-psycho-dynamic days, which in itself would not be of great concern if it were successful and did not harm the patient. It is a man-made self-destructive procedure that specifically destroys several human functions which have been slowly evolved and that especially separate us from other animals. If the operation is of importance as a therapeutic procedure in certain selected cases, it becomes all the more important for us to establish definite clinical indications and controls so that its usefulness will not be diluted by utilization in situations where it can do little good and much harm.

Before such clinical indications can be delineated it is important to do much research which in itself requires the utilization of adequate scientific control. Among the areas in which careful, controlled observation must be made to result in scientific and valid conclusions are the following:

1. The utilization of selected cases from definite clinical entities of various types, so that the effect of the operation can be correlated with specific syndromes.
2. The adequate application of tests before and after operation which evaluate neurological, endocrinological, psychological, bio-chemical functions and the social inter-acting situations.
3. A proper psycho-dynamic formulation of the patient’s pre-operative condition.
4. An adequate control of the actual operative severance of definitely known fibers.
5. A thoroughly adequate study of the patient’s post-operative condition for as long as five years after the procedure.
6. A statistical evaluation of a large number of cases of each type.

We have indicated in brief outline the general principles of a comprehensive experimental study and have included in appendices details (although not by any means complete or all necessary) of the examination most suitable for solving the problem posed by the research.

Our general conclusions are mainly concerned with procedure. We recommend the establishment of a commission to be composed of accepted clinicians and scientists who are actively working on the problem, and independent critics who are not engaged in this particular research but who can make available to the commission, skills and talents from several important scientific disciplines. The commission should meet from time to time to receive data, discuss procedures and advise the individual research groups. This commission should develop a registry of patients, not only of new cases, but also of existing cases who have been previously operated on. In this way comparative data from various institutions could be pooled, and follow-up studies on earlier cases and
those to be operated in the future may be extended for as long as desired, even to death and necropsy. Although it is conceded that the value of restudying old cases may be limited when their records are incomplete or unscientific, yet something of significance may develop from following their longitudinal life sections.

**SAMPLE PLAN OF STUDY**

Herein is presented a general outline of available clinical, psychological, physiological, and behavior examinations, to determine the therapeutic benefits and deficits from prefrontal lobotomy in patients with psychiatric disorders. Until better procedures are devised or adapted for psychological research, at least those now available should be utilized with maximum precision. The details of the examinations will be presented in a series of appendices. Criteria of improvement in the disease and deterioration of function imply judgment involving values, hence cannot be standardized, and should be objectively stated.

It is recognized that it is not practically possible to use every patient operated on for research, i.e. for the rigid evaluation of this treatment. In some cases, owing to the individual hospital facilities and kinds or quantity of personnel, a few or even a single area of investigation may only be possible. In some hospitals it may be impossible to do more than a cursory clinical examination before and after lobotomy. Even limited observations are useful and should be made, but the results should be differentiated from those obtained in carefully planned and controlled studies. Although the initial interest has been to evaluate lobotomy, etc., as a therapeutic tool, valuable information can be obtained, from the effects of lobotomy, etc., on a variety of psychological and somatic functions. This information should lead to a better understanding of the functions of the frontal lobes in man. An especially suitable group for this understanding are non-psychotic patients operated for intractable pain.

**A. General Principles.**

1. **Methods of obtaining data.** Controlled observations on the behavior of the patient for a long period before and after operation are the basic sources of data. Whenever possible, these data are to be quantified, or appraised by semi-quantitative methods. It is suggested that, whenever possible, the data be arranged on a punch card system for correlation.

2. **Period of Observation.** The observation should extend over as long a period of time after the patient is accepted for surgery as is permitted by the available patients and their relatives. The importance of detailed post-operative examination cannot be overemphasized. The observations should continue after the patient has left the hospital and returned to some level of work and social activity. Results from the treatment, good or bad, often appear only when the patient is subject to the stresses attendant upon the resumption of his work and social relationships at long periods after leaving the hospital environment.

3. **Selection and Control of Subjects.** Subjects are to be selected on the basis of belonging to special categories of clinical diagnoses and the general capacity of the patient to cooperate in the various test procedures. Preferably they should be within a similar age group with similar symptoms and personalities and, if possible, with similar degrees of disability. If patients with chronic illness are used for the study, it is best not to use them until the illness has been stabilized for at least one year. Patients preferably should not have had previous shock treatment because of its own damaging effect in the cerebral cortex. At present this may not be a feasible basis of selection since most chronic cases come to operation as a last resort after multiple series of shock.

