

Spring 5-18-1959

Electrical Desiccation as a Method for Marking Functional Cortical Areas

Kenneth R. Earp

Follow this and additional works at: https://digitalrepository.unm.edu/psy_etds



Part of the [Psychology Commons](#)

Recommended Citation

Earp, Kenneth R.. "Electrical Desiccation as a Method for Marking Functional Cortical Areas." (1959).
https://digitalrepository.unm.edu/psy_etds/187

This Thesis is brought to you for free and open access by the Electronic Theses and Dissertations at UNM Digital Repository. It has been accepted for inclusion in Psychology ETDs by an authorized administrator of UNM Digital Repository. For more information, please contact disc@unm.edu.

UNIVERSITY OF NEW MEXICO-UNIVERSITY LIBRARIES



A14429 083688

378.789

Un3Oe

1959

cop. 2

WELLESLEY COLLEGE LIBRARY

DESCRIPTIVE

EVERY

THE LIBRARY
UNIVERSITY OF NEW MEXICO

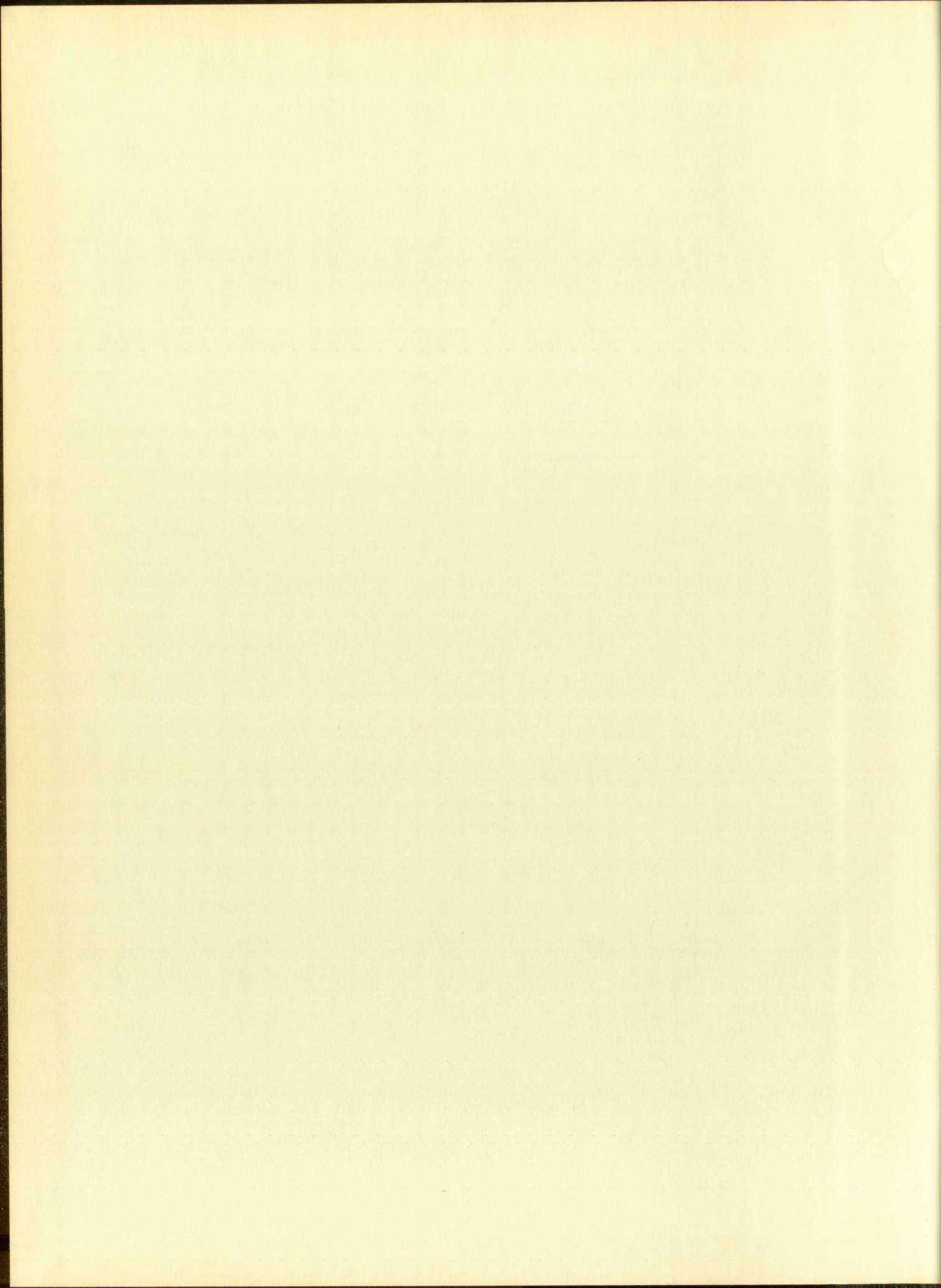


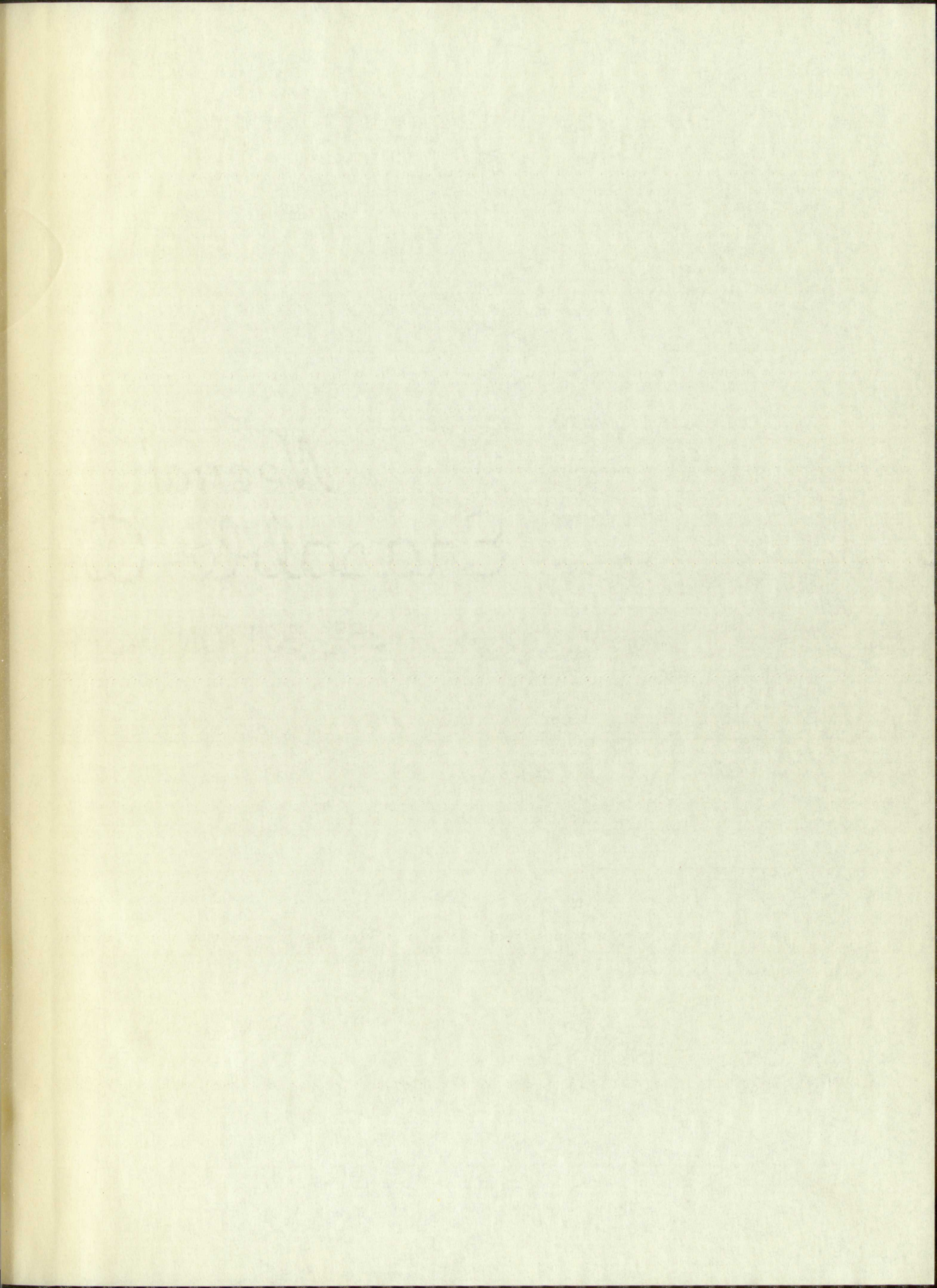
Call No.

Accession
Number

378.789
Un30e
1959
cop.2

247447





Handwritten text, possibly a signature or title, is visible in the center of the page. The text is extremely faint and illegible due to the low contrast and scan quality. It appears to be written in a cursive or semi-cursive style.

UNIVERSITY OF NEW MEXICO LIBRARY

MANUSCRIPT THESES

Unpublished theses submitted for the Master's and Doctor's degrees and deposited in the University of New Mexico Library are open for inspection, but are to be used only with due regard to the rights of the authors. Bibliographical references may be noted, but passages may be copied only with the permission of the authors, and proper credit must be given in subsequent written or published work. Extensive copying or publication of the thesis in whole or in part requires also the consent of the Dean of the Graduate School of the University of New Mexico.

This thesis by Kenneth R. Earp.....
has been used by the following persons, whose signatures attest their acceptance of the above restrictions.

A Library which borrows this thesis for use by its patrons is expected to secure the signature of each user.

NAME AND ADDRESS

DATE

MANUSCRIPT TERMS

Unpublished theses submitted for the Master's and Doctor's degrees and deposited in the University of New Mexico Library are open for inspection, but are to be used only with reference to the rights of the author. Bibliographical references may be made, but passages may be copied only with the permission of the author and proper credit must be given in subsequent writings or published work. Extensive copying or publication of the thesis in whole or in part requires also the consent of the Dean of the Graduate School of the University of New Mexico.

This thesis by _____ has been used by the following persons whose signatures at the time acceptance of the above restrictions _____

A library which borrows this thesis for use by its patrons is expected to secure the signature of each user _____

NAME AND ADDRESS _____
DATE _____

ELECTRICAL DESICCATION AS A METHOD
FOR MARKING FUNCTIONAL CORTICAL AREAS



By
Kenneth R. Earp

A Thesis
Submitted in Partial Fulfillment of the
Requirements for the Degree of Master of Science
in Psychology

The University of New Mexico

1959



ELECTRICAL ENGINEERING DEPARTMENT
FOR MAKING REVISIONS TO THE ORIGINAL

REVISION NO. 1

A THEORETICAL INVESTIGATION
SUBMITTED TO THE FACULTY OF ENGINEERING
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE
BY

The University of Toronto

1955

This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of the University of New Mexico in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

E. Castetter
DEAN

May 18, 1959
DATE

Thesis committee

G. W. Peterson
CHAIRMAN
R. D. Howard
D. T. Benedict

The first part of the report is devoted to a
summary of the work done in the field of
the study of the life cycle of the
insects for the season.

[Faint handwritten text]

[Faint handwritten text]

[Faint handwritten text]

The second part

[Faint handwritten text]

378.789
Un30e
1959
cop 2

Acknowledgments

The writer wishes to express appreciation to Dr. George M. Peterson for the assistance and advice given while this study was in progress.

