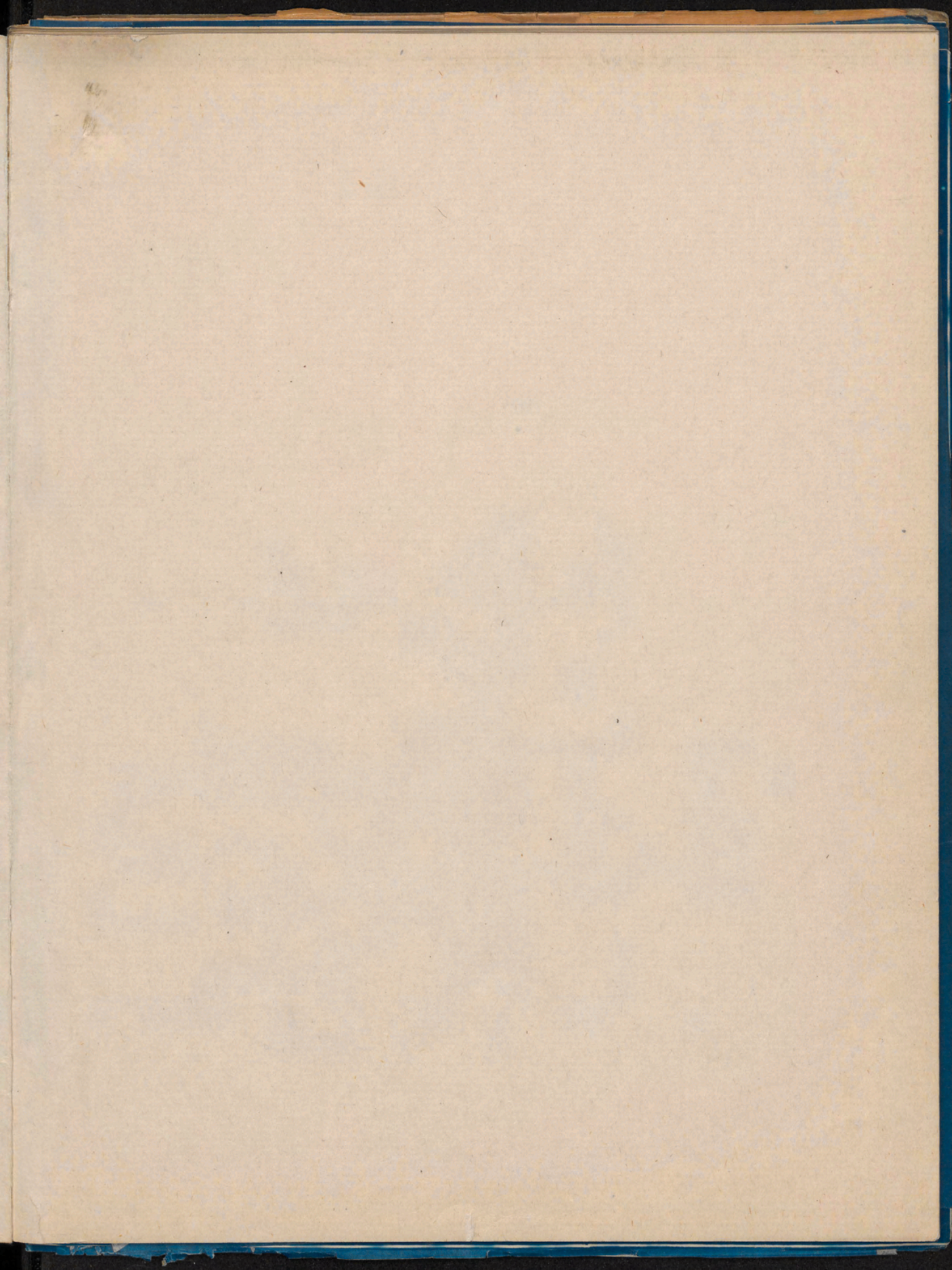


Mr. Felby ✓

REPORT ON THE
SCIENTIFIC AND FINANCIAL REQUIREMENTS
OF A
PROPOSED BIOLOGICAL FARM
FOR
THE UNIVERSITY OF CHICAGO

SUBMITTED TO PRESIDENT JUDSON
BY
M. H. MACLEAN
SUPERINTENDENT OF BUILDINGS AND GROUNDS
CHICAGO, ILL.
OCTOBER 29, 1907



Object of Report

The object of this report is to outline the needs of the Scientific Departments that will operate the farm, as to buildings and equipment, and to estimate the cost thereof and the cost of annual maintenance.

Location and Physical Character of Farm.

In order to make a typical case the estimates in this report are based on the assumption that a certain piece of ground which commands itself to the Department of Zoology will be chosen.

REPORT ON THE SCIENTIFIC AND FINANCIAL REQUIREMENTS OF A PROPOSED BIOLOGICAL FARM FOR THE UNIVERSITY OF CHICAGO SUBMITTED TO PRESIDENT JUDSON

BY

M. H. MAC LEAN SUPERINTENDENT OF BUILDINGS AND GROUNDS
CHICAGO ILL. OCTOBER 29, 1907.

The plot of land is bounded on the south and east by a highway and on other sides by a small stream. The area above described comprises about forty five acres. A rough map, not as yet accurately drawn but giving a fairly good idea of the physical character of the plot, is shown on page 23.

Though contour lines have been drawn to give one an idea of the slope and drainage of the land. The eastern and northern portions are some twenty feet above the other and form a small plateau which presents an excellent farming site. The eastern portion of the high land is wooded and is indicated by the light green coloring in the blue print. About one half of the plot is

REPORT ON THE SCIENTIFIC AND FINANCIAL REQUIREMENTS OF A
PROPOSED BIOLOGICAL PARK FOR THE UNIVERSITY OF CHICAGO
SUBMITTED TO PRESIDENT LUDSON

BY

W. H. MAC LEAN, DEPARTMENT OF BUILDINGS AND GROUNDS

CHICAGO, ILL., OCTOBER 22, 1907.

I. Object of Report

The object of this report is to outline the needs of the Scientific Departments that will operate the farm, as to buildings and equipment, and to estimate the cost thereof and the cost of annual maintenance.

II. Location and Physical Character of Farm.

In order to make a typical case the estimates in this report are based on the assumption that a certain piece of ground which commends itself to the Department of Zoology will be chosen as the site of the farm. Should some other site be chosen, the figures should hold in the main, unless a brook were lacking, in which case, the estimate of the cost of the three ponds asked for by the Department of Zoology, might be quite different.

The plat of ground which it is proposed to convert into a Biological Farm is situated about twenty five miles from the University of Chicago and about one mile from the nearest railroad station. The plat of land is bounded on the south and east by highways and on other sides by a small stream. The area above described comprises about forty five acres. A rough map, not at all accurately drawn but giving a fairly good idea of the physical character of the plat, is shown on page 33.

Rough contour lines have been drawn to give one an idea of the slope and drainage of the land. The eastern and northern portions are some twenty feet above low water and form a small plateau which presents an excellent building site. The eastern portion of the high land is wooded and is indicated by the light cross-hatching in the blue print. About one half of the plat is

Object of Report

The object of this report is to outline the needs of the Scientific Department that will operate the farm, as to buildings and equipment, and to estimate the cost thereof and the cost of annual maintenance.

Location and Physical Character of Farm

In order to make a typical case the estimates in this report are based on the assumption that a certain piece of ground which commands itself to the Department of Zoology will be chosen on the site of the farm. Should some other site be chosen, the figures should be held in the mind, unless a check were lacking, in which case, the estimates of the cost of the three ponds asked for by the Department of Zoology, might be quite different.

The plot of ground which it is proposed to convert into a Biological Farm is situated about twenty five miles from the University of Chicago and about one mile from the nearest railroad station. The plot of land is bounded on the north and east by highways and on other sides by a small stream. The area above described comprises about forty five acres. A rough map, not as all accurate as given but giving a fairly good idea of the physical character of the plot, is shown on page 22.

Rough contour lines have been drawn to give an idea of the slope and drainage of the land. The eastern and northern portions are some twenty feet above low water and form a small plateau which presents an excellent building site. The eastern portion of the high land is wooded and is indicated by the light cross-hatching in the blue print. About one half of the plot is

low and flat lying from four to five feet above the water level. It is said that at times in early spring some of the low land is submerged but it is thought that with the drainage which the stream will afford when cleared of rubbish there need be no fear from high water. No attention has therefore been given by me to the drainage of the low land except as noted above.

The stream in its course through the proposed plat has a fall of probably three feet, being made up of six or eight small riffles and with from four to six inches fall. The flow as estimated by eye I should say is about 400 to 500 gal. per minute during periods of low water.

III.

Educational Departments that will use the Biological Farm.

The Biological Farm will be used by the following Departments:

The Department of Zoology

The Department of Physiology

The Department of Physiological Chemistry

The Department of Anatomy

The Department of Botany

The Department of Bacteriology

The Department of Pathology

The Department of Psychology

IV

Sources of information concerning the needs of Educational Departments for the Biological Farm.

This report, in so far as it relates to the needs of the Educational Departments, is based on information obtained from Prof. C. O. Whitman and Dr. W.L. Tower, for the Department of

low and lying from four to five feet above the water level. It is said that at times in early spring some of the low land is submerged but it is thought that with the drainage which the stream will afford when cleared of rubbish there need be no fear from high water. No attention has therefore been given by me to the drainage of the low land except as noted above.

The stream in its course through the proposed plat has a fall of probably three feet, being made up of six or eight small riffles and runs from four to six inches fall. The flow as estimated by me I should say is about 400 to 500 gal. per minute during periods of low water.

III.

Explanatory Remarks that will use the Biological Farm.

The Biological Farm will be used by the following Departments:

- The Department of Zoology
- The Department of Botany
- The Department of Entomology
- The Department of Microbiology
- The Department of Anatomy
- The Department of Histology
- The Department of Pathology
- The Department of Physiology

IV.

Source of information concerning the needs of Educational Department.

Report for the Biological Farm.

This report, in so far as it relates to the needs of the Educational Department, is based on information obtained from Prof. C. O. Whitman and Dr. W. E. Tower, for the Department of

Zoology: from Dr. A. P. Mathews for the Department of Physiology and Physiological Chemistry: from Dr. R. R. Bensley, for the Department of Anatomy: from Prof. John M. Coulter and Prof. C. R. Barnes, for the Department of Botany: from Prof. E. O. Jordan, for the Department of Bacteriology: from Dr. H. G. Wells and Dr. H.T. Ricketts, for the Department of Pathology: and from Prof. J.R. Angell and Dr. J.B. Watson, for the Department of Psychology.

V

The purpose of the Biological Farm and the results that will be aimed at.

In reply to letters sent to all of the Departments interested in the proposed Biological farm asking for a statement regarding the purpose of the farm, I received replies from Prof. Angell, and from Dr. A. P. Mathews. Copies of their letters follow:

Chicago, Ill. Oct. 14, 1907.

My dear Mr. MacLean:-

Dr. Watson has requested me to reply to your letter of Oct. 8th concerning the object of the proposed biological farm, and the benefits that may be expected to accrue to the Department of Psychology.

The indirect benefits of such a farm would perhaps be as great for us as the direct ones. The unquestioned superiority which such a plant would afford, as compared with the facilities elsewhere, could only operate in innumerable ways to stimulate scholarly interest and to further the distinction which would attach to our work in the eyes of scholars. Upon such indirect benefits I will not, however, undertake to dwell.

Zoology: from Dr. A. P. Mathews for the Department of Physiology and Physiological Chemistry; from Dr. R. R. Bensley, for the Department of Anatomy; from Prof. John M. Coulter and Prof. G. B. Barnes, for the Department of Botany; from Prof. E. O. Jordan, for the Department of Entomology; from Dr. H. G. Wells and Dr. H. T. Nickerson, for the Department of Pathology; and from Prof. J. H. Angell and Dr. J. S. Watson, for the Department of Psychology.