4. **Matching of Patients and Control Subjects.** In order to be sure that the therapeutic results are due to the operation and not to the special post-operative hospital care, it is important to study matched or equated groups of patients. Each patient should be paired with a member of a control group of non-operated patients as to age, color, I. Q., schooling, and social and economic status. If possible, patients should also be matched with the control group as to symptoms, duration of illness, duration of period of stabilization of illness and hospitalization, and previous treatment. It would be ideal to have the matching include personality and some measures of adjustment and social efficiency such as earning power. The matching may be done at the beginning of the study or may occur during the course of study as large number of patients are operated and control subjects are accumulated. It is also necessary to match patients as to their motivation to get well; methods should be developed to appraise the desire of the patient to accept help and to cooperate. The motivation of the family (their wishes to see improvement, their death wishes and impatience) and of the physician (his pre-research bias) must also be taken into consideration. These matching possibilities are all desirable, but the most important element to match regardless of all others is the psychodynamic state.

5. **Control of Operation, Pre- and Post-operative Care.** The operative procedure if possible should be precisely the same in all of the patients in the operated
series. The operation should be standardized with the greatest amount of visibility, controlled by biopsy of the gray matter on the surface of which the cut is made and whenever possible by necropsy. The degree of operative trauma can only be assessed by the injection of radio-opaque substance, the position and extent of which can be followed by X-ray at specified times, but the only certain method of knowing what has been cut is by studies of the architectonic structure of the overlying or removed cortex. The degree and nature of post-operative bleeding and other complications should be noted and described in detail. The pre- and post-operative care including the description of the attention and solicitude of the nursing staff should be noted and controlled. The patients in the control series should receive the same pre-and post-operative care as the patients, for which all attendants should be suitably indoctrinated. The ideal control group could be "falsely" lobotomized by having a burr hole made and the dura cut, although this may rarely be feasible. Operation in other areas of the body could also be used as control. The staff of clinicians, psychologists, and nurses should not know which patient has actually had the lobotomy. This information could be kept secret by the neurosurgeon and released only after the full study is terminated. The patients and control subjects may be housed in the same ward to insure similar care, but since attendants will soon recognize lobotomized patients, a separate, completely duplicated ward may be a better control.

B. Plan of Study.

The plan of study should include a complete medical, neurological, and psychiatric examination, a series of physiological and biochemical tests, and a battery of psychological tests. These should all be made at pre-determined times if possible and should be recorded upon prepared worksheets. The test procedures should be repeated in patients and controls at similar time intervals before and after the operation, and should allow for observation in the resting state and while the patient is exposed to various types of physical stimuli and stress situations. Attention should be paid to the methods of history taking, methods of obtaining the mental status, and psychiatric examination. Plans should be made for adequate follow-up studies, which should include re-examination of the patient by the physician, observations of the patient by the family and others who have professional and social contact with him. Repeated psychological observations and social reports should be included as part of the follow-up study. It is realized that the physical and somatic tests may in themselves serve to gratify conscious and unconscious needs for punishment and personal attention, hence the need for control groups of non-operated subjects.

1. Psychiatric Examination.

(a) History. This should include a complete psychiatric history with data on the patient's development, early neurotic reactions, school, job, social and other adjustments, and a careful history of the onset, nature and degree of the patient's illness. This should be checked by material obtained from outside sources. (cf. appendix 1)

(b) Personality description. This should include a description of the personality with such factors as organization, maturity, energy, satisfactions, and capacity toward adjustment. The clinical description is to be amplified by personality tests as described below. (cf. appendix 2)

(c) Symptom review. This should include a careful and accurate description of the patient's complaint and symptoms, given in detail from the onset of the present illness through to the time of examination. Whenever possible, symptoms should be rated as to duration and intensity.