I am also indebted to Mr. Donald K. Gucker for his advice and information on the equipment and on the histological procedures used in this investigation.

This work was supported by N.S.F. project number 6-3878.

WILLIAM WATTS
1212 B V S E
WILLOW GROVE

27674
1939
1939
1939

INTRODUCTION

The writer wishes to express appreciation to
Dr. George M. Peterson for his assistance and advice
given while this study was in progress.
I am also indebted to Mr. Donald E. Johnson for
his advice and information on the various points of
histological procedure used in this investigation.
This work was supported by U.S. Army Research

6-3878

24717

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
Problem and Literature	1
II. METHOD	5
Animals	5
Apparatus	5
Procedure	6
III. THE PRELIMINARY INVESTIGATION	9
Method	9
Results	10
IV. THE MAIN INVESTIGATION	11
Method	11
Results	12
V. SUMMARY AND CONCLUSIONS	15
Summary	15
Conclusions	16
REFERENCES	17
APPENDIXES	19

TABLE OF CONTENTS

	CHAPTER
INTRODUCTION	I
Problem and Objectives	
METHOD	II
Animals	
Apparatus	
Procedure	
THE PRELIMINARY INVESTIGATION	III
Method	
Results	
THE MAIN INVESTIGATION	IV
Method	
Results	
SUMMARY AND CONCLUSIONS	V
Summary	
Conclusions	
REFERENCES	
APPENDICES	

LIST OF FIGURES

FIGURE	PAGE
1. Block Diagram of Electrical Equipment	7
2. The Locus of the Destructions for Group I	12
3. The Locus of the Destructions for Group II.	14
4. Destructions for Case 3	24
5. Destructions for Case 4	25
6. Destructions for Case 11.	26
7. Destructions for Case 21.	27
8. Destructions for Case 31.	28
9. Photomicrograph of Most Extensive Destruction for Group I	29
10. Photomicrograph of Least Extensive Destruction for Group I	30

FIGURE

1. Black Diagram of Histological Section
2. The locus of the histological section
3. The locus of the histological section
4. Distributions for Case 1
5. Distributions for Case 2
6. Distributions for Case 3
7. Distributions for Case 4
8. Distributions for Case 5
9. Photomicrograph of histological section
10. Photomicrograph of histological section

PLATE I

CONTENTS

I. Introduction

Investigators in the fields of psychology and physiology have postulated and searched for changes in the nervous system due to practice. However, there has been no direct evidence concerning the nature of this change.

Hilgard (1956, p. 481) states that "one of the most crying needs is for a crucial experiment identifying specifically a change occurring in neural tissues (or in bio-electrical fields related to such tissue) as learning takes place."

Recent progress in the development of highly refined apparatus for electrical stimulation and for the recording of neural activity has produced some evidence and theory concerning possible neural changes in the spinal cord (Eccles 1953). There has been no direct evidence, however, concerning cortical changes which presumably take place when learning occurs. (Hebb 1949).

An approach to the problem has been made possible by Peterson's (1934) work on handedness in rats. Peterson and Gucker state that, "Preferential handedness in the rat offers a means of attacking the issue without too many taxing assumptions and with certain advantages over other simple behavioral phenomena. It is highly localized in the cerebral cortex (Peterson and Fracorol, 1938) and can be influenced by practice (Peterson, 1951). A histological approach to the study of

I. Introduction

Investigators in the fields of psychology and physiology have postulated and searched for changes in the nervous system due to practice. However, there has been no direct evidence concerning the nature of such changes. Hilgard (1956, p. 481) states that "one of the major needs is for a critical experiment identifying specifically a change occurring in neural structure for all individuals fields related to such changes as learning, habit formation, etc." Recent progress in the development of highly refined apparatus for electrical stimulation and for the recording of neural activity has provided some evidence and theory concerning possible neural changes in the central nervous system. There has been no direct evidence, however, concerning cortical changes which presumably take place with learning occurs. (Hebb, 1949).

An approach to this problem has been made by Peterson's (1954) work on habituation in the rat. Gucker states that "Peterson's findings in the rat are a means of attacking the least of the many learning phenomena and with certain advantages over other learning phenomena. It is highly localized in the cerebral cortex (Peterson and Warriner, 1954) and can be induced by practice (Peterson, 1951). A habituated response is the result of

structural changes is feasible only when precise localization is possible. Such an investigation requires comparison of tissue before practice with tissue after practice, and this ordinarily calls for two animals" (1959, p. 2). Handedness offers an advantage because comparison of the cortical tissues in the areas controlling the preferred and non-preferred limbs can be made within a single animal.

Attempts to find a common cortical locus for handedness in all rats, however, has failed (Peterson and Fracorel, 1938), and therefore electrical stimulation has been used as a means for locating the area involved (Peterson and Gucker, 1959). Peterson and Gucker suggest that a means should be found for marking the point where electrical stimulation locates the area for handedness, so that histological examination of the tissue in this area can be made.

However, when tissue is marked or treated in any manner, there is risk of producing a functional change. If the cortical elements operative in handedness are destroyed or changed in an attempt to mark them for identification, then the mark has made further histologic investigation useless. One way to determine whether such a change has occurred is to test for handedness transfer after the rat has been marked.

The present study is concerned specifically with this problem, i.e., whether a means can be found to make a mark at

structural changes in the... as possible. Such an... tissue before... ordinarily calls for... efforts to... in the... limbs can be made...

Attempts to find... in all... and therefore... for locating... Peterson and... marking the... area for... tissue in...

However, when... manner, there is... the correct... or changed... then the... loss. One way... is to test... marked.

The present... problem...

the point where handedness has been localized by electrical stimulation without producing changes in that area sufficient to alter its functioning.

It has been suggested that the cells influencing handedness behavior are located in layer V or below in the cortex (Peterson, 1934). As a working assumption this implies that marks should not be made which penetrate the cortex beyond layer IV.

In order to make destructions of this magnitude, it is necessary to utilize an instrument which will give us the advantage of minute destructive effects. Tissue destruction utilizing high-frequency currents appears to give us this advantage. William L. Clark (Kelly and Ward, 1932) was the first man in this country to describe the destructive effects of high-frequency currents on tissue. He noted that the cells became dehydrated and consequently terms this kind of destruction desiccation.

Desiccation of cortical tissue was produced in this experiment with the use of a Hyfrecator¹. The Hyfrecator

¹A Hyfrecator is an electrosurgical device which produces radio frequency currents of 2.5 megacycles at a voltage of approximately 1800 volts maximum and at low amperage. It is used primarily for the removal of tumorous growths, and is manufactured by the Birtcher Corporation in Los Angeles, California.

the point where hands were not localized by electrical stimulation without producing a response. This was necessary to alter the threshold.

It has been suggested that the cortex is involved in handness behavior and located in layer IV of the motor cortex (Peterson, 1974). As a working assumption, it is implied that such a study not only would determine the cortex beyond layer IV.

In order to make a distinction of this study, it is necessary to realize a distinction with other studies in the advantage of using a computer system. It is possible that utilizing high-frequency electrical stimuli to produce an advantage. Utilizing a hand-held device, it is possible that first can be this study. The study of the motor cortex of high-frequency currents in animals, the neural basis of cells become depressed and consequently, the study of destruction is possible.

Distinction of electrical current was produced in this experiment with the use of a hand-held device.

A. Peterson is an assistant professor of psychology at the University of California, Los Angeles. He received his Ph.D. in psychology from the University of California, Los Angeles in 1968. He is currently working on a project of experimental psychology. He is currently working on a project of experimental psychology. He is currently working on a project of experimental psychology.

was chosen for this work because it offered the opportunity to combine the stimulating electrode and the desiccating needle into one, thus making it possible to locate and mark the handedness area in a single procedure. Other advantages of this instrument are that the amount of current and the length of time this current is supplied to the desiccating needle can be controlled precisely, and that the tissue is sterilized in the desiccated area. Since capillaries are sealed using this technique, damage due to bleeding is minimized.

Cortical tissue desiccated in this experiment had the appearance of being more lightly stained than surrounding tissue with an absence of neurons in a conically shaped area, with the apex of the cone directed toward the center of the tissue. These differences were used in determining the boundaries of the destruction for the measurement of the desiccated tissue.

was chosen for this work because it gives the most
to compare the anatomical structure and the
needle into one, the needle is held in the hand and
the handpiece used in a similar manner. The length
of this instrument is not the same as that of the
length of the handpiece. It is possible that the
needle can be controlled more easily, and that the
sterilized in the handpiece. This is possible and
sealed using heat treatment. Damage was to be
minimized.

Cortical tissue is located in the outer part of
the appearance of the bone. It is the outer part
ing tissue with a thickness of between 1 and 2 mm.
area, with the rest of the bone. The outer part
of the tissue. These differences were noted in
the boundary of the bone. The outer part of
the decalcified tissue.

II. Method

Animals:

Male albino rats, 3-4 months old, were used in this study. Sixteen rats were selected at random for the preliminary experiment. For the main experiment ten rats which met a criterion for 95% single-handedness were selected.

Apparatus:

The Peterson (1931) food-reaching situation was used to determine handedness of the rats.

A modified stereotaxic instrument was used to hold the rat in position during stimulation and marking. The base of the instrument consisted of two brass plates with smooth faces which allowed them to slide with moderate friction over each other. The top plate held a V block for the rat's jaws and a wire clamp for the teeth. To the lower plate was attached a steel arm which held the needle used for stimulation and/or desiccation. The needle could be raised or lowered vertically and was rigid horizontally. In order to stimulate various points on the cortex, the plate holding the rat was moved.

Electrical stimulation was performed with interrupted direct current at 200 pulses per second and ranging from 5 to 10 volts. This was supplied to the stimulating electrode by a Tektronix Type 160 A power supply, a Type 162 Waveform Generator, and a Type 161 Pulse Generator.

Animals:

Male albino rats, 150 grams, were used in this study. Sixteen rats were selected for the preliminary experiments. For the main experiment, a criterion for 25% strength was used.

Apparatus:

The Peterson (1931) force-measuring device was used to determine loadings in the test. A modified apparatus was used for the test in position during the experiment.

of the instrument used for the test. The faces which allowed them to work with the instrument on each other. The top plate had a hole for the wire clamp for the weight. To the lower plate was attached a steel wire which held the handle and the position and/or distance. The handle was lowered vertically and the force measured. The stimulus various kinds of responses, and the rat was moved.

Electrical stimulation was performed with a direct current of 200 pulses per second and voltage of 10 volts. This was regulated by a Tektronix Type 100 A power supply, a generator, and a type 100 A generator.

General Procedure:

Operations were performed using ether anaesthesia. A 3/16 inch trephine was used to expose the contralateral frontal cerebral cortex. Care was taken not to injure the pia mater during this process.

The tip of the stimulating electrode was placed on various points of the exposed cortex until the rat responded with the appropriate arm movement which consisted of an adduction of the preferred limb. The arm was then moved back and the movement confirmed by someone other than the operator. Stimulation ceased at this point and a double switch was thrown which activated the equipment used for producing the mark. The mark was then made. The needle used for the stimulating electrode was also used for the desiccation, and the relative position of the needle to the cortex was maintained with the stereotaxic instrument. After the rat had been stimulated and marked, the incision was closed and sutured. Post-operative observations were then made within 24 hours.