The purpose of the Biological Fair and the results that will be

aimed at.

In reply to letters sent to all of the Departments interested in the proposed Biological Fair asking for a statement regarding the purpose of the fair, I received replies from Prof. Angell, and from Dr. A. P. Mathews. Copies of their letters

follow:

Chicago, Ill. Oct. 14, 1907.

My dear Mr. Mathews:-

Mr. Watson has requested me to reply to your letter of Oct. 8th concerning the object of the proposed Biological Fair, and the benefits that may be expected to accrue to the Department of Psychology.

The indirect benefits of such a fair would perhaps be as great for us as the direct ones. The unquenchable curiosity which such a fair would afford, as compared with the facilities elsewhere, could only operate in innumerable ways to stimulate scholarly interest and to further the education which would accrue to our work in the eyes of scholars. Upon such indirect benefits I will not, however, undertake to dwell.

I may mention a few direct benefits which are of the very first importance, and upon which we could count with absolute certainty.

(1). Upon such a farm it would be possible to study many animals under conditions closely approximating those of nature. In the effort to study the evolution of intelligence, which is our fundamental problem, the inability to secure prolonged and systematic observation of animals under natural conditions, has proved a fatal obstacle to anything like real scientific work.

(2) It would be possible under such circumstances to perform experiments involving a change in the natural surroundings of the animal, which would enable a confident detection of many forms of mental adjustment, which can now only be gotten at with lamentable uncertainty.

(3) There are many problems involving the facts of heredity, which cannot be studied at all, save where one can control perfectly many succeeding generations. Such a farm as this will offer an unparalleled opportunity for doing this with scientific rigor, and amid surroundings which, in distinction from those of the ordinary laboratory, would enable the preservation of the genuine conditions of nature.

(4) I could develop these and many other points, at great length, but I fancy that what you desire is a general impression of the sort of benefits for which we look. The points already covered will, I hope, serve that purpose. I wish to add, in conclusion, that such a farm would, in my judgment, so far as concerns the understanding of the evolution of mind, be one of the most important, if not the most important step, which has yet been taken under the auspices of organized science, for solving the most fundamental and most perplexing problem of life, i.e., the

I may mention a few direct benefits which are of the very first importance, and upon which we could count with absolute certainty.

(1). Upon each a fact it would be possible to study many animals under conditions closely approximating those of nature. In the effort to study the evolution of intelligence, which is our fundamental problem, the inability to secure prolonged and accurate observation of animals under natural conditions, has proved a fatal obstacle to anything like real scientific work.

(2). It would be possible under such circumstances to perform experiments involving a change in the natural surroundings of the animal, which would enable a constant detection of any form of mental adjustment, which can now only be gotten at with lamentable uncertainty.

(3). There are many problems involving the facts of heredity, which cannot be studied at all, save where one can control perfectly many succeeding generations. Such a fact as this will offer an unparalleled opportunity for doing this with scientific rigor, and with surroundings which, in distinction from those of the ordinary laboratory, would enable the preservation of the genuine conditions of nature.

(4). I could develop these and many other points, but I must leave that to your desire for a general impression of the sort of benefits for which we look. The points already covered will, I hope, serve the purpose. I wish to add, in conclusion, that such a fact would, in my judgment, be far as concerned the understanding of the evolution of mind, as one of the most important, if not the most important, step, which has yet been taken under the auspices of organized science, for solving the most fundamental and perplexing problem of life, i.e., the

origin and developement of consciousness.

Yours very truly,

Jas. R. Angell.

October 19, 1907.

Mr. McLean, Supt. of Buildings and Grounds,
University of Chicago.

My dear Mr. MacLean:-

My delay in answering your letter requesting a statement of the main purposes of the Biological farm was not intentional but due to the illness of my wife making it impossible to give the time for it. I think that the main objects of such a farm as that proposed have already been so often stated to the President, by Professor Whitman especially, that he must be quite familiar with them. However, if you wish, I will briefly recapitulate them.

The first and prime object of such a farm is the study of the phenomena and laws of inheritance both in plants and animals: experiments in breeding, in the origin of species, in the mechanism of evolution. This is the root of the matter. A farm, in other words, to do what the Experimental Station of the Carnegie Institution at Cold Spring Harbor is doing. It may interest the President to know that that Station was the direct outcome of a recommendation of Professor Whitman to that Institution and it was established in accordance with his plans. This part of the work involves both the zoological and physiological departments.

The second object of such a farm is to serve us as a station for experimental physiology and surgery and experimental therapeutics. This station in the country away from the dust of the

origin and development of consciousness.

Yours very truly,

Wm. H. Angell.

October 12, 1907.

Mr. Nathan, Esq., of Hollister and Brown,

University of Chicago.

My dear Mr. Nathan:

My reply in answering your letter regarding a statement of the main purpose of the Biological Series was not intentional but due to the illness of my wife making it impossible to give the time for it. I think that the main object of such a series as that proposed have already been so often stated to the President, by Professor Wilson especially, that he must be quite familiar with them. However, if you wish, I will briefly recapitulate them.

The first and prime object of such a series is the study of the phenomena and laws of behavior both in plants and animals; experiments in psychology, in the origin of species, in the mechanism of evolution. This is the rest of the matter. A series, in other words, so as that the Experimental Station of the Carnegie Institution at Cold Spring Harbor is doing. It may interest the President to know that this Station was the direct outcome of a recommendation of Professor Wilson to that Institution and it was established in accordance with his plans. This part of the work involves both the sociological and physiological departments.

The second object of such a series is to serve as an institution for experimental physiology and surgery and experimental therapeutics. This station is the country away from the dust of the

city where the animals could be properly cared for would be worth everything to this department. It is impossible for us at the present time to care for sick animals in our buildings. It is impossible to keep them alive. Such stations as that planned for us would give us the facilities of Pawlows Institute in St. Petersburg. It would greatly stimulate our research work in the line of curative medicine.

In the third place such an institute would be invaluable to the psychologists for the study of animal behaviour, a subject of the highest importance.

Finally, the farm is to serve as a breeding station for the animals used in our experiments.

Other universities are already moving in this direction. Columbia this past year has indirectly through Prof. Morgan made somewhat similar arrangements. This University is fortunate in having already by the work of Professor Whitman taken the first place in the country in the investigation of inheritance. This work has been done hitherto under serious disadvantage and at a heavy personal expense.

I hope this will cover what you want.

Thanking you for your interest in the matter,

I am

Very truly yours,

Albert P. Mathews.

VI

Requirements of Educational Departments, as to buildings and equipment, and estimates of cost.

DEPARTMENT OF ZOOLOGY

I. Buildings.

city where the animals could be properly cared for would be worth everything to this department. It is impossible for us at the present time to care for sick animals in our buildings. It is impossible to keep them alive. Such stations as that planned for us would give us the facilities of Pawnee Institute in St. Helena, N.Y. It would greatly stimulate our research work in the line of curative medicine.

In the third place such an institute would be invaluable to the physiologists for the study of animal behavior, a subject of the highest importance. Finally, the farm is to serve as a breeding station for the animals used in our experiments.

Other universities are already moving in this direction. Columbia this past year has indicated through Prof. Morgan made permanent similar arrangements. This University is fortunate in having already by the work of Professor Wetmore taken the first place in the country in the investigation of inheritance. This work has been done without any special disadvantage and at a heavy personal expense.

I hope this will cover what you want. Thanking you for your interest in the matter, I am, Very truly yours,
Albert B. S. Henshaw.

VI
Department of Educational Department, as to buildings and equipment, and estimate of cost.

A. There should be an aviary and attached laboratory with rooms for laboratory purposes, flying cages for birds, etc. (For Prof. Whitman's work).

The building should be 50' x 60' of brick, two stories high. There should be cement floors and baseboards with floor drains in the animal rooms, and running water in each room. Connected with this building there should be inclosed yards for pigeons. Portable sides and roofs of boards and glass should be provided so that one-half of the yards can be inclosed in the winter. These inclosed yards should be 300' long and 70' wide. These yards will not require heat. In addition there should be an inclosure of one quarter of an acre for dove pens.

Estimated cost \$ 10,500.00

B. Laboratory and vivarium for insects and molluscs (For Prof. Tower's work)

See page 34

This building should be 50' x 60' with vivarium annex 50' x 90'. The main building should be brick, one story high, with cement floors and baseboards, and running water in each room. The vivarium may be of common greenhouse construction. Both buildings should be furnished with gas for incubators and power for electric apparatus. There should be a constant temperature room in the laboratory building 10' x 15' x 6'.

In connection with the laboratory there should be a plat of ground 250' x 200' inclosed with a 6' fence, made of galvanized iron poultry netting 1" mesh, for out-of-door cages for experiments in segregation. There should also be a plat of ground 150' x 190' inclosed with a fence for plats of potatoes, etc., for insects, to study effects of selection and place variation in some

A. There should be an aviary and attached laboratory with
rooms for laboratory purposes, flying cages for birds, etc. (For
Prof. Whitman's work).
The building should be 30' x 60' or brick, two stories
high. There should be cement floors and passageways with floor
drains in the animal rooms, and running water in each room. Con-
sidered of this building there should be enclosed yards for pigeons.
Portable cages and racks of boards and glass should be provided
so that one-half of the yards can be enclosed in the winter. These
enclosed yards should be 300' long and 70' wide. These yards
will not require heat. In addition there should be an enclosure
of one quarter of an acre for dove pens.

Estimated cost \$10,000.00

B. Laboratory and vivarium for insects and mollusks (For
Prof. Tower's work)

See page 34

This building should be 30' x 60' with vivarium annex
30' x 90'. The main building should be brick, one story high,
with cement floors and passageways, and running water in each room.
The vivarium may be of common greenhouse construction. Both build-
ings should be furnished with gas for incubators and power for elec-
tric apparatus. There should be a constant temperature room in the
laboratory building 10' x 12' x 8'.
In connection with the laboratory there should be a plot
of ground 300' x 200' enclosed with a 6' fence, made of galvanized
iron poultry netting 1" mesh, for one-of-door cages for experi-
ments in vegetation. There should also be a plot of ground 150'
x 100' enclosed with a fence for plots of potatoes, etc., for in-
sects, to study effects of selection and place variation in some

specie.

See page 35

Estimated cost \$13,400.00

C. In connection with A and B there should be a brook and three ponds.

Estimated cost of ponds 300.00

Total estimated cost of Buildings and Ponds- \$24,200.00

II. Equipment.

1. Tools.- Small carpenter bench and common carpenter and plumbers' tools. Small lathe, vice, etc.- \$ 200.00

2. Flower pots 12", 6", 4" (500 each)-- 40.00

3. Cages - A (18" x 18") 100 @ 3.50 ea. 350.00

B (24" x 36") 50 @ 4.75 ea. 237.50

C Const. Temp. 20 @ 7.00 ea. 140.00

4. Cages - 10 large out-of-door cages of Cypress frame galv. iron wire mesh, 24 mesh to inch, 10' x 15' x 4'; See

page 36. 250.00

5. Laboratory glassware, bottles, bell jars, etc. 200.00

6. Gardeners' tools - hose, etc. 25.00

7. Thermographs - 4 125.00

8. Miscellaneous equipment for Prof. Whitman's (work. 500.00

9. Twelve laboratory tables 360.00

Total estimated cost of initial equipment \$ 2,427.50

III. Furniture

36 Chairs \$ 72.00

2 Office desks and chairs 110.00

8 Wall cases (Small) 48.00

6 Wall Cases (Large) 150.00

See page 25

\$17,400.00

C. In connection with A and B there should be

a brick and three ponds.