(d) Mental status and behavior examination. These should include a description of general behavior, mood, special ideas, hallucinations, and survey of the cognitive functions. Memory should be examined accurately by means of special psychological tests. Behavior should be examined and whenever possible measured. It should include the patient's subjective account, the observer's account, and eventually the report of the family and associates. Special emphasis is placed upon the interaction of the patient in the social setting and under conditions of stress. The purpose of these is to obtain some measure of the patient's capacity to adapt to specific situations before and after the operation. (cf. appendix 3)

(e) Dynamic formulation. In addition to the more formal aspects of the history, a dynamic formulation of the patient's adjustment should be worked out. This should describe the dynamic mechanisms operating in the patient's pre-morbid adjustment, and the mechanisms operating during the patient's illness. Attention should be paid to the family constellation and the patient's adjustment to the significant figures in his environment (cf. appendix 4)

(f) Neurological examination. This should include complete neurological examination. Special note should be made of the presence of weakness, aphasia, convulsions and of neurological disorders.

(g) Vegetative nervous system. Examinations of skin, sweating, G. I. tract, genito-urinary system,
respiration, blood vessels, circulations and nutritional state. (cf. appendix 5)

(h) Biochemical and endocrine. These should include measurements of oxygen metabolism and adrenal cortical activity as determined by urinary ketosteroids, circulatory lymphocytes and eosinophils under resting and stress conditions. (cf. appendix 6)

(i) EEG examination. This should include a series of tracings with monopolar and bipolar recording from electrodes placed at measured points on the skull before and after the operation. In addition to the routine leads, tracings should be obtained for the region anterior and posterior to the lobotomy incision. The EEG should be studied in the resting stage and in response to such stimuli as hyperventilation, low oxygen, low blood sugar, light and various psychological stimuli. The records should be subject to mechanical analysis if possible. (cf. appendix 7)

(j) Psychological tests. The test battery should include personality tests, performance tests, and projection tests. These tests should obtain descriptions and preferably measures of various skills and functions on verbal and non-verbal abilities, personality traits, ideational content and motivation, modes of reaction to stress and frustrations. The Halstead test battery and other similar tests are suggested for evaluating changes or defects before and after operation. The personality tests should attempt to identify profiles and should be factorially as pure as possible. The projection tests should include the Rorschach, Thematic Apperception Test, and others. All tests are to be given according to a planned schedule. (cf. appendix 8)

APPENDIX 1
HISTORY TAKING

Accuracy and completeness of information are essential in taking the history of the patient. The history as obtained from the patient should be checked by descriptions from outside sources, preferably from members of the family who have known the patient intimately for years and who are interested in the patient’s welfare. It is best for the physician to have access to a check list covering significant items in the family history and such items in the patient’s history as the early development, adjustment in childhood, childhood neurotic reactions, school, job and other social adjustments. Special interest centers about the pre-morbid personality and the onset, nature and degree of the patient’s illness. A complete system review and mental status should be included. These data can be obtained by interviews with the patient.

In interviewing it is suggested that the patient be given the opportunity to talk freely or to browse about topics as they come to him in order to obtain information as to the importance and meaning of events to the patient. He should be encouraged to discuss all topics of interest. Questions should be reduced to a minimum and be so designed as to prompt the patient to talk freely. The study of the patient’s verbatim material often allows the opportunity to study the nature and type of associations from which dynamic inter-relations can be deduced.

The interview material can be supplemented if possible by written material dealing with special topics and by questionnaires, preferably self-administered. Questionnaires are of limited value, but if given judiciously after the patient has developed a therapeutic relationship with the doctor may help in obtaining more complete information. Questions should be stated clearly, avoiding ambiguity, and should aim to obtain data on the presence as well as the absence of traits and symptoms.

APPENDIX 2
RATING SCALES FOR PATIENT’S HISTORY, PERSONALITY AND BEHAVIOR

These scales are useful only as adjuncts to the history and descriptions of the patient’s personality and behavior as obtained in the interview, but many clinicians discount their value. It is best to have several observers in addition to the patient’s personal physician, rate the developmental and social history. The Elgin Developmental Scale could be useful. Likewise several observers could independently rate the observable behavior of the patient on the ward. Useful rating scales for behavior have been developed by Malamud, Hoagland and Kaufman and by Anna Roe. The ratings for each item could be recorded daily on a summary chart. Frequent conferences of the staff are essential in order to sustain interest and accuracy in rating. The items could include:

1. Developmental and Social History.
2. Personal Appearance.
3. Activity.
6. Sleep.
7. Appetite.
8. Speech.
9. Attention.
10. Mood.
11. Orientation.
12. Insight.
13. Symptoms such as Hallucinations, Delusions, Flight of Ideas, Appropriate Behavior.