After reobservation for handedness, the rat was sacrificed, the brain removed and placed in 10% neutral formal solution and allowed to harden for a minimum of 24 hours. The quarter of the brain containing the destruction was frozen and sectioned at 50 microns. The sections were placed in 20% alcohol and serially affixed to albuminized

General Procedure

Operations were carried out in a...
A 3/16 inch diameter...
Frontal cerebral cortex...
The size of the...
various points of the...
with the appropriate...
abduction of the...
back and the...
operator. Stimulus...
switch was...
producing the...
used for the...
dissection, and...
cortex was...
the rat had...
closed and...
made within...
After...
ascertained, the...
formal...
24 hours. The...
tion was...
were placed in...

slides and allowed to dry in a 40°C. oven for 24 hours. The sections were then stained with thionin. The staining procedure will be found in Appendix B. All sections containing destructions were examined microscopically and the amount and locus of the destruction determined.

The system used for marking the cortex consisted of a Birtcher Hyfrecator, a Hunter Decade Timer which was monitored by a Standard timer, and a Triplit A.C. Voltmeter which monitored the amount of volts coming from the power line through a variac to the primary coil of the Hyfrecator.

A block diagram of the instrumentation for electrical stimulation and desiccation is shown in Figure 1:

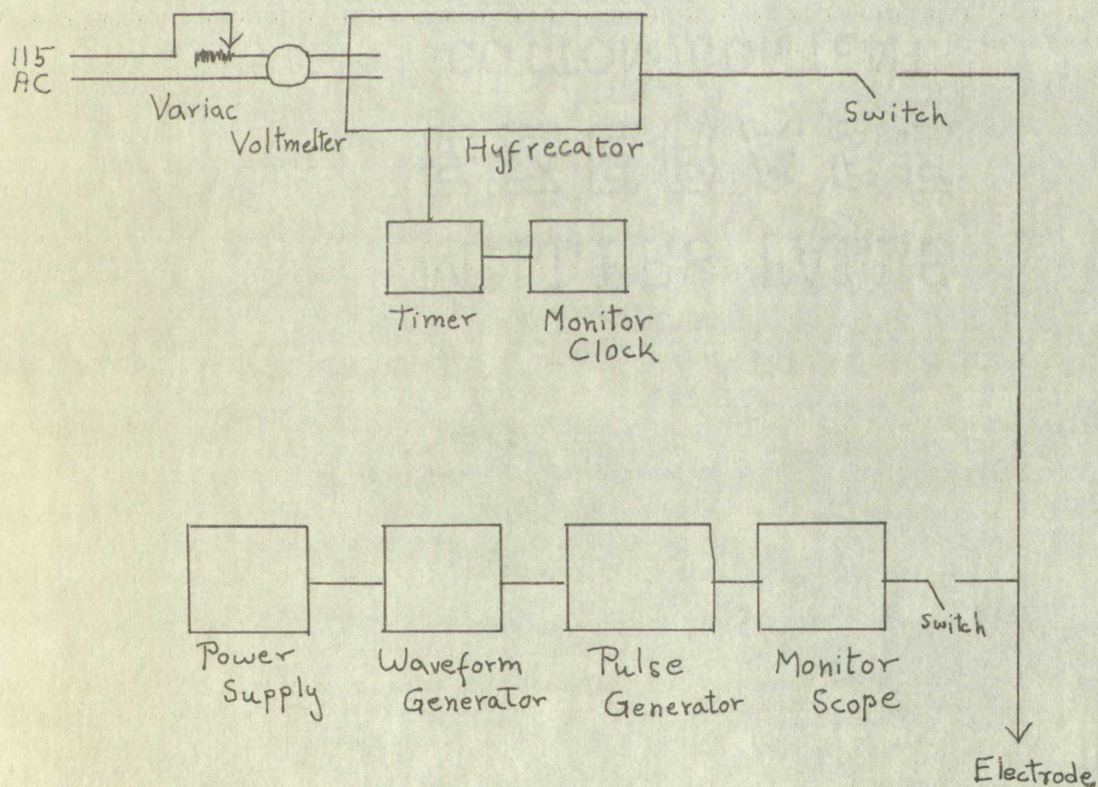
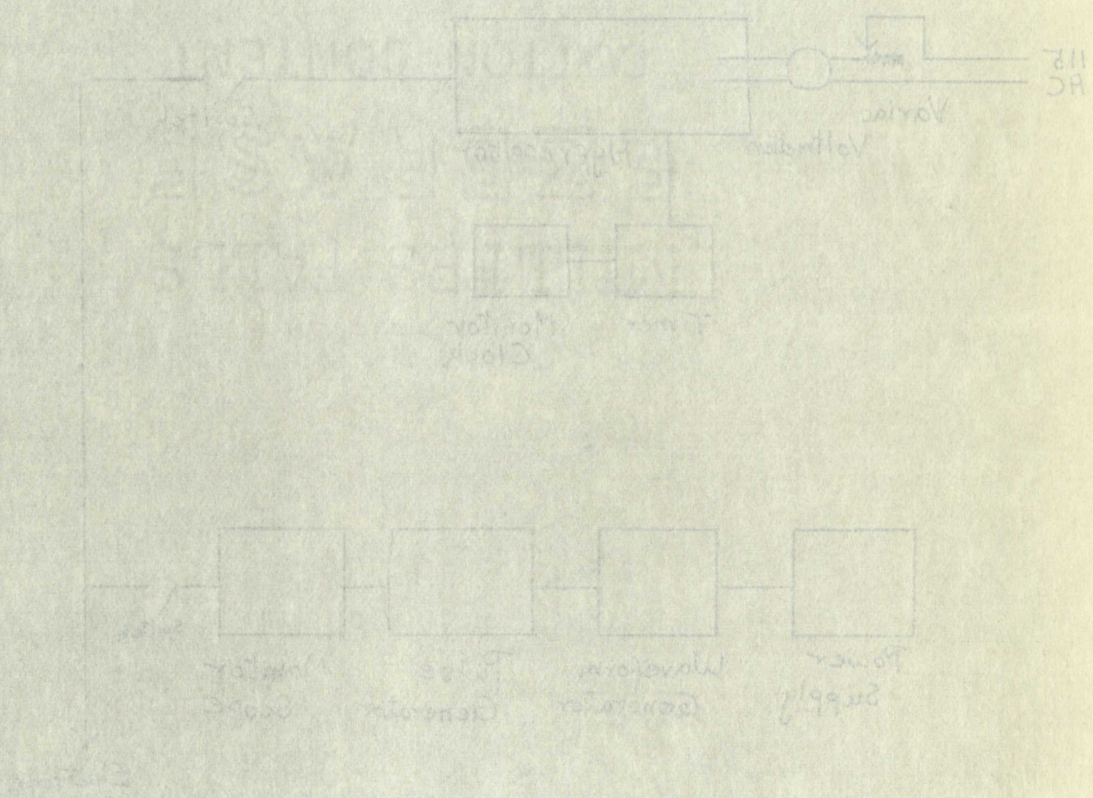


Figure 1

Block Diagram of Electrical Equipment

The system used for measuring the output voltage of a Bipolar Junction Transistor (BJT) is shown in Figure 1. The circuit is monitored by a standard meter, and a signal which is monitored in terms of voltage is sent through a series of amplifiers. A block diagram of the instrumentation used for stimulation and detection is shown in Figure 1.



Block Diagram of Instrumentation Used for Stimulation and Detection

III. The Preliminary Investigation

Method:

A preliminary experiment was performed in order to determine the utility of the Hyfrecator for marking. Since minute destructions were desired, the Hyfrecator was set at 25 (the lowest possible) and the low power output utilized. Time, voltage to the primary coil of the Hyfrecator, and the diameter of the desiccating needles were varied in order to determine the relative influence of these factors on the size of the destruction.

The time series was .2, .4, .6, and .8 seconds; and the voltages fed to the primary coil of the Hyfrecator were 25, 50, 75, and 100 volts. The diameter of the desiccating needles were .005 and .025 inches. This gives $4 \times 4 \times 2$ or 32 combinations of factors.

The frontal cortex of each of the 16 rats was exposed and a mark involving one of the possible 32 combinations of factors placed on the left hemisphere, and another one of the possible combinations applied to the right hemisphere. After marking, the rats were allowed 24 hours to recover from the operation and the brains were then removed and sectioned at 50 microns. All sections which included the destruction were mounted and stained.

III. The preliminary experiment

Method:

A preliminary experiment was conducted to determine the effect of the frequency of the stimulus on the rate of response. Since minute fluctuations were observed, the frequency was set at 25 (the lowest possible) and the rate of response was recorded. This, however, is the first of the series of experiments, and the frequency at the subsequent series were varied in order to determine the relationship between these factors on the rate of response.

The stimulus was a tone of 1000 cycles per second and the voltage of the primary coil of the transformer was 25, 50, 75, and 100 volts. The secondary coil was connected to a series of resistors. The resistors were 100, 200, 300, 400, 500, 600, 700, 800, 900, and 1000 ohms. The rate of response was recorded for each combination of factors.

The first series of experiments was conducted with a mark levelled out on the scale of the transformer and factors placed on the left-hand side of the scale. The possible combinations of factors in the first series are:

After marking, the rate of response was recorded for each factor from the operator and the factors were then placed on the scale as 25 minutes. The rate of response was recorded for each combination of factors.

Disturbance was observed in the first series.

Results:

In general, measurement with an ocular micrometer revealed that the narrow needle resulted in destructions which were better defined than the needle with the large diameter. The amount of voltage on the primary coil tended to be positively related to the depth of the destruction. This experiment was not carried to completion, because as the data were being collected, it was apparent that results would be so variable as regards the time and voltage factors that it would not be beneficial to spend any more time preparing the slides in order to make the measurements of all the hemispheres marked. It was noted, however, that relatively small well-defined marks could be made using 25 volts on the primary coil, the narrow needle, and the Hyfrecator set at 25 power units for 0.4 seconds.

Results:

In general, the results of the experiment revealed that the major quality factor which were better defined than the results with the large diameter. The results of values of the diameter to be positively related to the length of the diameter. This experiment was not carried out in parallel, because the data were being collected, it was found that results would be so variable as to make the data not very reliable that it would not be possible to obtain any data from preparing the alloy as a rule to give the measurements. All the measurements carried out in the experiment, the results were relatively small and the results were not very significant. The results on the alloy coil, the results were not very significant. The results on the alloy coil, the results were not very significant.

IV. The Main Investigation

Method:

Ten single-handed rats were divided into two groups of five in order to observe for immediate and delayed post-operational effects on handedness. The two groups were first observed for three days in order to determine handedness. Individual results are given in Appendix A.

They were then operated upon and marks placed on the hemisphere contralateral to the preferred hand. The mark was placed at the point where electrical stimulation had produced the arm movements. Group I rats were then observed within 24 hours post-operationally to check for any noticeable effects upon handedness. The brains were then removed and sectioned at 50 microns. All sections which included the destruction were mounted and stained. The locus of the destruction was then plotted and the extent of the destruction measured.

Post-operational observations in Group II were continued for four weeks, until a total of 500 reaches were taken. Slides of the destructions were prepared, although no measurements of the destructions were made because of healing and consequent influx of intact tissue into the desiccated area.

Results:

None of the rats in either Group I or Group II transferred nor were they noticeably affected in their reaching. There was a well-defined, and very small mark which located the area where stimulation produced arm movements. The destruction penetrated layer I and in most cases only superficially involved layer III of the cortex. (Layer II is not present in the frontal cortex of the rat.)

Group I

The location of the marks are plotted on the Lashley chart illustrated below. All the marks from each case are superimposed on one chart, and placed on the left hemisphere for comparison. The point indicates the locus of deepest penetration. The red circle indicates the surface area of the destruction.