200.00

\$24,200.00

Total estimated cost of Buildings and Ponds-

II. Equipment.

1. Tools. - Small carpenter bench and common carpenter

200.00

and plumbers' tools, small iron, vice, etc.

40.00

2. Flower pots 12" x 6" x 4" (500 each) -

250.00

3. Cages - A (12" x 12" x 12") 100 @ 2.50 ea.

\$250.00

B (24" x 36") 50 @ 4.75 ea.

\$237.50

C Constant Temp. 20 @ 7.00 ea.

140.00

4. Cages - 10 large out-of-door cages of Cypress frame

each 12' x 12' x 12' mesh, 8' mesh 10 inch, 10' x 12' x 4' 2" mesh

250.00

5. Laboratory glassware, bottles, bell jars, etc. 200.00

25.00

6. Gardeners' tools - hose, etc.

125.00

7. Thermographs - 4

200.00

8. Miscellaneous equipment for Proj. Williams' (work)

250.00

9. Twelve Laboratory tables

\$2,427.50

Total estimated cost of initial equipment

III. Furniture

25.00

10. Chairs

110.00

11. Office desks and chairs

45.00

12. Wall cases (small)

150.00

13. Wall cases (large)

1 Set kitchen furniture	\$	30.00
1 Set bedroom furniture		25.00
6 Babcock Fire Extinguishers		96.00
200 Eureka Linen fire hose		40.00
1 Refrigerator		25.00
Total estimated cost of furniture--	\$	596.00

IV. Annual Maintenance.

1. Help.

A. Laboratory attendant and custodian at \$75.00 per month--	\$	900.00
B. Helper at \$50.00 per month		600.00

2. Equipment - Annual purchase of new, and repairs to old equipment.

A. Prof. Tower's work-	400.00
B. Prof. Whitman's work-	400.00

3. Supplies and Expense.

Ice, acids, express, cartage, feed for animals, etc.

A. Prof. Tower's work-	\$	400.00
B. Prof. Whitman's work-		600.00
C. Expense of collecting material and necessary work in tropics: (Prof. Tower's work)-		1,000.00
	\$	4,300.00

----- 0 -----

SUMMARY

Department of Zoology

I. Buildings	\$24,200.00
II. Equipment	2,427.50
III. Furniture	596.00
IV. Annual Maintenance	4,300.00

1 Set kitchen furniture	20.00
1 Set bedroom furniture	25.00
8 Bamboo Ware Kitchenshelves	32.00
200 Bureaus, linen fire hose	40.00
1 Refrigerator	25.00
Total estimated cost of furniture	242.00

IV. Annual Maintenance	
1. Help	
A. Laboratory attendant and custodian at	
575.00 per month	690.00
B. Helper at 250.00 per month	300.00
2. Equipment - Annual purchase of new, and repairs to old equipment	
A. Prof. Tower's work	400.00
B. Prof. Wilson's work	400.00
3. Supplies and Expense	
Ice, acids, expense, cartage, feed for animals, etc.	
A. Prof. Tower's work	400.00
B. Prof. Wilson's work	400.00
4. Expense of collecting material and necessary work in projects (Prof. Tower's work)	
2,300.00	
\$ 3,500.00	

SUMMARY

Department of Zoology

I. Buildings	\$24,200.00
II. Equipment	2,127.50
III. Furniture	255.00
IV. Annual Maintenance	4,700.00

DEPARTMENTS OF
PHYSIOLOGY AND PHYSIOLOGICAL CHEMISTRY

I. Buildings

A. There should be a main laboratory building, two stories high and basement, 50' x 75', of brick, with cement floor, and baseboards, with hot and cold water in each room.

See page 37

Estimated cost-- \$16,800.00

B. There should be an animal house 25' x 50', one story high, of brick construction.

Estimated cost-- \$ 2,625.00

Total estimated cost of buildings \$19,425.00

See page 37

II. Equipment

Equipment of operating rooms	\$ 450.00
Surgical Instruments	50.00
Instrument Sterilizers	10.00
B. & L. Autoclave 25 x 50 c.M.	50.00
Burners and tubing	5.50
Two operating tables	18.00
One operating table	40.00
One metal operating stove	3.75
Three immersion bowl stands and basin	12.00
Two glass instrument stands 3x 12 x 18"	5.00
One bedside table	4.50
Operating cloths, gauze adhesive, plaster,	
brushes, vaseline, soap, antiseptic cloth, etc.	40.00
Preparation table, two wood stools, slop bucket,	20.00

DEPARTMENTS OF PHYSIOLOGY AND PHYSIOLOGICAL CHEMISTRY

I. Buildings

A. There should be a main laboratory building, two stories high and basement, 50' x 75', of brick, with cement floor, and passageway, with hot and cold water in each room.

See page 37

\$10,800.00

Estimated cost--

B. There should be an animal house 25' x 50', one story high, of brick construction.

\$2,625.00

Estimated cost--

\$13,425.00

Total estimated cost of buildings

See page 37

II. Equipment

Equipment of operating rooms

\$50.00

Surgical Instruments

10.00

Instrument Sterilizers

50.00

N. & L. Associates 25 x 50 c.m.

8.80

Burners and tubing

18.00

Two operating tables

40.00

One operating table

3.75

One metal operating stove

12.00

Three immersion foot stands and basin

5.00

Two glass instrument stands 32 1/2 x 18"

4.80

One bedside table

Operating cloths, gauze adhesive, glass

Brushes, vaseline, soap, antiseptic cloth, etc. 40.00

Preparation table, two wood stools, soap bucket, 20.00

One spray pump	2.35
Fine plain deal tables	12.50
Glass tops for same	15.00
Cage, fan and motor for drying dogs	100.00
Miscellaneous	70.00
One Microscope, oil immersion	60.00
Two Kymographs	250.00
One long paper kymograph	100.00
Two cheaper kymographs	50.00
Stands for instruments	25.00
Galvanometer	50.00
Timesignals, clock, etc.	50.00
Two piston recorders	10.00
Three oncometers	10.00
Manometers	5.00
Three tambours and attachment	10.00
Two pairs Scales for animals	25.00
One Polaniscopes Schmidt & Hansen	350.00
One balance	75.00
One balance	40.00
One balance	10.00
Centrifuges with Motors	100.00
Chemicals and drugs	300.00
Glassware (Beakers, Condensers, Bottles, Lamps, etc.)	400.00
Five Chemical desks with sinks	500.00
Cages for rabbits and guinea pigs	100.00
Cages for dogs	100.00
Equipment for machine shops (Laths, tools, etc.)	600.00
Total estimated cost of initial equipment	4,128.60

One spray pump	2.50
Fine plain desk tables	12.50
Glass tops for same	12.00
Cases, fan and motor for drying dogs	100.00
Miscellaneous	70.00
One microscope, all immersion	60.00
Two Kymographs	250.00
One large paper kymograph	100.00
Two cheaper kymographs	50.00
Stands for instruments	25.00
Galvanometer	50.00
Thermopiles, clock, etc.	50.00
Two photo recorders	10.00
Three anemometers	10.00
Manometers	5.00
Three tambours and attachments	10.00
Two pairs Biotin for animals	25.00
One Polariscope Schmidt & Hansen	350.00
One balance	75.00
One balance	40.00
One balance	10.00
Centrifuges with Motors	100.00
Chemicals and drugs	200.00
Glassware (Barkere, Condensers, Retorts, Lamps, etc.)	400.00
Five Chemical benches with sinks	500.00
Cases for bottles and tubes etc	100.00
Cases for dogs	100.00
Refrigerant for machine shops (Lettie, tools, etc.)	500.00
Total estimated cost of initial equipment	4,125.00

III. Furniture.

Office furniture, desks, chairs, tables, files, etc.

Bedroom furniture

Kitchen furniture

Fire extinguishers

\$ 500.00

Total estimated cost of furniture

\$ 500.00

IV. Annual Maintenance.

1. Help.

A. One laboratory attendant--

\$ 900.00

B. One helper

600.00

2. Equipment. Annual purchase of new, and repairs
to old equipment.

700.00

3. Supplies and expenses.

Purchase of animals, feed, etc. express charges
cartage, etc.

700.00

Total estimated cost of annual maintenance--

\$ 2,900.00

----- 0 -----

SUMMARY

DEPARTMENTS OF PHYSIOLOGY AND

PHYSIOLOGICAL CHEMISTRY.

I.	Buildings-	\$19,425.00
II.	Equipment	4,128.60
III.	Furniture	500.00
IV.	Annual Maintenance-	2,900.00

III. Furniture.

Office furniture, desks, chairs, tables, files, etc.

Bedroom furniture

Kitchen furniture

Fire extinguishers

\$ 200.00

\$ 200.00

Total estimated cost of furniture

IV. Annual Maintenance.

1. Help.

\$ 200.00

A. One laboratory attendant--

\$ 200.00

B. One helper

2. Equipment. Annual purchase of new, and repairs

\$ 200.00

to old equipment.

3. Supplies and expenses.

Purchase of animals, food, etc., express charges

\$ 200.00

carriage, etc.

\$ 2,200.00

Total estimated cost of annual maintenance--

RESEARCH

DEPARTMENT OF PHYSIOLOGY AND

PHYSIOLOGICAL CHEMISTRY.

\$12,425.00

\$4,125.00

\$200.00

\$2,200.00

I. Salaries

II. Equipment

III. Furniture

IV. Annual Maintenance

DEPARTMENT OF ANATOMY

I. Building.

A. There should be a barn for breeding, caring for, etc., a continuous supply of laboratory animals, such as rabbits, guinea pigs, rats, and other small animals. There should also be accommodations for the large domestic animals, and a separate provision for dogs.

The barn noted under "Animal Supply" would be adequate for this work. No additional barn will be needed.

Estimated cost---

See "Animal Supply".

B. Laboratory Building. There should be a laboratory building having 2250 sq.ft. of floor space, sub-divided into units 15' x 15', room en suite. This building should be similar to the laboratory noted under "Dept. of Physiological Chemistry," and should contain hospital quarters for operated animals.

Estimated cost---

\$ 4,725.00

II. Equipment.

Surgical equipment for operating work, instruments, and sterilizers.

Estimated cost---

\$ 500.00

III. Furniture

Office Furniture

Kitchen "

Bed Room "

Fire Apparatus

Estimated cost

\$ 200.00

DEPARTMENT OF ANATOMY

I. Building.

A. There would be a room for preserving, caring for, etc., a continuous supply of laboratory animals, such as rabbits, guinea pigs, rats, and other small animals. There should also be accommodations for the large domestic animals, and a separate provision for cages.

The part noted under "Animal Supply" would be adequate for this work. No additional part will be needed. Estimated cost-- See "Animal Supply".

B. Laboratory Building. There should be a laboratory building having 2200 sq. ft. of floor space, sub-divided into units 15' x 15', room on suite. This building should be similar to the laboratory noted under "Dept. of Physiological Chemistry," and should contain hospital quarters for operated animals. Estimated cost-- \$4,755.00

II. Equipment.

General equipment for operating work, instruments, and supplies. Estimated cost-- \$200.00

III. Furniture.

Office furniture
 Kitchen
 Bed Room
 Five apparatus
 Estimated cost \$200.00

IV. Annual Maintenance

1. Help

One half the time of one man- \$ 450.00

SUMMARY

DEPARTMENT OF ANATOMY

I. Buildings	\$ 4,725.00
II. Equipment	500.00
III. Furniture	200.00
IV. Annual Maintenance	450.00

O

DEPARTMENT OF BOTANY

The present needs of the Department of Botany are stated in Prof. John M. Coulter's letter of March 7, 1907, copy of which follows:

DEPARTMENT OF BOTANY

March 7, 1907.