**APPENDIX 3**

**MEASUREMENTS OF INTERACTION**

One aspect of the patient's behavior deals with his activity in the social situation. Observations in this area are difficult to make, because the variations or changes in the patient's behavior may reflect changes in the social setting to which the patient is reacting. In the ward setting, the control of the field in which the patient is interacting is difficult. In the interview situation it is possible more readily to control the behavior of the interviewer, and thus, the interaction of the patient more clearly reflects the internal processes of the patient. Further, the methods of observing interaction in the interview situation have been somewhat better standardized.

**Interaction in the Social Setting.**

These could include observation on:

1. The amount of time the patient spends alone in the ward and the amount spent with other patients.
2. The nature of the interaction. This should describe the role the patient takes in the group and should measure the tendency of the patient to dominate the group, to assume initiative or to be a follower.
3. The patient's reaction to the group, especially to significant figures in the group.
4. The quantification or scoring of these items for comparing the patient's behavior before and after the operation.

**Interaction in the Interview Situation.**

The interview situation offers an opportunity to study the interaction of the patient and the doctor. The patient may show a distinctive pattern of verbal and gestural activity which can be described and some aspects of which can be measured. Some device such as the interaction chronogram can be used to record the pattern of activity (speech and gestures) by showing in sequence the duration of each period of action and silence of the patient and the doctor. Measurements of the patient's activity, interruptions, failures to respond, initiation, dominance, simultaneous actions and silences of both the patient and doctor can be obtained. Since the patient's interaction is partly a function of the interviewer's behavior and of the type of interview, it is necessary to use a type of interview in which the behavior of the doctor is controlled. Data obtained this way might show differences in interaction due to the operative procedures.

**APPENDIX 4**

**DYNAMIC FORMULATION**

On the basis of the patient's complaint, history and reactions, it is suggested that the physician work out a dynamic formulation. This should include statements as to the significant personal relationships during various periods of the patient's life, with special emphasis on the patterns operating during childhood. This formulation should include the events which are important in the development and persistence of personality traits, types of conflict present, the development and role of the defense mechanisms and methods of dealing with anxiety. A formulation should be presented of the psychological mechanisms which have been developed and are at the disposal of the patient in adjusting to his life situations past and present. Special attention is to be paid to the factors responsible for disturbing the patient's equilibrium and resulting ultimately in the morbid process. Attempts should be made to understand the purpose of the illness, the meaning of the symptoms and the relation of these to the role of the physician in the doctor-patient relation. The effects of the operative procedures on the patient's dynamic situation could be assessed and evidence obtained to indicate the meaning of this to the patient and the mechanics of the patient's adjustment. In a similar manner, formulation of the patient's psycho-dynamic situation at various periods after the operation might be helpful in understanding the changes due to the deficit resulting from the operation. These formulations are little furthered by stereotyped tests but develop from psychiatrists knowing their patients as human beings struggling with severe problems and making the best available adjustments within their own limitations to their stress situations. Such formulations are best obtained from a study of the physician-patient interpersonal relationship.

**APPENDIX 5**

**VEGETATIVE NERVOUS SYSTEM**

The examination of the vegetative nervous system is to be done at varying time intervals before and after the lobotomy. If possible, it is best to examine several functions simultaneously and to obtain data in the form of continuous tracings obtained by automatic recording devices for detailed analysis. Two types of study have given fruitful results. The first type attempts to determine the effects of various
physical, chemical and emotional stimuli upon functions of the Autonomic Nervous System. Measurements should be made in the resting state as well as during the stimulus period. Accurate data can be obtained by these studies on the variations in response to certain isolated stimuli before and after the operation. The second type of study deals with the effect of more diffuse but meaningful life situations upon the vegetative functions. In many respects data of this kind, though more difficult to assess, may be more pertinent to the clinical problem. It is necessary to have repeated observations on the same patient and relate these physiological measurements to the emotional status and the dynamic situation of the patient. Much care must be used in the experimental design to avoid artifacts and changes due to uncontrolled variables.

Circulation and Respiration.

Studies in circulation may include the following functions:

1. **Heart Rate.** This can be measured from records obtained by means of a cardiachometer, E. K. G., or other type of tracing. The mean values for a given period as well as the variability can be determined.

2. **Cardiac Output.** Absolute values can be determined by the Grollman method or the ethyl iodide method of Starr. The ballestocardiogram is useful in obtaining comparisons of reactions to various stimuli in the same patient.

3. **Circulation Time.** This can be obtained by the use of various dyes, decholin, or of the more recent radioactive substances.