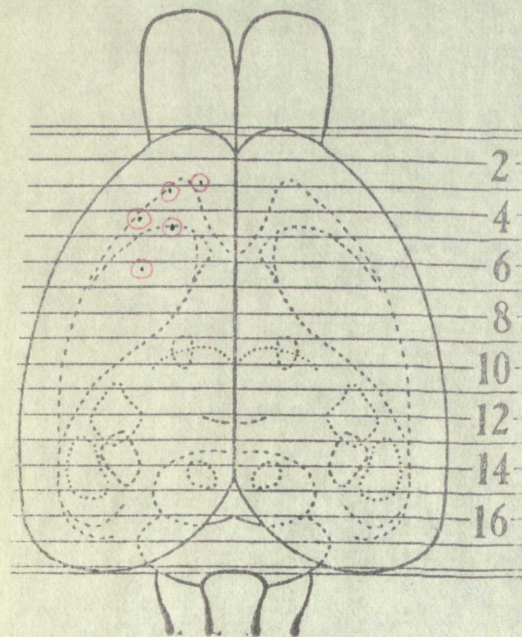


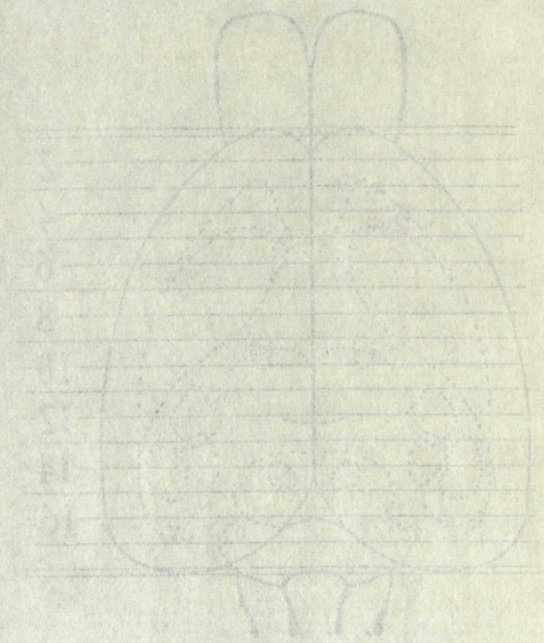
Figure 2

The Locus of the Destructions for Group I

Results:

None of the tests... referred not... There was a well-defined... the area where... friction generated... involved layer III of the... in the frontal cortex...

The location of the... sharp illustrated below... superimposed on the... for comparison. The... lesion. The red... destruction.



The location of the lesion...

The volume of the destructions were computed by plotting all sections which showed signs of desiccation (especially absence of neurons) on graph paper. These figures can be found in Appendix C.

The thickness of each section was known to be 50 microns, and the side of a square of the ocular micrometer on the microscope was known to be 0.21 millimeters. Therefore, each square which included destruction contained $.050 \text{ mm.} \times .210 \text{ mm.} \times .210 \text{ mm.} = .0022 \text{ mm}^3$. All squares invaded for all sections within one brain were summed and multiplied by $.0022 \text{ mm}^3$. and this result was the figure used as the volume of tissue destroyed.

The size of the destructions ranged from $.092 \text{ mm}^3$. to $.9062 \text{ mm}^3$.

Table I below summarizes the destruction for this group:

Table I

Volume of destruction for rats of Group I

Rat Number	Amount of destruction
3	.1452 mm^3
4	.0920 mm^3
11	.9062 mm^3
21	.1018 mm^3
31	.1232 mm^3

The volume of the ...
 plotting all ...
 (especially ...)
 figures can be found in ...
 The thickness of each ...
 microns, and the side of a ...
 on the microscope was ...
 fore, each square with ...
 .050 mm. x .210 mm. x ...
 invaded for all sections ...
 multiplied by .0025 ...
 as the volume of these ...

The size of the ...
 to .0002 mm³ ...

Table I below summarizes the ...
 groups

Volume of ...

Group	Volume
1	...
2	...
3	...
4	...
5	...
6	...
7	...
8	...
9	...
10	...
11	...
12	...
13	...
14	...
15	...
16	...
17	...
18	...
19	...
20	...
21	...
22	...
23	...
24	...
25	...
26	...
27	...
28	...
29	...
30	...
31	...
32	...
33	...
34	...
35	...
36	...
37	...
38	...
39	...
40	...
41	...
42	...
43	...
44	...
45	...
46	...
47	...
48	...
49	...
50	...

Photomicrographs of the most and lease extensive of these destructions can be seen in Appendix D.

Group II

The location of the marks for this group are plotted on the Lashley chart illustrated below. Marks were drawn in the same manner as was done with Group I.

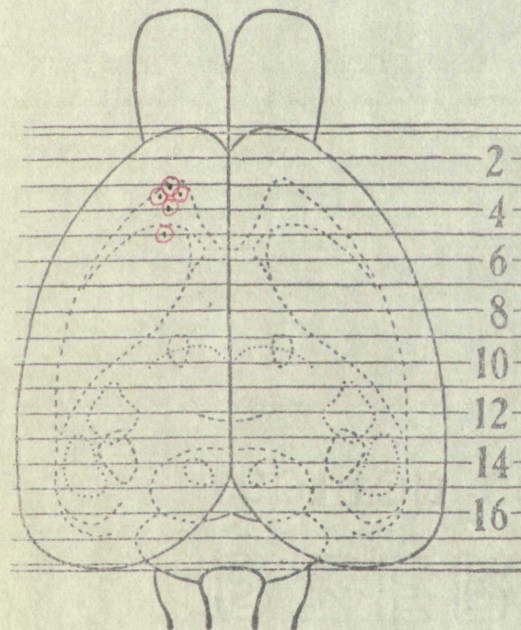
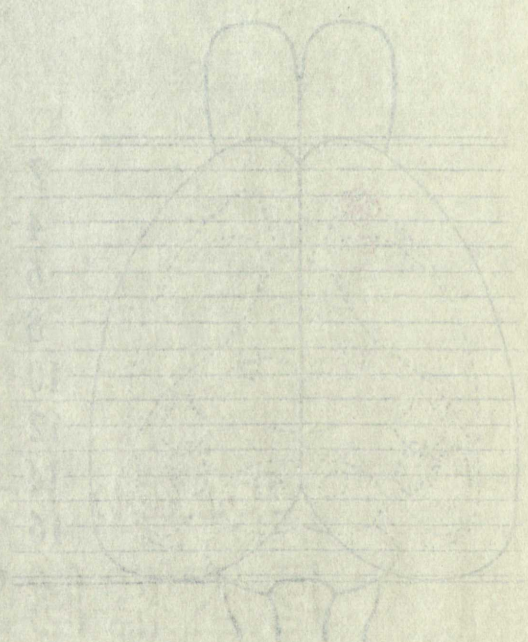


Figure 3

The Locus of the Destructions for Group II

Although the volume of destruction was not computed for this group because of healing, in all cases except case 51 the damage was less than the smallest destruction in Group I. Case 51 had approximately the same amount of destruction as case 21 of Group I ($.1018 \text{ mm}^3$).

Photomicrographs of the ...
of these destructions can be seen ...
The location of the ...
on the ...
in the same manner as was done with ...



The nature of the ...
Although the volume of ...
for this group because of ...
case of the damage was ...
in Group I. Case 51 had ...
destruction as seen ...

V. Summary and Conclusions

Summary:

The possibility of making a mark at the point where handedness has been localized by electrical stimulation without producing changes in that area sufficient to alter its functioning was investigated. Two groups of single-handed rats were used, each group consisting of 5 rats. All rats were marked with a modified Hyfrecator which delivered high-frequency currents to a needle point of .005 inches in diameter for a period of 0.2 seconds. The voltage on the primary coil of the Hyfrecator was 25 volts, and the setting on the Hyfrecator was 25 units. The low power outlet on the Hyfrecator was used. The point where the mark was to be placed on the cortex was determined by electrical stimulation, and correct marking was insured with the aid of a stereotaxic instrument and the use of the same needle for both stimulation and desiccation.

Five of the rats were observed within 24 hours post-operationally and five were observed at weekly intervals for four weeks post-operationally. The brains were sectioned, stained, and the marks located and measured; also, the loci of these marks were plotted on a Lashley brain chart.

Summary:

The possibility of ... has been ...
 handedness has been ...
 without producing ...
 its functioning ...
 handed rate ...
 All rats were ...
 delivered high-frequency ...
 inches in diameter ...
 on the primary coil of the ...
 setting on the ...
 left on the ...
 to be placed ...
 stimulation, and ...
 of a stereotaxic ...
 for both stimulation ...
 Five of the rats were ...
 operationally and ...
 for four weeks post-operationally ...
 stained, and the ...
 of these ...

Conclusions:

Rats can be marked at the most stimuable area of the cortex for handedness, and not be affected in their hand preference. This mark does not influence handedness over a period of four weeks.

It is thus possible to study the intact region immediately below this marking, except for the portion confined largely to layer I and to a slight extent the superficial portions of layer III of the cortex.

Conclusions

Data can be obtained at the rear of the cortex for the cortex for the hand preference. It is thus possible to obtain data immediately below the surface of the cortex. The data are confined largely to the superficial portions of layers II, III, and IV of the cortex.

Barber, J. W.

Bohn, W. H.

Bilgert, J. H.

Billy, J. W.

Bishop, J. W.

REFERENCES

Bishop, J. W.

Bishop, J. W.

Bishop, J. W.

MILITARY

RECORDS

OFFICE

RECORDS

References

- Eccles, J. C. The neurophysiological basis of the mind: the principles of neurophysiology. Oxford: Clarendon Press, 1953. 314 pp.
- Hebb, D. O. The organization of behavior - a neurophysiological theory. New York: John Wiley and Sons, Inc., 1949. 335 pp.
- Hilgard, Ernest R. Theories of learning. (2nd ed.) New York: Appleton-Century-Crofts, Inc., 1956. 563 pp.
- Kelly, Howard A., & Ward, Grant E. Electrosurgery. Philadelphia: W. B. Saunders Company, 1932. 305 pp.
- Peterson, Geo. M. Mechanisms of handedness in the rat. Comp. Psych. Monogr., 1934, 9, 1-67.
- Peterson, Geo. M. Transfers in handedness in the rat from forced practice. J. comp. physiol. Psychol., 1951, 44, 184-190.
- Peterson, Geo. M., & Fracorol, La C. The relative influence of the locus and mass of destruction upon the control of handedness by the cerebral cortex. J. comp. Neurol., 1938, 68, 173-190.
- Peterson, Geo. M., & Gucker, Donald K. Factors influencing identification of the handedness area in the cerebral cortex of the rat. J. comp. physiol. Psychol., in press.

Becker, J. C. The neuro-psychological basis of the
the principles of handwriting. Journal of Psychology
Press, 1933, 314 pp.

Hebb, D. O. The organization of behavior - a new theory.
New York: John Wiley and Sons, 1949, 312 pp.

Hilgard, Ernest R. Theories of learning. Journal of Experimental Psychology
Applied-Century-Books, Inc., 1952, 212 pp.

Kelly, Howard A., & Kelly, Ernest W. Handwriting
W. B. Saunders Company, 1932, 312 pp.

Peterson, Geo. M. Mechanisms of handwriting
Psych. Monographs, 1937, 1938.

Peterson, Geo. M. Handwriting in handwriting
forced practice. A. J. A. Journal of Psychology, 1931,
44, 184-190.