Dear Mr. MacLean:-

Professor Barnes has communicated to me your question in reference to the biological farm. The department of Botany is very much interested in securing the necessary land for such a farm at the earliest possible date. It is also very much interested in having a part of such tract set apart for its experimental needs. In a few years it would expect to enter upon such an area and conduct some extensive experimental work.

In the immediate future, however, no such attempt would be made, for it is absolutely necessary to develop our

IV. Annual Maintenance

I. Help

One half the time of one man - \$ 450.00

DEPARTMENT OF ANATOMY

I. Buildings \$ 1,750.00

II. Equipment 200.00

III. Furniture 200.00

IV. Annual Maintenance 450.00

DEPARTMENT OF BOTANY

The present needs of the Department of Botany are stated in Prof. John M. Coulter's letter of March 7, 1907, copy of which follows:

DEPARTMENT OF BOTANY

March 7, 1907.

Dear Mr. Washburn:-

Professor Barnes has communicated to me your question in reference to the botanical farm. The department of Botany is very much interested in securing the necessary land for such a farm at the earliest possible date. It is also very much interested in having a part of your tract set apart for the experimental uses. In a few years it would expect to enter upon such an area and conduct some extensive experimental work. In the immediate future, however, no such attempt would be made, for it is absolutely necessary to develop our

home establishment in some directions first. Therefore, so far as the Department of Botany is concerned, there need be no immediate consideration of equipment and maintenance in connection with the biological farm.

Yours sincerely,

(Signed) John M. Coulter.

SUMMARY

Department of Botany

No expense for the present.

DEPARTMENT OF BACTERIOLOGY

AND

DEPARTMENT OF PATHOLOGY

-Animal Supply-

I. Building

There should be a frame barn 25' x 50', two stories high, with heat in the upper story. The first story should have stalls for six horses. The second story should be equipped for small animals, such as rabbits, guinea pigs, rats, etc., and there should be separate provision for dogs. This barn will be adequate for the work noted under "Animal Supply" for the Department of Anatomy.

Estimated cost--

\$ 4,125.00

II. Equipment

Some establishment in some direction first. Therefore, so far as the Department of Botany is concerned, there need be no immediate consideration of equipment and maintenance in connection with the biological laws.

Yours sincerely,

(Signed) John M. Coulter.

REMARKS

Department of Botany

No expense for the present.

DEPARTMENT OF BACTERIOLOGY

AND

DEPARTMENT OF PATHOLOGY

-Animal Supply-

I. Building

There should be a frame built 25' x 50', two stories high, with heat in the upper story. The first story should have stalls for six horses. The second story should be equipped for small animals, such as rabbits, guinea pigs, rats, etc., and there should be separate provision for dogs. This barn will be adequate for the work noted under "Animal Supply" for the Department of Anatomy.

\$4,125.00

Estimated cost--

II. Equipment

6 horses at \$75.00 each--	\$ 450.00
4 goats	
2 sheep	
Guinea Pigs (Breeding females)	100.00
Rabbits	25.00
Mice	10.00
Stable Equipment	150.00
Cages	<u>100.00</u>
TOTAL--	\$ 835.00

III. Animal Maintenance--

1. Help	
One man----	900.00
2. Supplies and Expense	
Animal Feed	1,500.00
Purchase of new animals	500.00
Expense, cartage, ice, etc.	<u>250.00</u>
	\$ 3,150.00

SUMMARY

Department of Bacteriology
and
Department of Pathology

Animal Supply

I. Building	\$ 4,125.00
II. Equipment	835.00
III. Annual Maintenance	<u>3,150.00</u>

4 horses at \$75.00 each	300.00
4 goats	100.00
2 sheep	25.00
Guinea pigs (breeding females)	10.00
Rabbits	150.00
Mice	100.00
Stable Equipment	100.00
Cages	625.00
TOTAL	\$ 1,225.00

III. Animal Maintenance-

1. Help	900.00
One man	
2. Supplies and Expense	1,800.00
Animal Feed	500.00
Purchase of new animals	250.00
Expense, cartage, etc., etc.	\$ 3,150.00

SUMMARY

Department of Entomology
and
Department of Pathology

Animal Supply

I. Building	\$ 4,125.00
II. Equipment	825.00
III. Animal Maintenance	3,150.00

----- 0 -----

DEPARTMENT OF PSYCHOLOGY

I. Building.

There should be a laboratory building for Animal Psychology, one story high, of frame construction, 50' x 70', with a roof cupola room 15' x 30'. There should be cement floors and baseboards in all animal rooms, and hot and cold water. There should be a fire proof vault in the office for keeping records.

See page 38

In connection with this building there should be a plat of ground 45' x 50' with a 6' fence made of heavy wire netting, for use as an animal yard. This yard should be divided into three divisions, 15', 15' and 20' wide respectively, with running water in each division. In connection with this yard there should be six dog kennels, and seven bee gums.

See page 38

Estimated cost	\$ 5,700.00
----------------	-------------

II. Equipment.

6 Cages for cats	\$ 24.00
6 Cages for rabbits	24.00
6 Bee Gums	24.00
6 Cages for guinea pigs	24.00
12 Cages for birds	24.00
12 Cages for rats	24.00
4 Cages for squirrels	16.00
1 Incubator and 1 Brooder for Domestic Fowls	35.00
1 Refrigerator	25.00
Tables for rat and bird cages	30.00
200' -1" Garden Hose	30.00

DEPARTMENT OF PSYCHOLOGY

I. BUILDING.

There should be a laboratory building for Animal Psychology, one story high, of frame construction, 50' x 50', with a roof capable room 15' x 50'. There should be cement floors and basements in all animal rooms, and hot and cold water. There should be a fire proof vault in the office for keeping records.

See page 38

In connection with this building there should be a plot of ground 25' x 50' with a 6' fence made of heavy wire netting, for use as an animal yard. This yard should be divided into three divisions, 25', 15' and 10' wide respectively, with running water in each division. In connection with this yard there should be six dog kennels, and seven bee hives.

See page 38

Estimated cost \$ 3,700.00

II. EQUIPMENT.

\$ 24.00	5 cages for cats
\$ 24.00	5 cages for rabbits
\$ 24.00	5 bird cages
\$ 24.00	5 cages for guinea pigs
\$ 24.00	12 cages for birds
\$ 24.00	12 cages for rats
\$ 16.00	4 cages for squirrels
\$ 28.00	1 incubator and 1 brooder for Domestic Poultry
\$ 28.00	1 refrigerator
\$ 20.00	Tables for rat and bird cages
\$ 20.00	200' - 1" garden hose

1 Spectrum light apparatus	
2 Heliostats	
1 Carbon bisulphide prism	
8 Slits	
1 Tube	
Apparatus for feeding, etc.	200.00
1 Continuous Kymograph	50.00
1 Reflex Camera	110.00
1 Photographic developing outfit	25.00
1 Stereo-Binocular (Observing animals at a distance)	45.00
1 Braus-Duner Binocular Microscope	100.00
1 Split-second stop watch	25.00
1 Laboratory outfit of clamps, rods, stands, portable electric lights, kymograph drawing instruments, glassware, rubber tubing, signal markers, time markers (Low estimate)	200.00
1 Star lathe	
1 Upright drill	
1 Small band saw	
1 Set lathe tools for iron and steel	
1 Set lathe tools for brass	
1 Set lathe tools for wood	
Special lathe attachments	
1 Grindstone	
1 Emery wheel	
1 Set carpenter's tools	
1 Cabinet maker's bench	
Belts, pulleys, shafting	
1 3 h.p. motor	
Common garden tools--	600.00

300.00	1 Spectroscopic light apparatus
50.00	2 Helioscopes
110.00	1 Carbon bisulphide prism
25.00	2 Slits
25.00	1 Tube
25.00	Apparatus for feeding, etc.
25.00	1 Continuous kymograph
25.00	1 Reflex Camera
25.00	1 Photographic developing outfit
25.00	1 Stereo-kinometer (Observing animal at a distance)
100.00	1 Stereo-kinometer microscope
25.00	1 Split-second stop watch
	1 Laboratory outfit of clamps, rods, stands, portable electric lights, kymograph drum, fine instruments, glassware, rubber tubing, animal markers, time markers (low estimate)
300.00	1 Bear lathe
	1 Upright drill
	1 Small band saw
	1 Hot lathe tools for iron and steel
	1 Hot lathe tools for brass
	1 Hot lathe tools for wood
	Special lathe attachments
	1 Grinding stone
	1 Heavy wheel
	1 Set carpenter's tools
	1 Cabinet maker's bench
	1 Set, plane, chisel, marking
	1 3 H.P. motor
500.00	Common garden tools

Original purchase of animals (Low)-	\$ 200.00
Total estimated cost of equipment--	\$ 1,835.00

III. Furniture

1 set kitchen furniture, including stove, dishes and cooking utensils	30.00
1 Set bed room furniture	30.00
1 Set office furniture	100.00
1 Dozen chairs	24.00
7 Pine tables	42.00
6 Babcock Fire Extinguishers	96.00
100'2" Eureka Linen Fire Hose	20.00
Total estimated cost of furniture--	342.00

IV. Annual Maintenance.

1. Help.

Laboratory assistant and custodian at
\$75.00 per month-- \$ 900.00

(This man must be of a much higher
grade of intelligence than the
ordinary janitor).

2. Equipment.

Repairs to apparatus and purchase of
new apparatus, conservative estimate for
first three years, liberal for succeed-
ing years--- 300.00

Purchase of new animals, conservative estimate
for second and third year, liberal for
succeeding years-- 200.00

3. Supplies and Expense.

Food for animals, considerable meat and

Original purchase of animals (low) - \$ 200.00
Total estimated cost of equipment - \$ 1,550.00

III. Furniture

1 set kitchen furniture, including stove, dishes and cooking utensils 20.00
1 set bed room furniture 20.00
1 set office furniture 100.00
1 dozen chairs 24.00
1 pine table 22.00
2 bar stools 28.00
100' x 20' Barker linen floor 20.00
Total estimated cost of furniture - 244.00

IV. Annual Maintenance

1. Help
Laboratory assistant and custodian at \$75.00 per month - \$ 900.00
(This man must be of a much higher grade of intelligence than the ordinary janitor).
2. Equipment
Repairs to apparatus and purchase of new apparatus, conservative estimate for first three years, liberal for succeeding years - 300.00
Purchase of new animals, conservative estimate for second and third year, liberal for succeeding years - 200.00
3. Supplies and Expense
Food for animals, considerable meat and

fruit must be supplied. Car fare, express,
cartage, etc.--

400.00

Total estimated cost of Annual Maintenance-- \$ 1,800.00

SUMMARY

Department of Psychology

I. Building-	\$ 5,700.00
II. Equipment-	1,835.00
III. Furniture-	342.00
IV. Annual Maintenance-	1,800.00

VII. ENGINEERING FEATURES

Heating System.

Due to the nature of the work to be done on the farm, namely, original investigation or research work in which the temperature of certain rooms must be maintained within reasonable limits regardless of the fluctuation of the outside temperature it is advised that a hot water system with mechanical circulation be adopted. The hot water system with its large thermal storage capacity is particularly well adapted to this class of heating. The cost of the heating system has been estimated on this basis.

For the control of temperature with a hot water system the Powers Thermostatic Control System is recommended as probably more nearly satisfying the requirements than any other. The estimates of cost of the heating system include the cost of this control mechanism.

fruit must be supplied. Car fare, express,

\$200.00

carfare, 500.00

\$ 1,800.00

Total estimated cost of Annual Maintenance--

Department of Psychology

I. Building	\$ 5,700.00
II. Equipment	1,825.00
III. Furniture	242.00
IV. Annual Maintenance	1,800.00

VII. ENGINEERING FEATURES

Heating System.