4. **Cerebral Circulation.** This can be studied by the methods of Schmidt and Kety or possibly at time of operation by the Bronk electrode.

5. **Respiratory Tracings.** These can be used to determine the detailed pattern of respiration and its stability under various stimuli.

6. **Pulmonary Ventilation and Oxygen Consumption** and various indices obtained for measurements by standard methods.

**Gastro-Intestinal Tract.** Examinations can include measurements of motility, acidity, and vascularity—by standard methods. Appetite and weight should be accurately recorded.

**Vasomotor Activity** can include examination of the circulation in extremities by means of the finger plethysmograph, photo-electric cell, and the use of thermocouple for skin temperature. Sweating can be grossly estimated by the starch-iodine method, or more precisely by measurements of skin resistance with careful attention to the details of placing the electrodes, electrode paste, previous activity of the subject and the control of temperature, humidity and other variables.

APPENDIX 6
ENDOCRINE STUDIES

**Measurement of Circulating Lymphocytes and Eosinophils.**

Circulating lymphocytes and eosinophils are used for the measurement of adrenal cortical hormones. Reliable data are available to indicate that the 11-oxysteroid (sugar-active) group of hormones are involved in the breakdown of circulating lymphocytes. Similar evidence for the circulating eosinophils is not as yet available. It is well known that the circulating lymphocytes, and to a lesser degree the circulating eosinophils, vary in number during the course of the day. It is therefore necessary to establish the diurnal variation before the effect of a stress situation can be properly evaluated. It appears that a variety of factors, including exercise, food, sleep, extremes of heat and cold, and emotional tension influence the numbers of lymphocytes and eosinophils, and it is important that the experiments be very rigidly controlled.

**Time of Examination.**

A single measurement of lymphocytes or eosinophils is inadequate to establish a base line owing to the diurnal variation. It is suggested that measurements be made at definite periods through the day to obtain a plot of the variation. A reasonable schedule would be to obtain blood for counting the lymphocytes or eosinophils at 8:30 and every two to three hours thereafter throughout the day. These counts should be repeated at the same time intervals for two or three days to establish a base line. Most stressful stimuli bring about a decrease in the lymphocytes. Hence, it is best to apply the stressful stimulus during the morning hours when a rise in the absolute numbers occurs. The stress stimuli must be very intense or must be used for a long period of time (30 to 60 minutes) in order to obtain a reaction.

After the diurnal variations have been established, the stress stimulus can be used on another day, comparable measurements being made at the same time intervals. Comparisons can then be made to determine the effect of the stress situation.
Urine Studies.

Several methods are available for estimating variation in adrenal cortical function by measuring the excretion of various urinary components. In such studies, it is important to make sure that the patient has no renal disease and that he excretes an adequate volume of urinal. In investigating uric acid and electrolyte excretion, attention must be given to the protein and electrolyte intake of the subjects previous to the test.

1. Uric Acid. The excretion of uric acid appears to be related to the breakdown of lymphocyte protein, and useful information may be obtained by following uric acid excretion. This is a gross measure and is more useful in conditions where a large breakdown of lymphocytes may be anticipated.

2. Electrolytes. Potassium, sodium and chloride excretion are directly related to adrenal cortical function. It seems likely that the most useful information is to be derived from studies of potassium excretion.

3. Hormone Studies. Direct studies of urinary excretion of the metabolic products of adrenal cortical steroids are of interest. The easiest of these hormones to measure are the 17-ketosteroids; and although these compounds are products of androgenic hormone metabolism, there seems to be a relationship between 11-oxysteroid and 17-ketosteroid elaboration so that useful information can be obtained.

Direct measurement of 11-oxysteroid compounds in the urine is extremely difficult because of the minute quantities which are excreted. Usually a full 24-hour specimen is necessary for accurate determination, thus rendering impossible the estimation of acute changes. A less accurate but easier method has been devised by Pincus for measuring total reducing steroids in the urine, and in fresh samples it seems probable that this too might yield useful information.

APPENDIX 7
EIG EXAMINATION

The EEG can be used to obtain a record of the electrical activity of the brain and to detect changes due to the lobotomy. It is necessary to obtain a series of tracings before and after the lobotomy to determine the differences presumably due to the lobotomy. Since it is known that post-operatively the EEG may change considerably, it is important to record a large series of tracings immediately after the operation and at frequent subsequent time intervals.