Peterson, Geo. M., & Frydholm, J. E. The relation
of the form of handwriting to the structure
of handwriting by the nervous system. Journal of Psychology
1938, 68, 173-190.

Peterson, Geo. M., & Gamm, Donald L. Handwriting
identification of the handwriting system in the
cortex of the rat. Journal of Experimental Psychology

APPENDIX

COLLEGE COURSE
EXEMPTION
MICHIGAN STATE

Appendix A

The Preoperational and Postoperational Reaching Records for Group I

OBSERVATIONAL PERIOD	Rat 3		Rat 4		Rat 11		Rat 21		Rat 31		
	R	L	R	L	R	L	R	L	R	L	
Preoperation:											
1	46	4	50	0	48	2	50	0	0	0	50
2	100	0	100	0	99	1	100	0	2	2	98
3	50	0	50	0	50	0	50	0	0	0	50

24 Hour Postoperation:											
1	50	0	50	0	50	0	50	0	0	0	50

SECRET
CONFIDENTIAL

Category	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10
Group A	100	200	300	400	500	600	700	800	900	1000
Group B	150	250	350	450	550	650	750	850	950	1050
Group C	200	300	400	500	600	700	800	900	1000	1100
Group D	250	350	450	550	650	750	850	950	1050	1150
Group E	300	400	500	600	700	800	900	1000	1100	1200
Group F	350	450	550	650	750	850	950	1050	1150	1250
Group G	400	500	600	700	800	900	1000	1100	1200	1300
Group H	450	550	650	750	850	950	1050	1150	1250	1350
Group I	500	600	700	800	900	1000	1100	1200	1300	1400
Group J	550	650	750	850	950	1050	1150	1250	1350	1450

SECRET
CONFIDENTIAL

THE INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE

SECRET

The Preoperational and Postoperational Reaching Records for Group II

OBSERVATIONAL PERIOD	Rat 41		Rat 51		Rat 32		Rat 62		Rat 72		
	R	L	R	L	R	L	R	L	R	L	
Preoperation:											
1	50	0	47	3	30	0	50	0	0	0	50
2	100	0	100	0	120	0	100	0	0	0	100
3	50	0	50	0	50	0	50	0	0	0	50

24 Hour Postoperation:											
1	100	0	100	0	100	0	100	0	0	0	100

Weekly Postoperation:											
1	100	0	100	0	100	0	100	0	0	0	100
2	100	0	100	0	100	0	100	0	0	0	100
3	100	0	100	0	100	0	100	0	0	0	100
4	100	0	100	0	100	0	100	0	0	0	100

Year	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970			
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970
 JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

THE UNIVERSITY OF CALIFORNIA LIBRARY

Appendix B

Staining Procedure

Slides with tissue affixed are placed in the following solutions for the stated length of time.

	<u>Solution</u>	<u>Time</u>
1.	Toluene	5 min.
2.	Toluene	5 min.
3.	95% Alcohol	5 min.
4.	70% Alcohol	5 min.
5.	40% Alcohol	5 min.
6.	20% Alcohol	5 min.
7.	Distilled Water	10 min.
8.	Thionin (1.668 gr/200ml. Distilled Water)	5 min.
*9.	95% Alcohol	5 min.
*10.	100% Alcohol	5 min.
11.	Toluene	5 min.
12.	Toluene	5 min.

* Steps 9 and 10 may have to be shortened if the solutions are clear and too much bleeding of the dye from the tissue results.

Appendix B

Staining procedures

Slides with tissue sections are stained in the following solutions for the special fast of time.

<u>Solvent</u>	<u>Solution</u>
1. Toluen	1. Toluen
2. Toluen	2. Toluen
3. 95% Alcohol	3. 95% Alcohol
4. 70% Alcohol	4. 70% Alcohol
5. 40% Alcohol	5. 40% Alcohol
6. 20% Alcohol	6. 20% Alcohol
7. Distilled water	7. Distilled water
8. Tannin (1.5% in 20% alcohol)	8. Tannin (1.5% in 20% alcohol)
9. 95% Alcohol	9. 95% Alcohol
10. 100% Alcohol	10. 100% Alcohol
11. Toluen	11. Toluen
12. Toluen	12. Toluen

* Steps 9 and 10 may have to be repeated if the solutions are clear and no stain is visible on the slides from the tissue sections.

Appendix C

Reproductions of Destructions

Explanatory note:

Small grid divisions are equal to 0.21 mm.

Each section including destruction is numbered serially from anterior to posterior position in the brain.

Dotted line in case 11 indicates the surface of the tissue.

STATION REPORT
NO. 100
DATE

DESCRIPTION OF SECTION

EXPLANATORY NOTES

Small grid divisions are 0.25 cm.

Each section including description is numbered

serially from anterior to posterior within the series.

Dotted line is used to indicate the extent of

fixation.

1

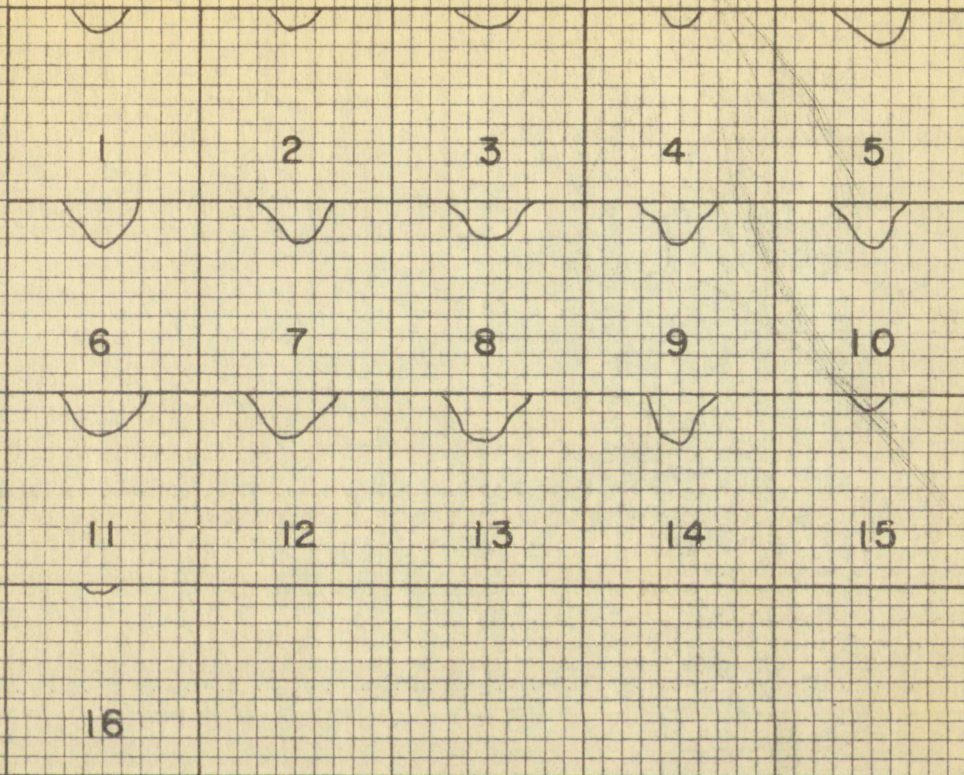
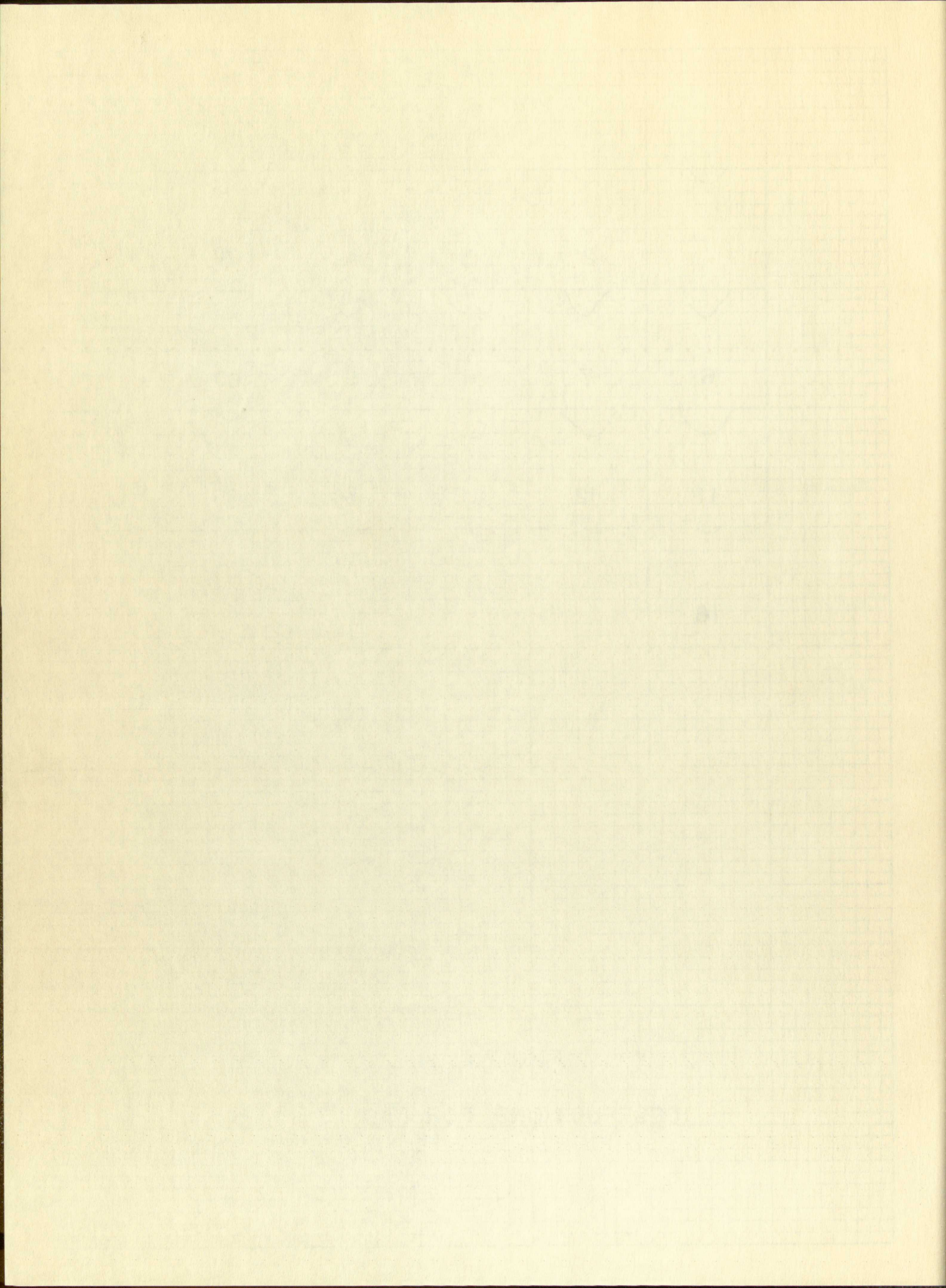