Due to the nature of the work to be done on the farm, namely, original investigation or research work in which the temperature of certain rooms must be maintained within reasonable limits regardless of the fluctuation of the outside temperature it is advised that a hot water system with mechanical circulation be adopted. The hot water system with the large thermal storage capacity is particularly well adapted to this class of heating. The cost of the heating system has been estimated on this basis. For the control of temperature with a hot water system the Powers Thermostatic Control System is recommended as probably more nearly satisfying the requirements than any other. The estimated cost of the heating system includes the cost of this control mechanism.

Lighting System.

For lighting the buildings and grounds the use of electricity is recommended. The fire hazard is probably lower with the electric system of lighting than with any other, even when the wires for lighting are run open on knobs or cleats. In the estimate of cost in each building provision has been made for a complete iron pipe conduit system in which the wires are to be run and for sheet metal fuse and switch boxes so that the fire hazard can be said to have been eliminated. In the power plant, as will be seen later, provision has been made for a storage battery in addition to the generating units, so that one may expect to have absolute continuity of electric service.

The North Shore Electric Company has lighting mains within easy reach of the proposed site, but due to the liability of break downs in their lines, and consequent interruption of service, it would hardly seem advisable to purchase electric power in preference to manufacturing it. A rotary converter with a storage battery could be used with the alternating current furnished by the Electric Company, but this machinery would call for as much attendant labor as the proposed generating plant, and would not be much cheaper to install.

Water System.

For a water supply the use of water from the stream is recommended. The water should be allowed to pass into a large sedimentation reservoir near the power plant where initial separa-

Lighting System

The lighting of the building and grounds was of a satisfactory character. The first hazard is probably lower with the electric system of lighting than with any other, even when the wires for lighting are run open on knobs or cleats. In the estimate of cost for each building provision has been made for a complete fire alarm system in which the wires are to be run and for manual alarm boxes and switch boxes so that the fire hazard can be kept to a minimum. In the power plant, as will be seen, provision has been made for a storage battery in addition to the generating plant, so that one may expect to have absolute security of electric service.

The North Shore Electric Company has lighting mains within each block of the proposed site, but due to the difficulty of breaking into these lines, and consequent interruption of service, it is recommended that the electric power be purchased from the city of Boston. A rotary converter with a storage battery could be used with the alternative current supplied by the Electric Company, but this machinery would call for as much attention as the proposed generating plant, and would not be much cheaper to install.

Water System

For a water supply the use of water from the stream is recommended. The water should be allowed to pass into a large sedimentation reservoir near the power plant where initial impurities

tion of suspended matter can take place. The water can be taken from this reservoir by a service pump and pumped into the system and water tower passing meanwhile through some efficient form of filter. This method of treatment would give a good water supply and would be more desirable than the questionable artesian well water.

For fire protection provision has been made in the estimate for a fire pump having capacity of 1000 gallons per minute at a pressure of 125 lbs. This pump will have ample capacity to supply four fire streams without reducing the pressure at the pump.

Gas System.

Gas will be needed for Bunsen burners and incubators, and since no gas is to be had at the proposed site there has been included in the estimate of cost a gasoline gas generator to be installed near the power house. The distributing piping from the gas generator may be laid in the trench with the heating pipes, thereby reducing to a minimum the condensation of the gas in transit.

Sewage System.

Sewage and drainage piping of sufficient capacity to serve the domestic requirements of the farm and to conduct the roof drainage from buildings has been provided. It is advised that the sewage system discharge through a series of septic tanks, into the stream at the farthest corner of the property. The cost of sewage and drainage system, outside of buildings and including the septic tanks, is included in the estimate of cost.

Location of Buildings.

The principal buildings are shown on the map, page 33, as located on the small plateau having a south exposure, and with the ground gradually sloping away to the south. This location on high ground gives good drainage facilities, and insure dryness to the

tion of suspended matter and lake glass. The water can be taken from this reservoir by a service pump and pumped into the system and water tower passing meanwhile through some efficient form of filter. This method of treatment would give a good water supply and would be more desirable than the present method of treatment.

The fire protection provision has been made in the estimate for a fire pump having capacity of 1000 gallons per minute at a pressure of 125 lbs. This pump will have a capacity to supply four fire streams without reducing the pressure at the pump.

Gas System

Gas will be needed for house burners and incinerators, and since no gas is to be had at the proposed site there has been included in the estimate of cost a gasoline gas generator to be installed near the power house. The gas line will be laid from the gas generator to the house burners and the incinerator, thereby reducing to a minimum the condensation of the gas in transit.

Power System

Power and drainage piping of sufficient capacity to serve the domestic requirements of the farm and to connect the roof drains to the main drainage line has been provided. It is advised that the house system discharge through a series of septic tanks, into the stream at the farmstead corner of the property. The cost of power and drainage system, outside of buildings and including septic tanks, is included in the estimate of cost.

Location of Buildings

The principal buildings are shown on the map, page 23, as located on the small plateau having a south exposure, and with the ground gradually sloping away to the south. This location on high ground gives good drainage facilities, and insures exposure to the

buildings at all times. The buildings are kept far enough apart so that the fire hazard to the group would be reduced to a minimum. The power plant was located at the extreme north-east corner of the plat, this being the nearest point to the railroad station, thus keeping the coal and supplies haul as short as possible. The prevailing wind being from the south west will insure the major buildings being free from coal dust or smoke. The power house in its proposed location is also isolated both by hill and timber from the group of buildings which it serves.

Advantage has been taken of the natural slope of the ground about the proposed power plant site by designing the coal storage vault so that wagons can be driven directly from the highway onto the roof of the coal vault. By this arrangement the driver has simply to shove the coal from his wagon when it will fall into the coal vault through openings provided for this purpose. A wagon scale should be placed between the road and the coal vault.

Equipment in Buildings.

In making these preliminary designs the buildings have been considered as work shops rather than the usual form of lecture room or college building. It has been assumed that the equipment considered in this report is to be installed in such a way that the liability of accident to the equipment or to the subjects under investigation due to disarrangement in the equipment shall be a minimum. For this reason it has been assumed that all heating, water and gas pipes and electric conduits be run on the surface of walls and ceilings rather than to be run concealed. By placing these conduits in the open the systems will at all times be accessible for inspection and repairs and the initial cost of installation

buildings at all times. The buildings are kept for enough space so that the fire hazard to the group would be reduced to a minimum. The power plant was located at the extreme north-east corner of the plant, this being the nearest point to the railroad station, thus keeping the coal and supplies from an open as possible. The prevailing wind being from the south-west will insure the major buildings being free from coal dust or smoke. The power house in the proposed location is also isolated from the mill and timber from the group of buildings which it serves.

Advantage has been taken of the natural slope of the ground about the proposed power plant site by designing the coal storage vault so that wagons can be driven directly from the highway onto the foot of the coal vault. By this arrangement the driver has simply to shove the coal from his wagon where it will fall into the coal vault through openings provided for this purpose. A wagon scale should be placed between the road and the coal vault. Equipment is as follows:

In making these preliminary designs the buildings have been considered as most shops rather than the usual form of lecture room or college building. It has been assumed that the equipment considered in this report later be installed in such a way that the liability of accident to the equipment or to the subjects under investigation due to disarrangement in the equipment be at all be a minimum. For this reason it has been assumed that all heating, water and gas pipes and electric conduits be run on the surface of walls and ceilings rather than to be run concealed. By placing these conduits in the open the systems will at all times be accessible for inspection and repairs and the initial cost of installation

will be less than with concealed work.

In all piping systems an ample supply of valves should be provided so that any system may be sectionalized for repairs without cutting off the whole system from any one building.

Hot and cold water has been provided for in each building. A hot water heater should be provided for each building and connected to a high pressure steam pipe from the power house.

Power Plant.

Building. The power plant building (see page 39) should be built of brick with concrete foundations, cinder concrete with tar and gravel roof and steel roof trusses and purlins. The floors should be cement. Windows and doors between boiler room and engine room should be of standard fire-proof construction. The battery room should be accessible only from without the building to prevent acid fumes from coming in contact with the electrical machinery. The building contemplated herein is of sufficient size to accommodate a fifty percent extension in the equipment without disturbing the building walls. By removing one side wall the building may have unlimited extension without disturbing the equipment.

Coal Storage.

A concrete coal storage vault has been provided for with a sufficient capacity for twenty days continuous operation of the plant at full load. This will allow the plant to tide over periods of foul weather or interruptions to railroad traffic. A wagon scale has been included for the weighing in of all coal to the plant or supplies to the farm.

will be less than with conventional work.

In all piping systems an ample supply of valves should be

provided so that any system may be isolated for repairs

without shutting off the whole system from any one building.

Hot and cold water has been provided for in each building.

A hot water heater should be provided for each building and connected

to a high pressure steam pipe from the power house.

Power Plant

The power plant building (see page 25) should

be built of brick with concrete foundations, chimneys concrete with

tar and gravel roof and steel roof trusses and purlins. The floors

should be cement. Windows and doors between boiler room and

engine room should be of standard fire-proof construction. The

boiler room should be accessible only from within the building

to prevent cold from being in contact with the electrical

machinery. The building contemplated herein is of sufficient

size to accommodate a fifty percent extension in the equipment

without disturbing the building walls. By removing one side

wall the building may have unlimited extension without disturbing

the equipment.

Coal Storage

A concrete coal storage vault has been provided for with

a sufficient capacity for twenty days continuous operation of the

plant at full load. This will allow the plant to ride over periods

of foul weather or interruptions to railroad traffic. A wagon

hoist has been included for the weighing in of all coal to the

plant or supplies to the farm.

and live steam heaters for the heating system, also for the two circulating pumps and the air compressors. All of this apparatus will be required by the Chimney.

The chimney should be of cement of sufficient capacity to accommodate a fifty percent increase in the boiler plant and of sufficient height to carry smoke well above surrounding trees.

Boilers.

Two boilers of the horizontal return tubular type are herein contemplated, either of which will have sufficient capacity to heat the entire group in any except the most extreme weather.

Engine and Generators.

Two generators (one 25 K.W. and one 50 K.W. capacity) direct current, 125 volts direct connected to two horizontal four valve medium speed engines are contemplated. The larger generating unit will have sufficient capacity to carry the entire electrical load of the farm. During periods of light load this unit can be used to charge the storage battery to be described later. The smaller generating unit is of sufficient capacity to carry the probable average load of the farm and with the aid of the storage battery can carry the peak or maximum demand on the electrical equipment.

Storage Battery

A storage battery with a capacity of 800 ampere hours should be provided to carry the right load and in case of emergency to carry for a short period of time the entire load. This battery would have a normal discharge rate of 200 amperes for a period of four hours.

Heating Apparatus in Plant.

Space has been left in the plant to accommodate the exhaust

General

The battery should be of sufficient capacity to accommodate a fifty percent increase in the boiler plant and of sufficient height to carry smoke well above surrounding trees.

Boilers

Two boilers of the horizontal return tubular type are herein contemplated, either of which will have sufficient capacity to heat the entire group in any except the most extreme weather.

Engine and Generator

The generator (one 25 K.W. and one 50 K.W. capacity) direct current, 100 volts direct connected to the horizontal return tubular boiler is contemplated. The larger generating unit will have sufficient capacity to carry the entire electrical load of the farm. During periods of light load this unit can be used to charge the storage battery to be described later. The smaller generating unit is of sufficient capacity to carry the probable average load of the farm and with the aid of the storage battery can carry the peak or maximum demand on the electrical equipment.

Storage Battery

A storage battery with a capacity of 500 ampere hours should be provided to carry the light load and in case of emergency to carry for a short period at times the entire load. This battery would have a normal discharge rate of 200 amperes for a period of four hours.