All records should be obtained under the same controlled conditions in patients whose blood sugar is well over 100 mgm.

Conditions for Obtaining Records.

A series of tracings should be obtained at varying time intervals before the lobotomy to determine the type of tracing and its stability. Similarly a series of tracings should be obtained from exactly similar electrode placements if possible immediately after the operation and at definite intervals throughout the course of convalescence and the follow-up period. The stability of the record can be determined by (1) comparing repeated records before the operation under controlled conditions and (2) determining the effect of physical, chemical and ideational stimuli, such as low oxygen, high CO2, low sugar (insulin), light, auditory and psychological stimuli. The same methods and similar stimuli are to be used after the lobotomy.

Electrodes and Their Placement.

Tracings should be obtained from electrodes placed at measured positions from the fixed bony landmarks. The recordings should be from scalp electrodes placed over (1) the prefrontal region (anterior to the lobotomy section), (2) the frontal region (posterior to the site of the lobotomy), and (3) Rolandic area, (4) temporal area, (5) parietal and (6) occipital areas. All recordings should be bipolar, and scalp-to-ear linkages should only be used with the full recognition that the second electrode (on the ear) may be the more active of the pair and may be contributing potentials originating in that part of the brain nearest to it (i.e. the temporal lobe). The foci of the subject's normal activity should be determined by localizing techniques before lobotomy. Should abnormal waves result from the operation, the focus or foci of these should be similarly determined.

Analysis of the Tracings.

All records should be analyzed in the same way to obtain data on the dominant pattern, the wave form, voltage and frequency. This can be done by manual measurement of the record or preferably by the use of some mechanical or electronic type of simultaneous analyzer. The pre-operative pattern should be compared with the records of normal control subjects, and the post-operative record should be compared with the pre-operative record. The EEG findings are to be correlated with results from other studies. An attempt should be made to compare the post-operative EEG records with those after other brain operations in order to differentiate between
abnormal waves due to surgical trauma and those due to interruption of fiber pathways from lower centers. Localization studies should be able to give data on this point. Possibly the use of a nasal lead would prove helpful.

APPENDIX 8

The test battery should include performance tests, personality tests, projection tests and measurements of affectivity administered before the operation and at regular pre-determined intervals after the lobotomy. Tests should be selected so as to avoid duplication of measurement and so as to be readily scored. Some self-administrative tests could also be included. A comprehensive battery has been prepared by Dr. J. F. Miller in a report on the "Experimental Plan for Appraising the Effects of Prefrontal Lobotomy," for the U. S. Veterans Administration. This has been liberally consulted in preparing this appendix. A list of suggested tests is presented below. This list is by no means all-inclusive:

Performance Tests.

1. Motor Performance
   (a) Steadiness
   (b) Tapping Speed
   (c) O’Connor Tweezer Dexterity
   (d) O’Connor Finger Dexterity

2. Concept Formation
   (a) Halstead Category Test
   (b) BRL Sorting Tests (N. Y. Psychiatric Institute)
   (c) Other tests of conceptual thinking such as Hanfmann-Kasanin

3. Spatial Relations
   (a) Grace Arthur Stencil Design Test I
   (b) O’Connor Wiggly Blocks
   (c) Seguin Form Board (administered blindfolded—Halstead)
   (d) Kohs Block Design

4. Memory
   (a) Wechsler-Bellevue Intelligence Scale Form I—Memory Span for Digits Backward and Forward
   (b) Memory for Stories after Stanford-Binet
   (c) Time Tense Memory (Halstead)
   (d) Graham-Kendall Memory for Designs

5. Visual Planning
   (a) Porteus Maze (Vineland Revision)

6. Verbal Meaning
   (a) Wechsler-Bellevue Intelligence Scale—The Vocabulary Tests

7. Critical Flicker Frequency

Other tests could be included which attempt to measure more complex functions and degrees of cerebral deficit. Among these the Chicago Primary Mental Abilities Tests and tests determining the speed of judgment, decision time, distractability and persistence.

Personality Tests.

These tests are used to supplement the personality profiles determined by clinical study. Several types of Personality Questionnaires are available, such as:

1. Minnesota Multiphasic Personality Inventory (not given high rating by many clinicians)
2. Kuder Preference Record (Interests)
3. Allport-Vernon Study of Values

A consideration of specific items in the tests in addition to the over-all score might be informative.

Projective Tests.

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