FIGURE 4

DESTRUCTIONS FOR CASE 3



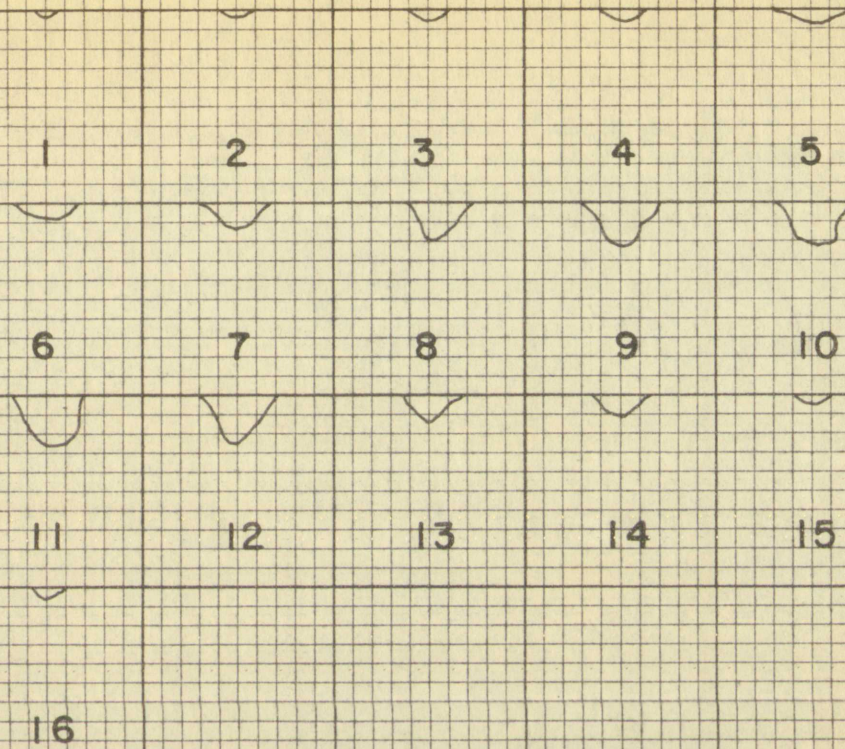
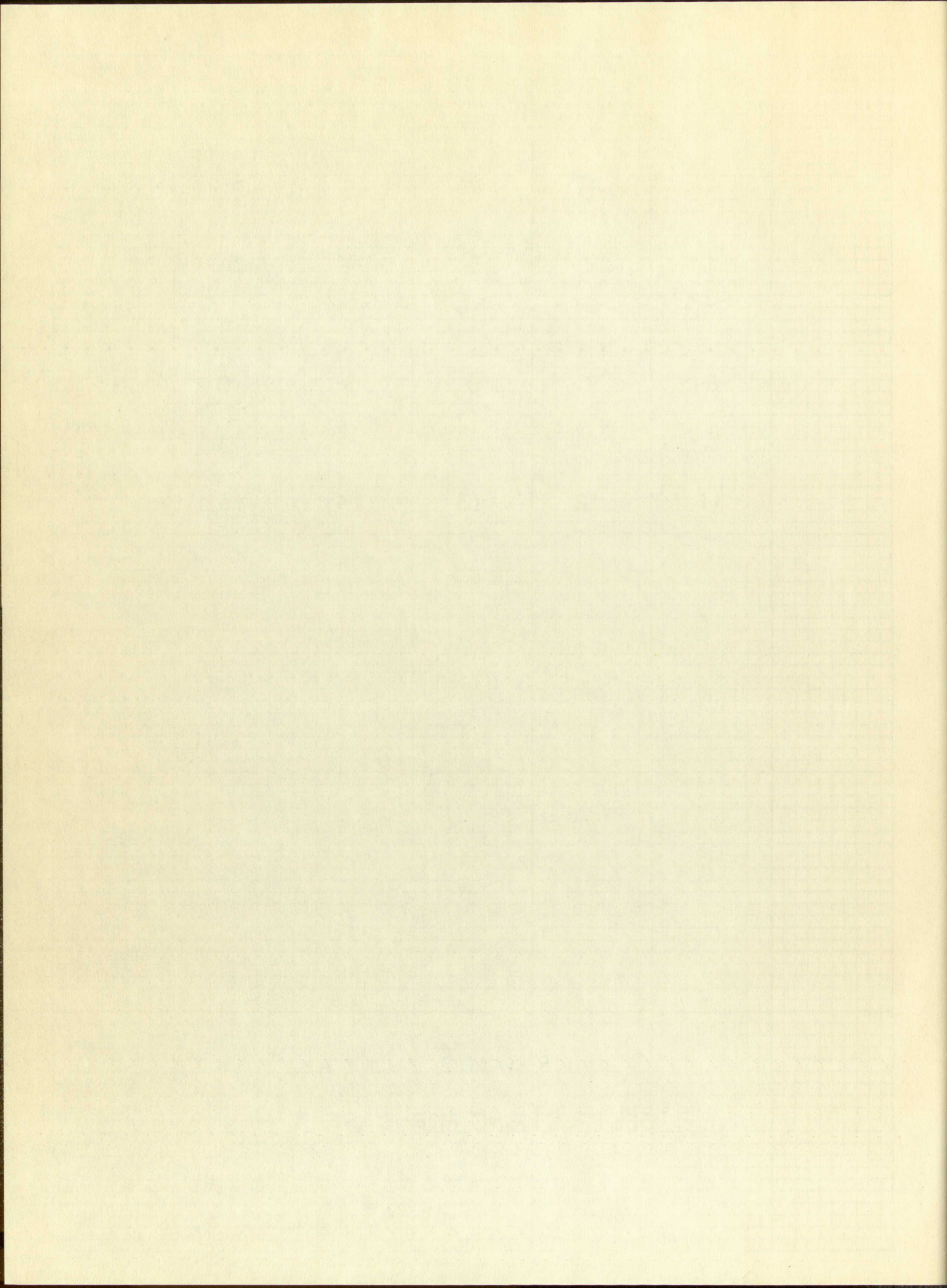


FIGURE 5

DESTRUCTIONS FOR CASE 4



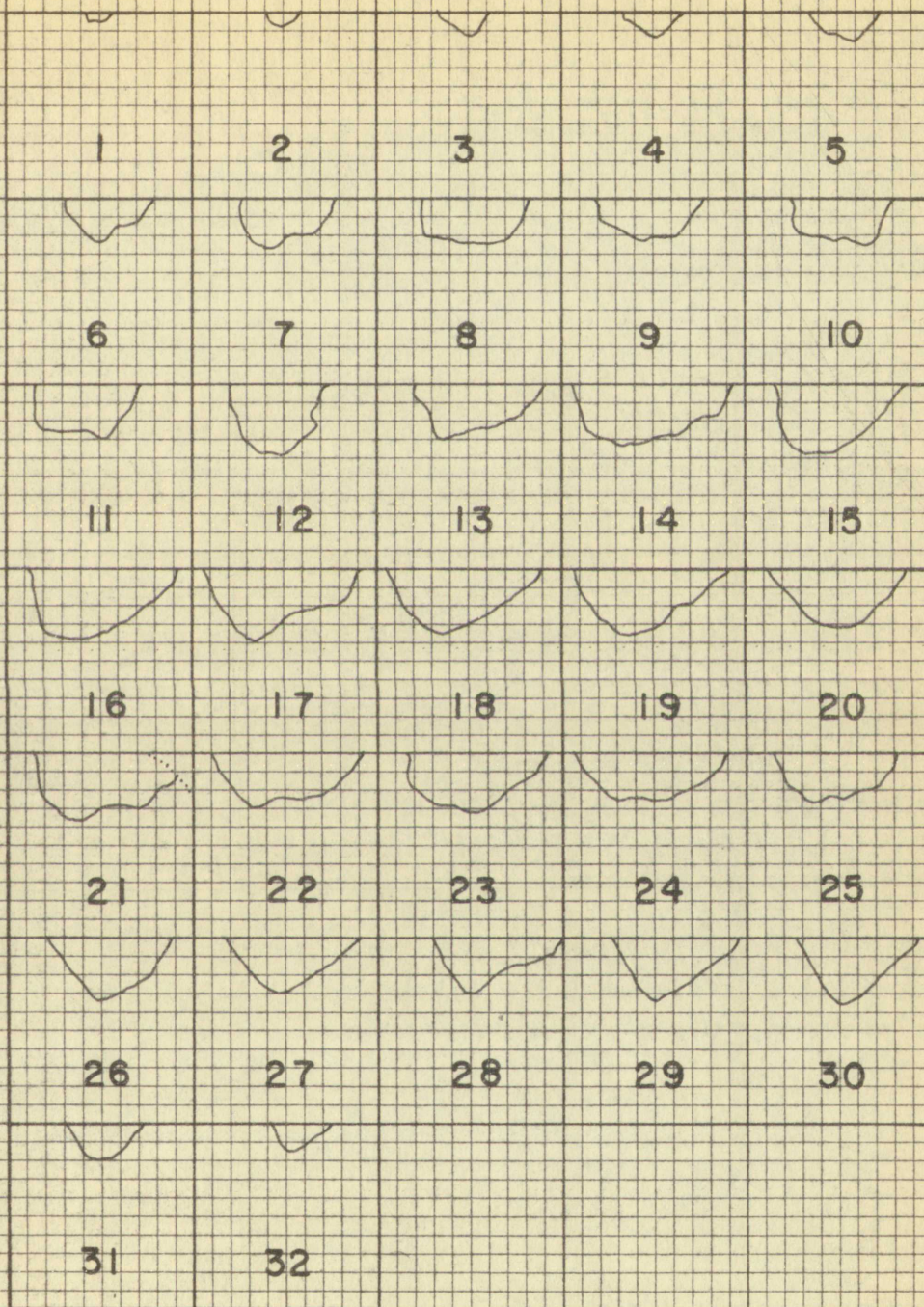
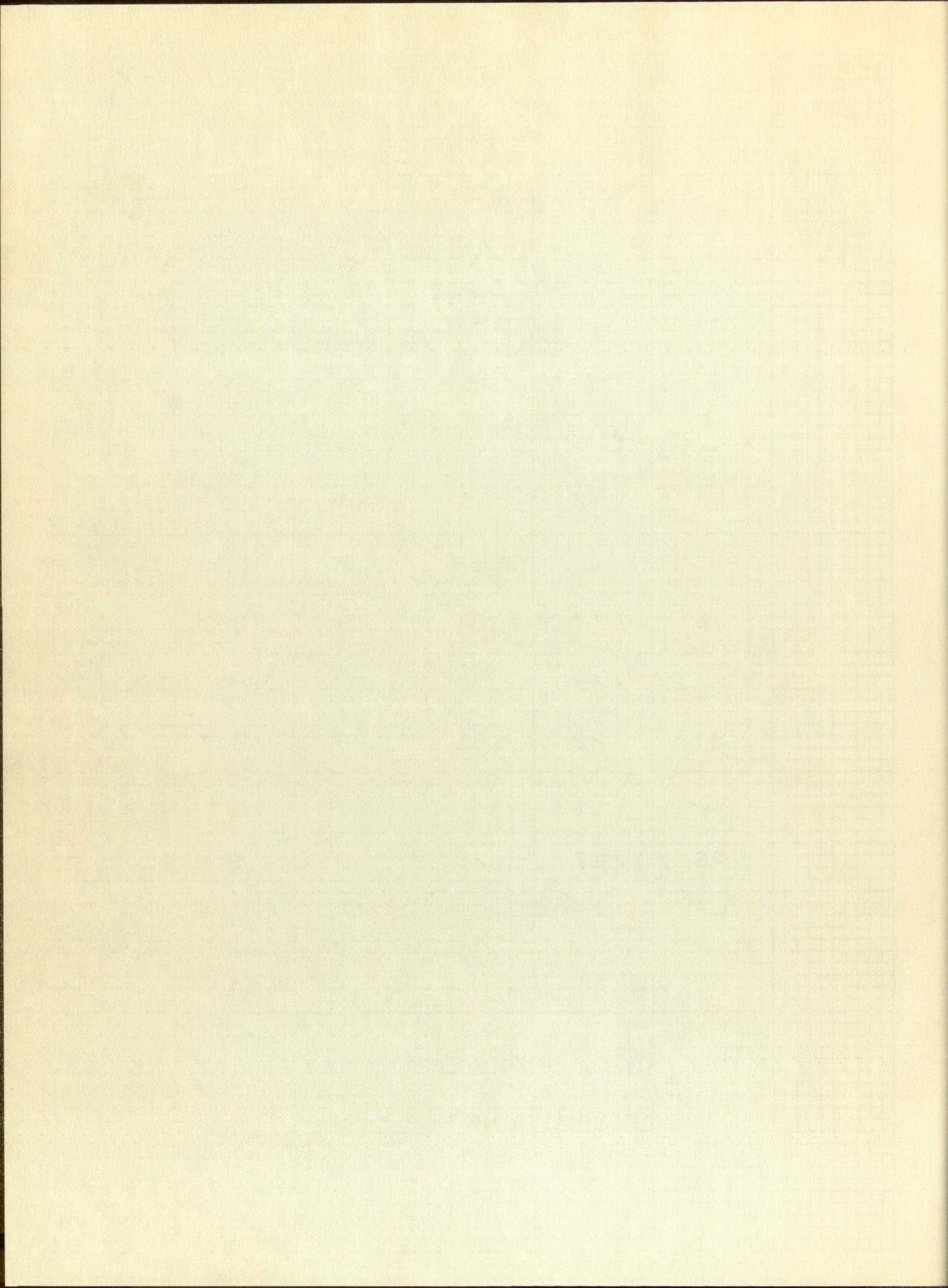