Heating Apparatus in Plant

Space has been left in the plant to accommodate the expansion

and live steam heaters for the heating system, also for the two circulating pumps and the air compressors. All of this apparatus will be required by the heating system and is included in the estimate of cost.

Reservoir.

A raw water reservoir and sedimentation tank having 425,000 gallons capacity has been provided, so that sufficient water may at all times be on hand for fire protection and (with a small filter) for domestic purposes.

Estimate of cost of power plant, with distributing heating, water gas, and electric mains and piping, lighting and heating systems in the various buildings.

1 Department of Physiology with animal house

Heating system in place, with temperature control apparatus ---	1,550.
Lighting system in building	1,365.
Water piping for sanitary, fire and domestic purposes--	1,028.
Gas piping-	200.

4,143

2 Department of Zoology - Laboratory and Aviary

Heating system in place	1,170.
Lighting system	600.
Water	1,500
Gas Piping	200.

3,470

3. Department of Zoology - Laboratory and Vivarium

Heating system	7,090.
----------------	--------

and live steam heaters for the heating system, also for the two circulating pumps and the air compressor. All of this apparatus will be repaired by the heating system and is included in the estimate of cost.

Reservoir.

A raw water reservoir and sedimentation tank having 425,000 gallons capacity has been provided, so that sufficient water may at all times be on hand for this purpose and (with a small filter) for domestic purposes.

Estimate of cost of power plant, with distribution heating, water gas, and electric main and piping, lighting and heating systems in the various buildings.

1. Department of Physiology with animal houses

Heating system in place, with temperature control apparatus	1,500.
Lighting system in building	1,300.
Water piping for sanitary, fire and domestic purposes	1,000.
Gas piping	500.
Total	4,300.

2. Department of Zoology - Laboratory and Aviary

Heating system in place	1,100.
Lighting system	800.
Water	1,500.
Gas piping	500.
Total	3,900.

3. Department of Zoology - Laboratory and Vivarium

Heating system	7,000.
----------------	--------

Lighting system	600.	
Water	1,500.	
Gas Piping	200.	
		8,590

4. Department of Phycology

Heating system	780.	
Lighting system	880.	
Water "	588.	
Gas Piping	150	
		2,398

5. Animal Supply:

Heating system	215.	
Lighting system	50.	
Water system	275.	
		540

6. Power Plant Building.

Brick with 17 in. walls steel		
roof trusses, cement roof with tar and		
gravel, concrete foundations, fire-		
proof coal storage vault---		18,000.

Power Plant Equipment:

2 Boilers 72" x 18' H.R. Tubular erected	3,250.	
2 Boiler settings	1,000.	
1 Cement Chimney 300 h.p. with breeching	2,100	
2 Engines (1-25 K.W. 1-50 W.W.) in place	2,800	
2 Generators 25 K.W. and 50 K.W.	2,200	
1 -1000 gal. fire pump steam, in place-	1,500	
2 Boiler feed pumps-	" "	300.
1 Triplex Service Pump 5½ x 6"		
with motor-	500.	

Lighting system	800.
Water	1,500.
Gas Piping	500.

2,800

Department of Hygiene	750.
Heating system	850.
Lighting system	850.
Water	150.
Gas Piping	150.

3,250

Animal Supply:	215.
Heating system	50.
Lighting system	275.
Water system	

540

Power Plant Building.
Buildings with 12 ft. walls steel
roof trusses, cement roof with corr. and
gravel, concrete foundations, fire-
proof coal storage vaults.

18,000.

- Power Plant Equipment:
- 2 Boilers 72" x 12' H.R. tubular erected 2,500.
 - 2 Boiler casings 1,000.
 - 1 General Chimney 300 h.p. with breeching 1,100
 - 2 Engines (1-25 H.P. and 50 H.P.) in place 2,500
 - 2 Generators 25 H.P. and 50 H.P. 2,500
 - 1-1000 Gal. fire pump steam, in place 1,500
 - 2 Roller feed pumps 500.
 - 1 Triplic Service Pump 5 1/2" x 6" with motor 500.

1 Storage battery - 100 amp. for 8 hrs.		
with switchboard--	5,000.	
1 Switchboard	1,500.	
All wiring in plant	700.	
Piping including heating system	5,660.	
Coal handling apparatus and scales	400.	
All machinery foundations	900.	
1 Feed water heater 200 h.p. in place	230.	
1 Exhaust steam heater for heating system)		
1 Live " " " " "		} 6,500
1 Expansion tank		
2 Turbine driven centrifugal pumps "		
Miscellaneous instruments, gauges,		
etc. for heating system apparatus		
1 60 gal. pressure filter	1,050.	
Miscellaneous steel-work	200.	
Power plant tools	300.	
Air Receiver	100.	
Catch basin	70.	36,260

Distributing systems:

Heating distribution piping	5,000.	
Water system including water tower		
and reservoir--	8,000.	
Electric distributing system	3,129.	
Gasoline gas plant and distributing		
system--	1,564.	
Sewerage System	3,492.	

Total

21,185

Engineering 5%---

94,386

4,719.

Total

99,105

Say

100,000

Yearly operation expense of power plant: various distributing systems and equipments as estimated above in various buildings:-

Coal delivered at plant 600 tons @ 3.00

1,800.00

Oil waste supplies---

500.00

Attendance:

1 Engineer

1,200.00

1 "

960.00

1 Coal Passer

600.00

2 Repair men

1,680.00

4,440.00

Machinery repairs, renewals, etc.

1,000.00

7,740.00

22,385

2,712

22,385

100,000

Total

22,385

Yearly operation expense of power plant: various electrical systems and equipment as indicated above in various

building:-

1,600.00

800.00

Coal delivered at plant 800 tons @ 2.00

Oil waste supplies--

Attendance:

1,200.00

900.00

800.00

4,440.00

1,200.00

5,000.00

2,740.00

Machinery repairs, renewals, etc.

RECAPITULATION

I- INITIAL EQUIPMENT.Department of Zoology-

Buildings-- \$24,200.00

Equipment- 2,427.50

Furniture- 596.00

Total-----

\$27,223.50

Department of Physiology-
and
Physiological Chemistry

Buildings- 19,425.00

Equipment- 4,128.60

Furniture- 500.00

Total-----

24,053.60

Department of Anatomy

Buildings- 4,725.00

Equipment- 500.00

Furniture- 200.00

Total-----

5,425.00

Department of Botany--

No expense for the present.

Department of Bacteriology
and
Department of PathologyAnimal Supply

Building- 4,125.00

Equipment- 835.00

Total-----

4,960.00

EXPENDITURE

1 - INITIAL EQUIPMENT

Department of Zoology

Building 884,500.00

Equipment 2,400.00

Materials 800.00

Total 887,700.00

Department of Zoology and
Physiological Chemistry

Building 15,400.00

Equipment 4,100.00

Materials 300.00

Total 19,800.00

Department of Anatomy

Building 4,700.00

Equipment 500.00

Materials 200.00

Total 5,400.00

Department of Botany

no expense for this present.

Department of Bacteriology
and
Department of Pathology

Animal Supply

Building 4,100.00

Equipment 450.00

Total 4,550.00

Department of Psychology

Building-	\$5,700.00	
Equipment-	1,835.00	
Furniture-	<u>342.00</u>	
Total-----		\$7,877.00

Estimated cost of Power Plant with
distributing, heating, water, gas,
and electric mains and piping,
lighting and heating systems in
the various buildings---

100,000.00

Grand Total Estimated--

Cost of Initial Equipment 169,539.10

Architects' Commission at 5% 3,476.95

Grand Total-- \$173,016.05

-----0-----

II. COST OF ANNUAL MAINTENANCE.

Department of Zoology 4,300.00

Departments of Physiology)
and) 2,900.00
Physiological Chemistry)

Department of Anatomy 450.00

Department of Botany - No expense at present.

Department of Bacteriology)
and)
Department of Pathology) 3,150.00
Animal Supply)

Department of Psychology 1,800.00

Annual Operating Expense of Power Plant,
various distributing systems and equip-
ments, as estimated above in various
buildings--

7,740.00

Department of Zoology

Building	\$2,700.00
Furniture	1,500.00
Books	300.00
Total	\$4,500.00

Estimated cost of power plant with
distribution, heating, water, gas,
and electric mains and piping,
lighting and heating system in
the various buildings--

Cost of initial equipment	162,839.10
Architect's Commission at 5%	8,141.95
Grand Total	\$170,981.05

II. COST OF ANNUAL MAINTENANCE

Department of Zoology	\$,300.00
Department of Botany	2,800.00
Department of Physiology and Psychological Chemistry	450.00
Department of Anatomy	1,200.00
Department of Entomology	1,500.00
Department of Bacteriology and Department of Pathology	3,150.00
Animal Supply	1,800.00

Annual Operating Expense of Power Plant,
various distributing systems and equip-
ments, as estimated above in various
buildings--

\$,740.00

Grand Total Estimated Cost	)	
of Annual Maintenance	)	\$20,340.00

----- 0 -----

III. AMOUNT NEEDED TO ENDOW FARM.

It will take \$508,500.00 at 4% to give an annual income of \$20,340.00.

SUMMARY

I-	Initial Equipment-	\$173,016.05
II-	Annual Maintenance-	20,340.00
III-	Endowment-	508,500.00
Total sum needed to equip)		
and endow the proposed		(\$701,856.05)
Biological Farm		
		\$881,576.05

Grand Total Estimated Cost }
 of Annual Maintenance }
 \$20,340.00

III. Amount needed to endow fund.

If will take \$208,800.00 at 4% to give an annual income of \$20,340.00.

SUMMARY

I-	Initial Endowment-	\$178,000.00
II-	Annual Maintenance-	\$20,340.00
III-	Endowment-	\$208,800.00

Total now needed to endow }
 and endow the proposed }
 Biological Farm }
 \$201,880.00