FIGURE 6

DESTRUCTIONS FOR CASE II



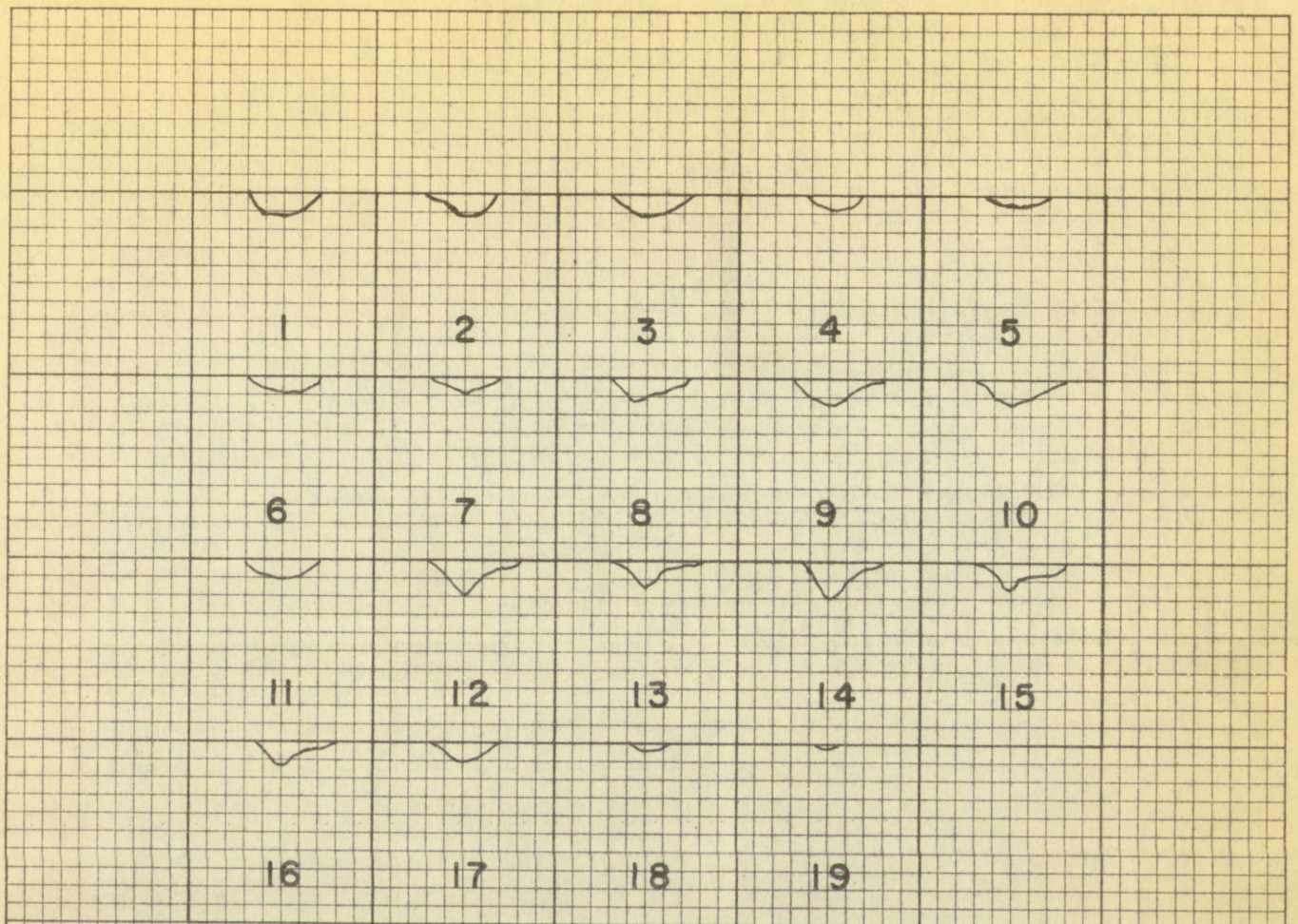
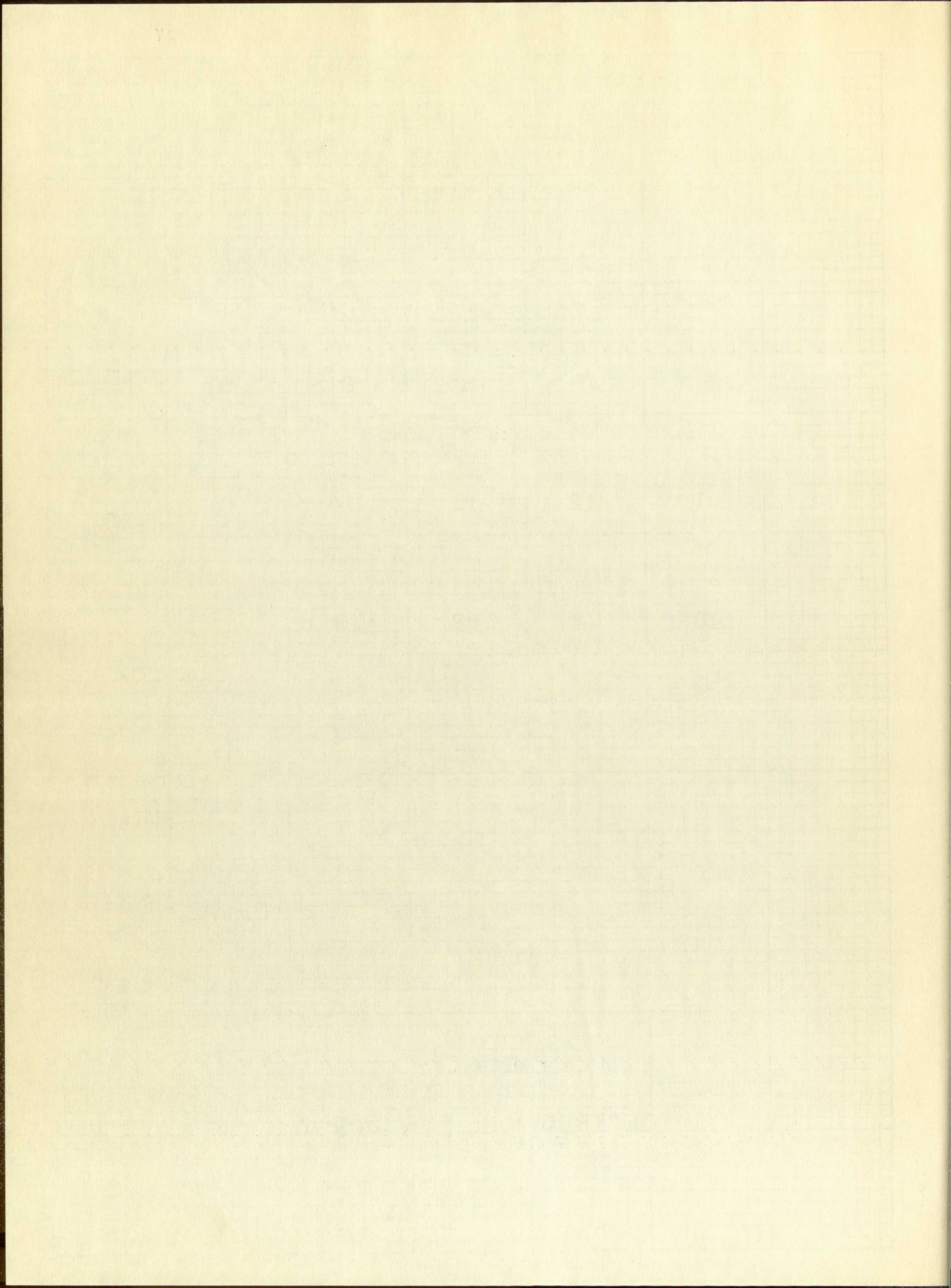