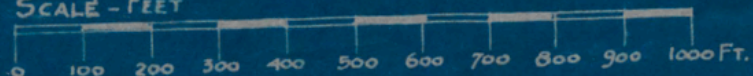


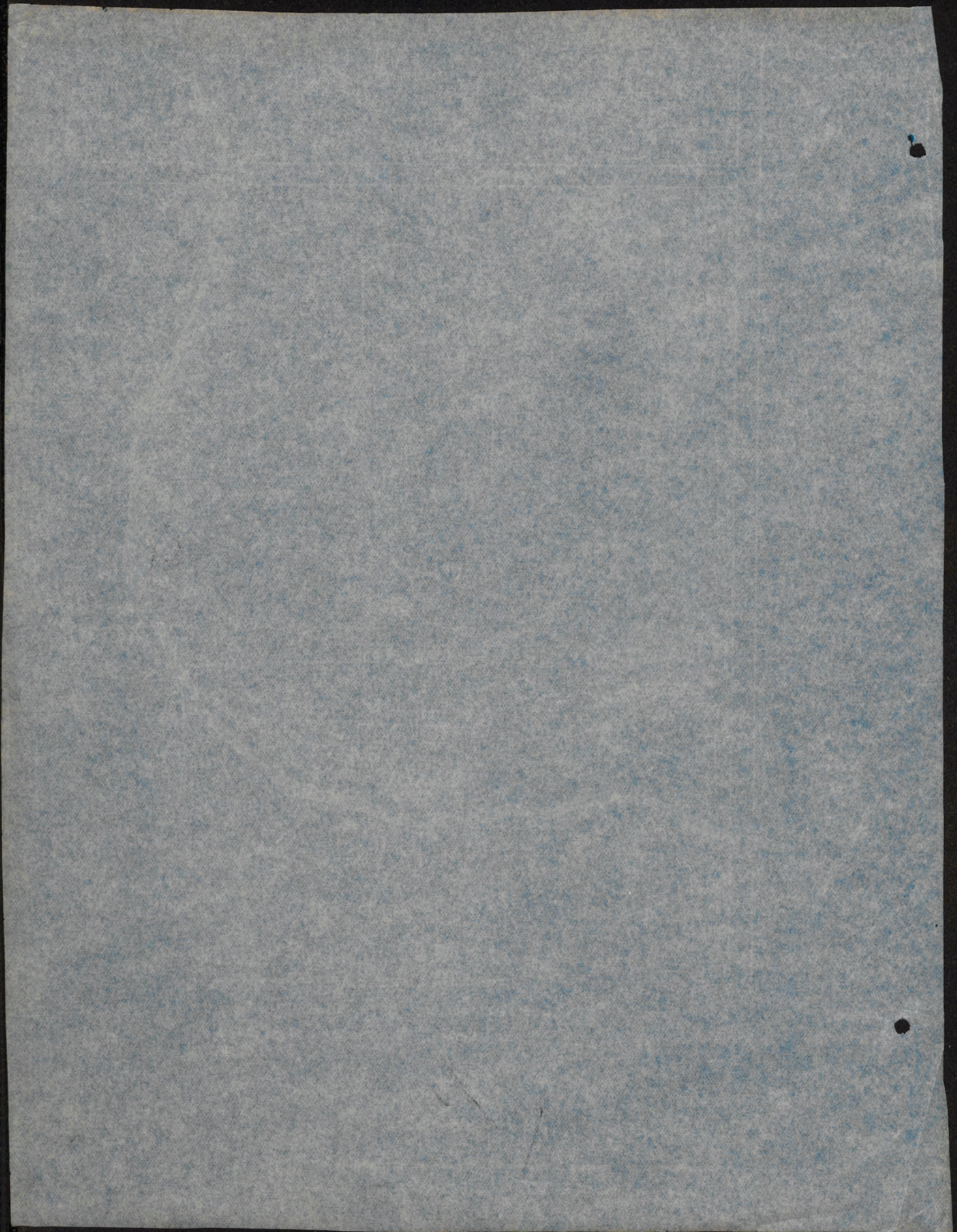
MAP OF PROPOSED BIOLOGICAL FARM.

DIMENSIONS ARE ONLY APPROXIMATE.

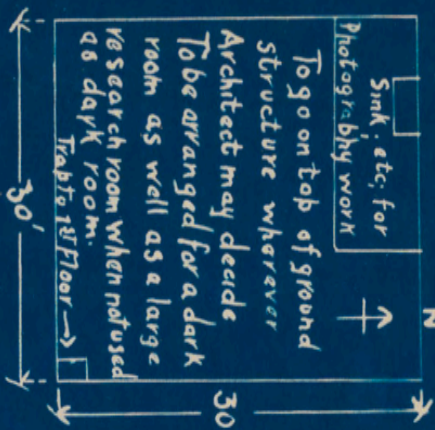
- BLDG- 1 PHYSIOLOGY.- WITH ANIMAL HOUSE
 " 2 ZOOLOGY.- LABRATORY AND AVIARY.
 " 3 " " " VIVARIUM.
 " 4 PHYCHOLOGY.-
 " 5 ANIMAL SUPPLY.-
 " 6 POWER HOUSE.-

SCALE - FEET





Cupola necessary to get full
Sunlight for Spectrum



Roof of Cupola to be flat and supplied
with 6' x 8' high lights.

Note - Floors of whole structure to be
of cement. Wash-board of cement 2 in
H.T. For all walls and partitions.

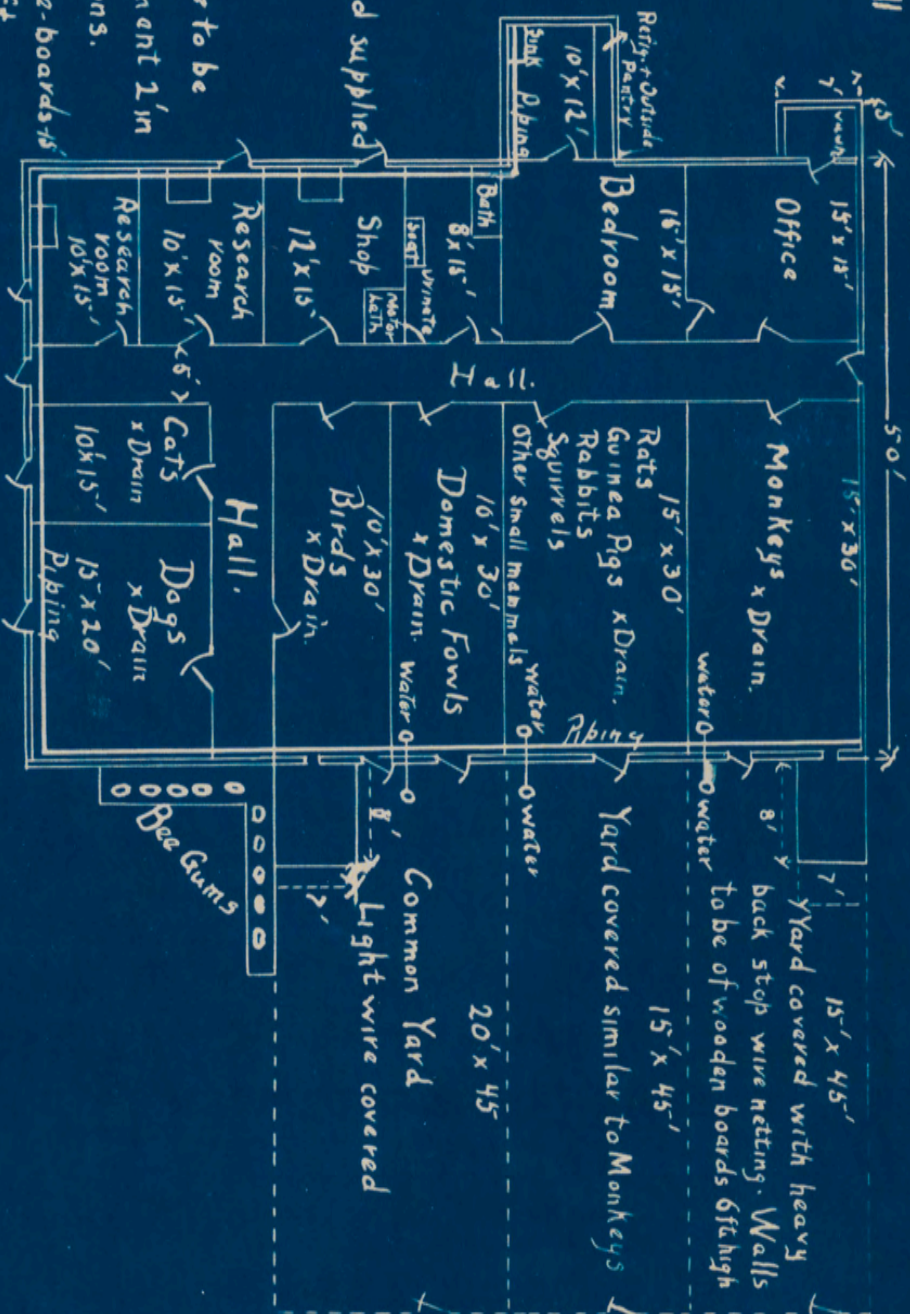
Height of walls including base-boards is
Total number of square ft.

Ground floor 50' x 70' = 3500.
Kitchen annex 10' x 11' = 110
Cupola 30' x 30' = 900
4520 sq. ft.

To be 200 yds. from other buildings.

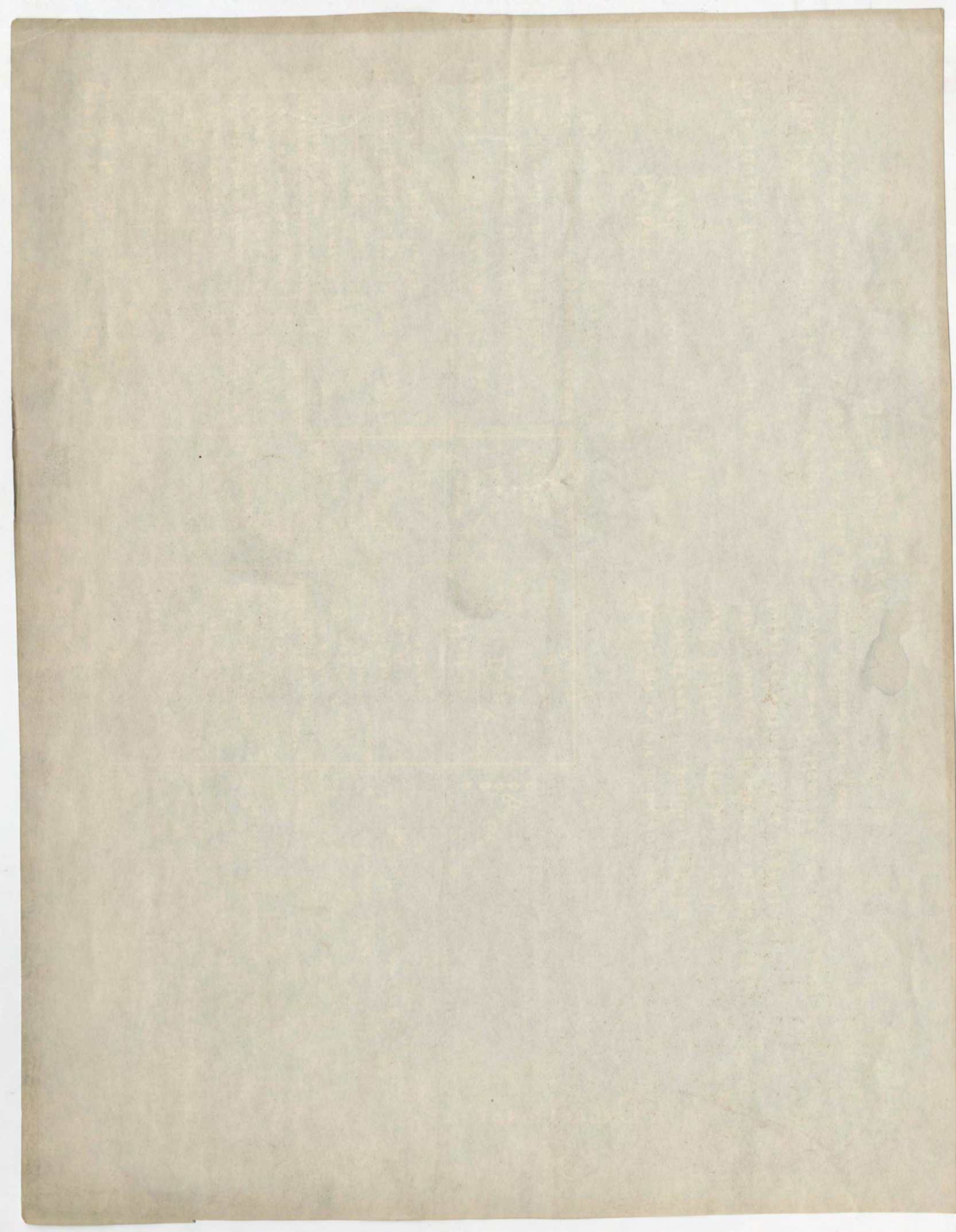
Ink lines show water pipes. This pipe to be laid in the cement floor. It is to be tapped so
connections can be made to lead both into the animals rooms and yard.