FIGURE 7

DESTRUCTIONS FOR CASE 21



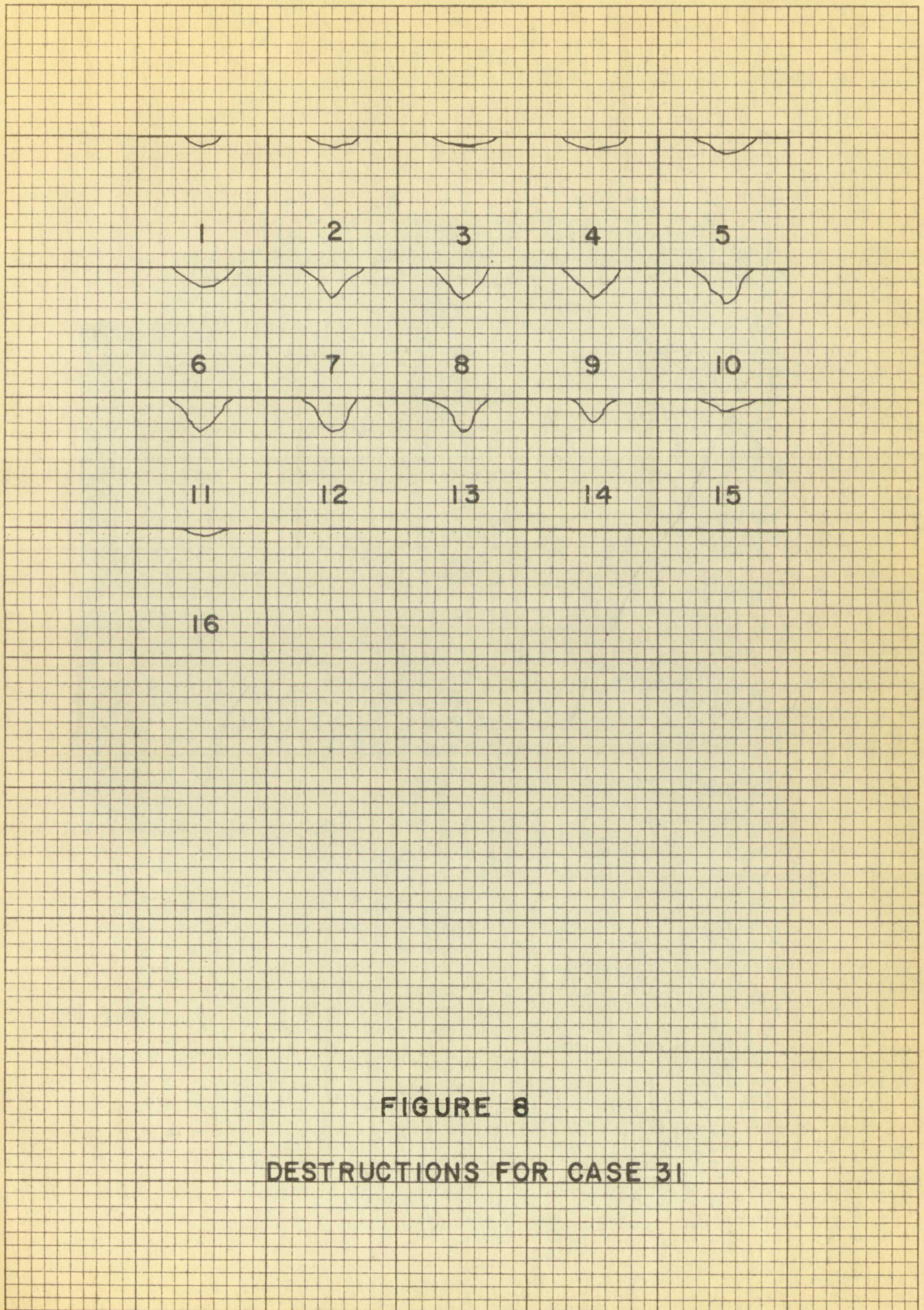


FIGURE 8

DESTRUCTIONS FOR CASE 31

Appendix D

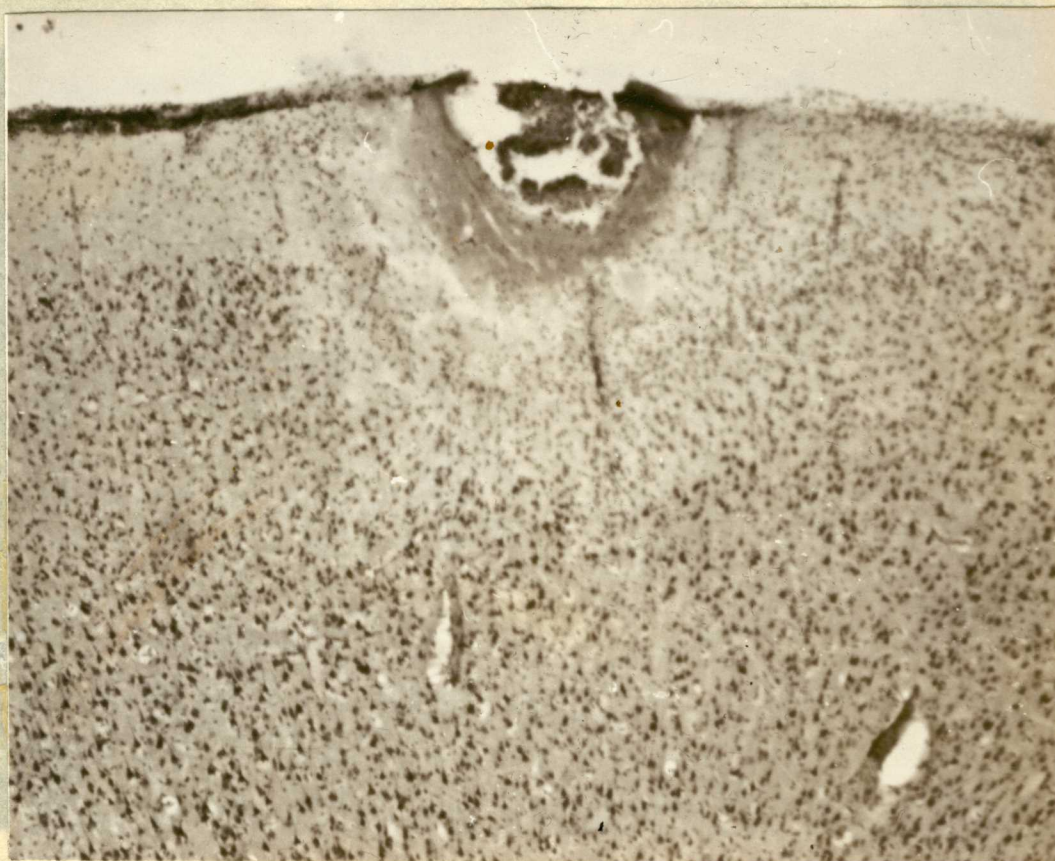


Figure 10

Figure 9

Photomicrograph of Least Extensive Destruction for Group I

Photomicrograph of Most Extensive Destruction for Group I

(Case 11 Scale: 1.5 cm. = 210 microns)

Appendix I

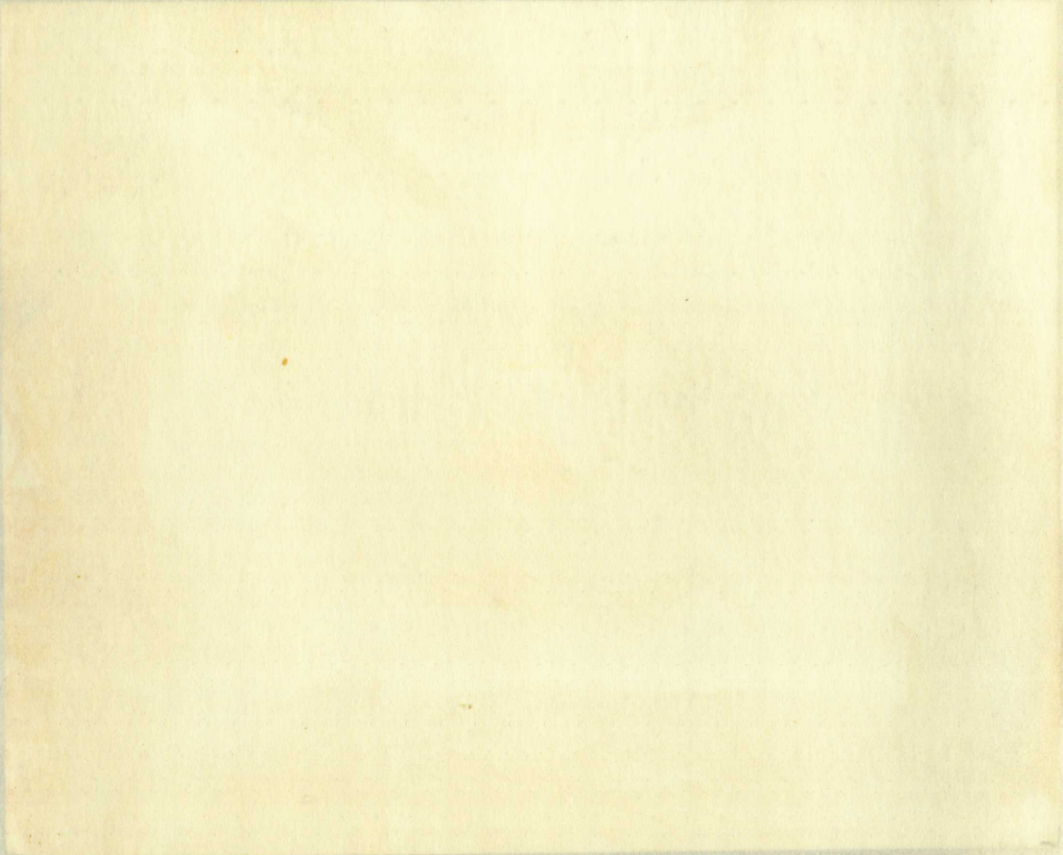


Figure 1

Photomicrograph of the ...

(Case II) ...

WILLIAM ...
E. R. ...

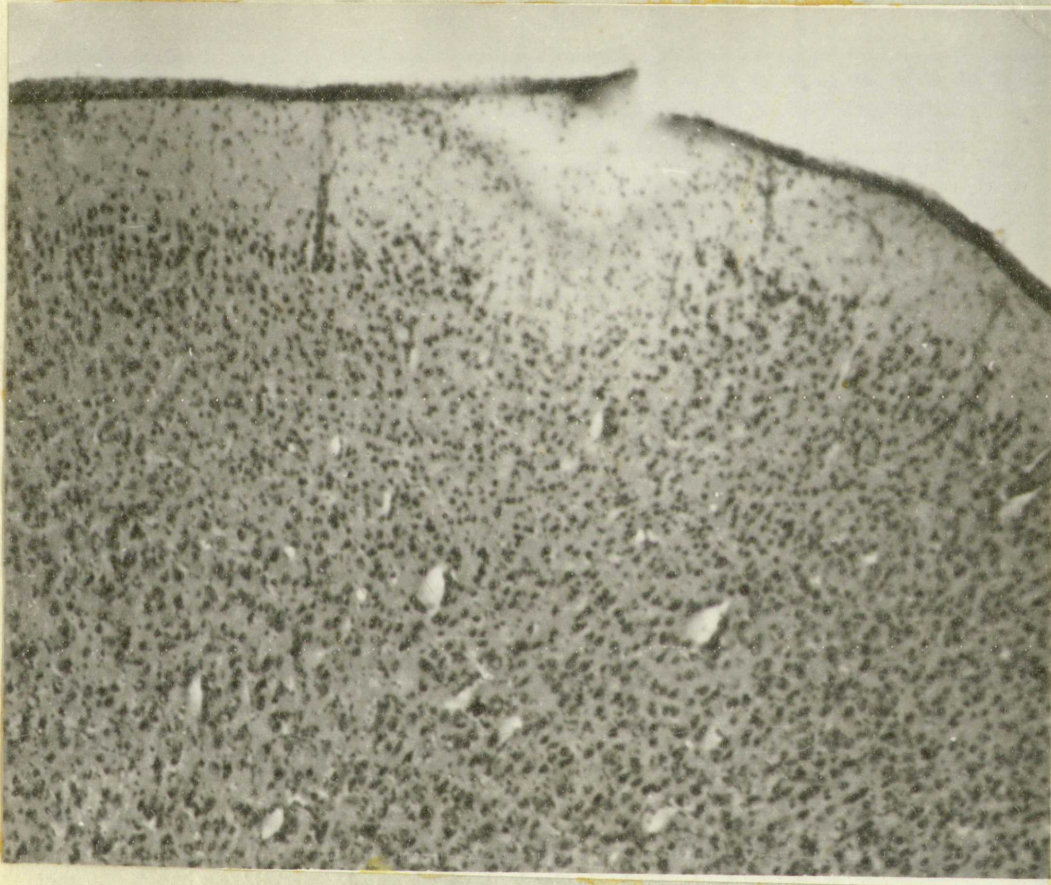


Figure 10
Photomicrograph of Least Extensive Destruction for Group I
(Case 4 Scale: 1.5 cm. = 210 microns)



Photomicrograph of latent fingerprint impression on the
back of the envelope of the [illegible]

YIMERS FILE
EZEASE

Keena
Enclosure
1890