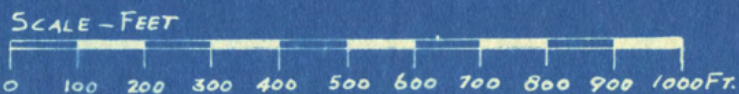
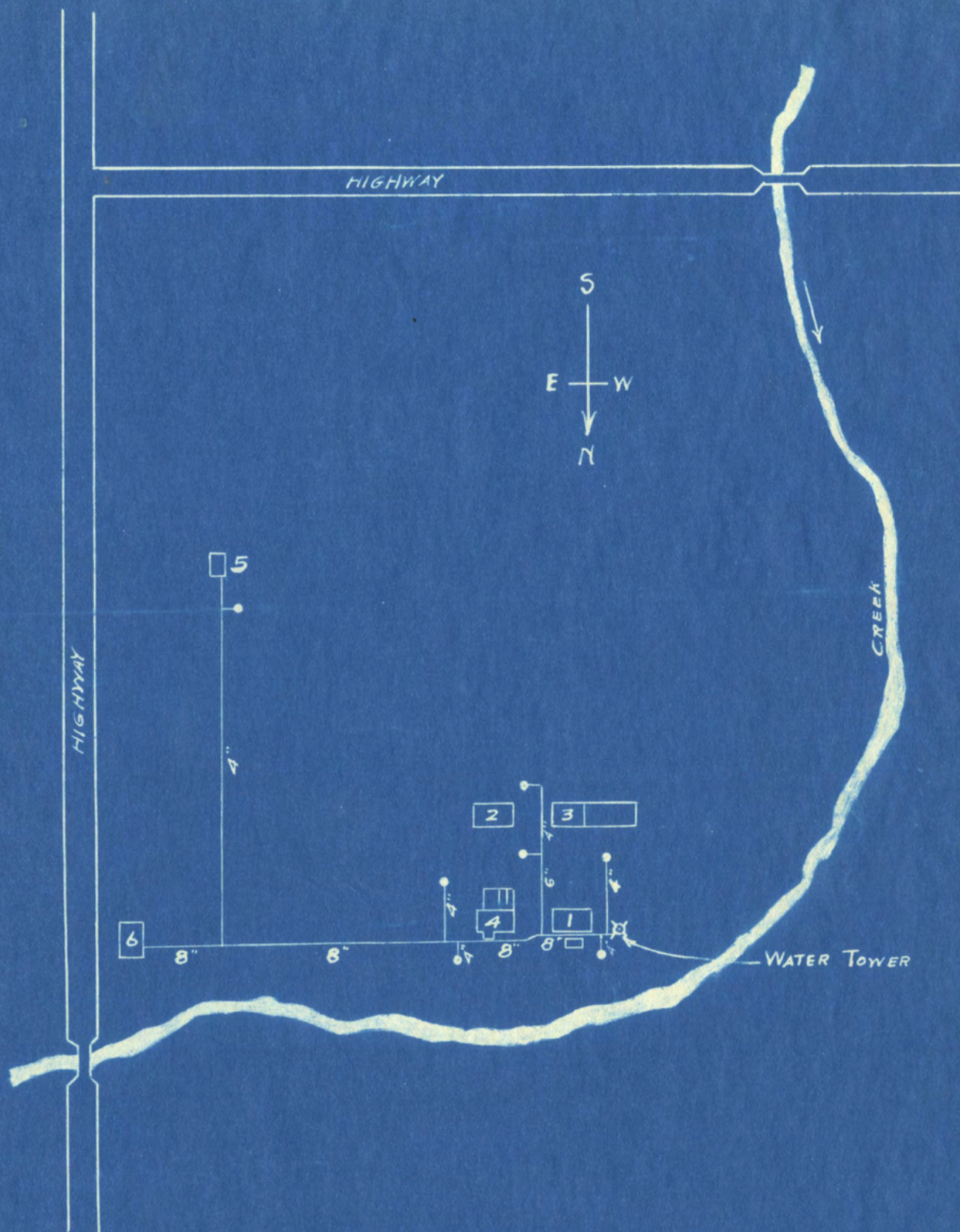
Scale $\frac{1}{16}$ inch to ft.

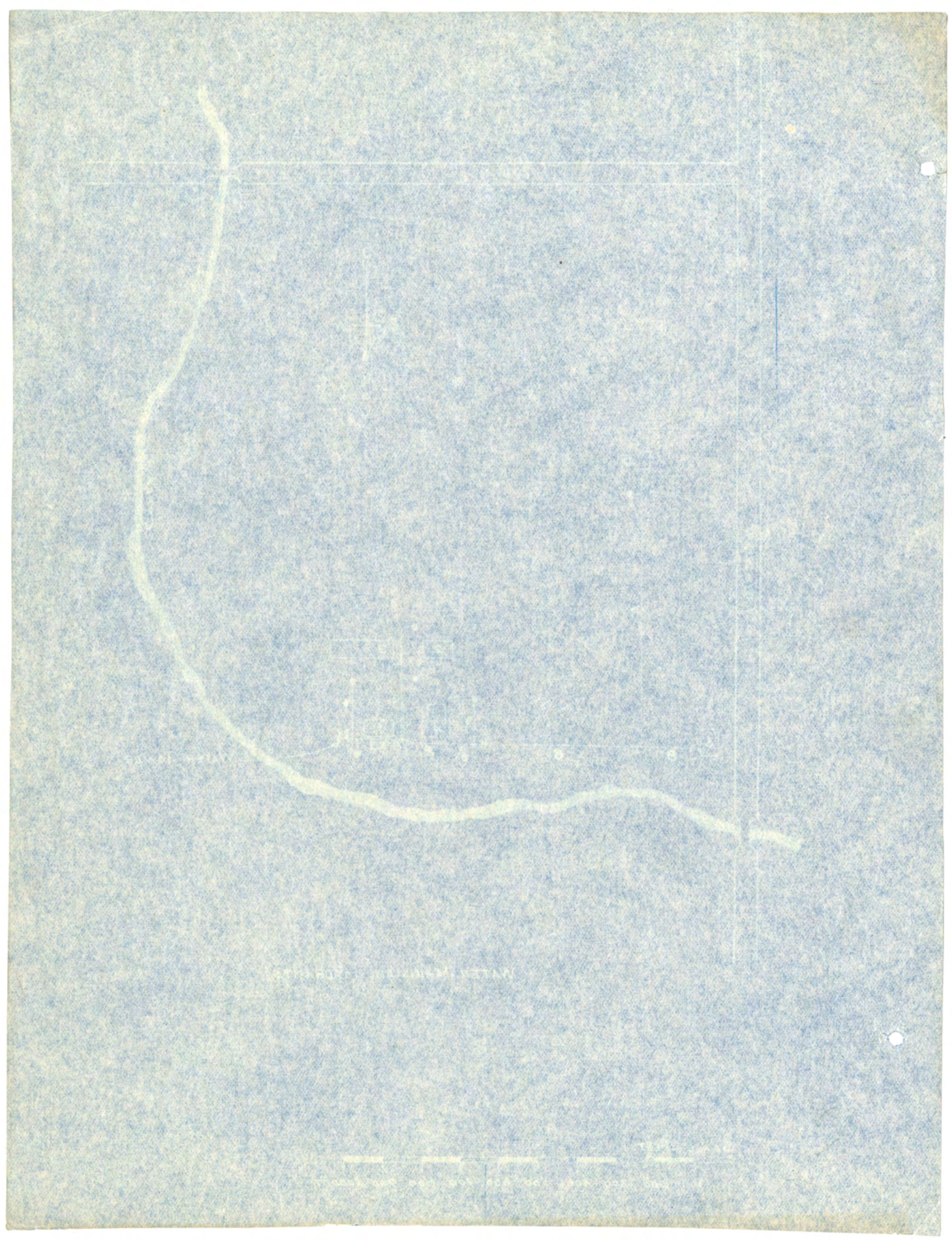


Note - The whole to be double ceiled
or plastered. The building is to be
well lighted with abundant high
long windows all rooms to be literally
supplied with electric lights.

Department of
Psychology









ELECTRIC DISTRIBUTION AND POLE LINE

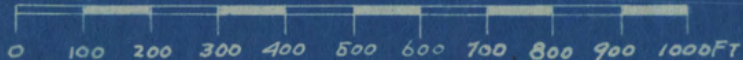
X ARC LAMPS 5 AMP EACH

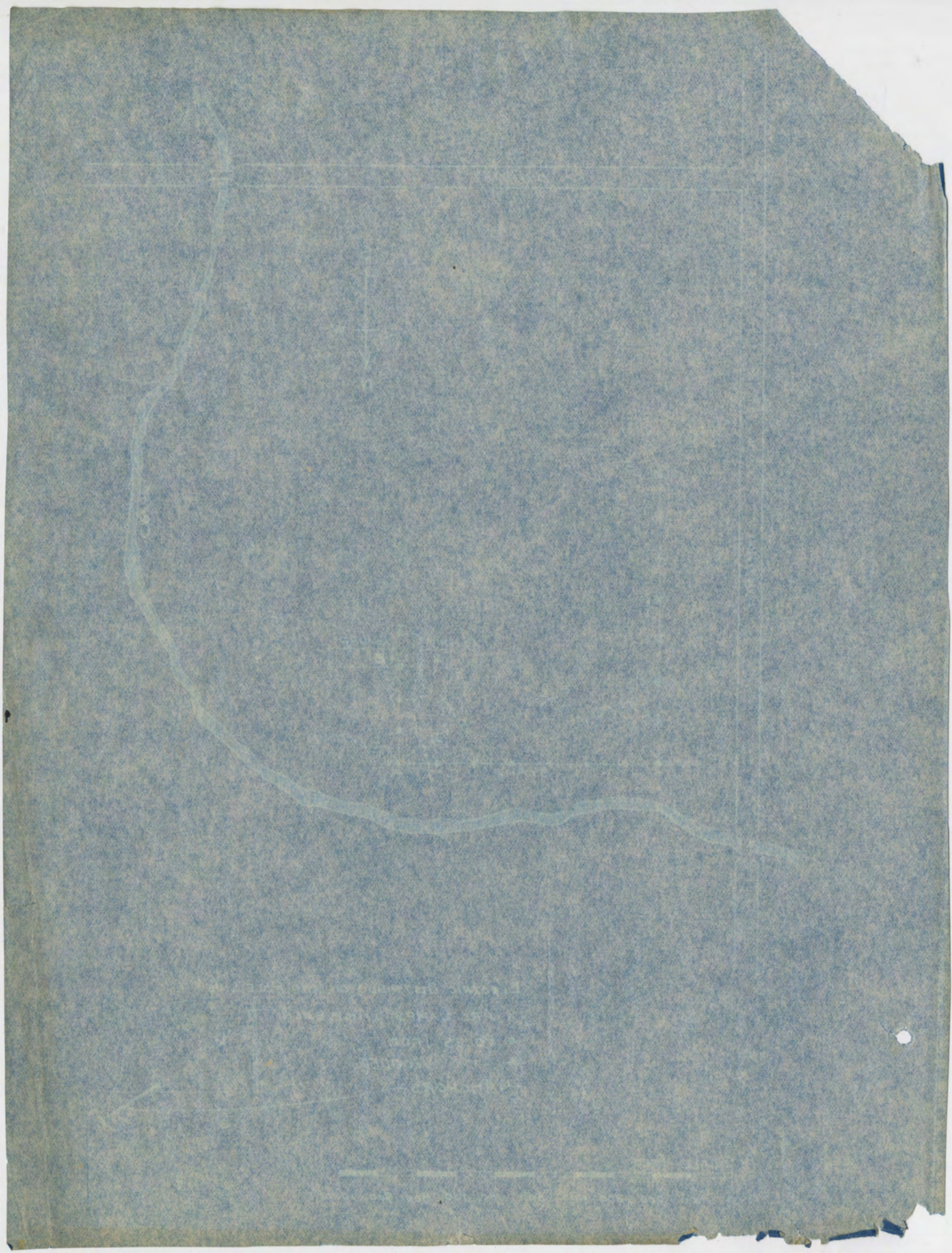
• POLES IRON

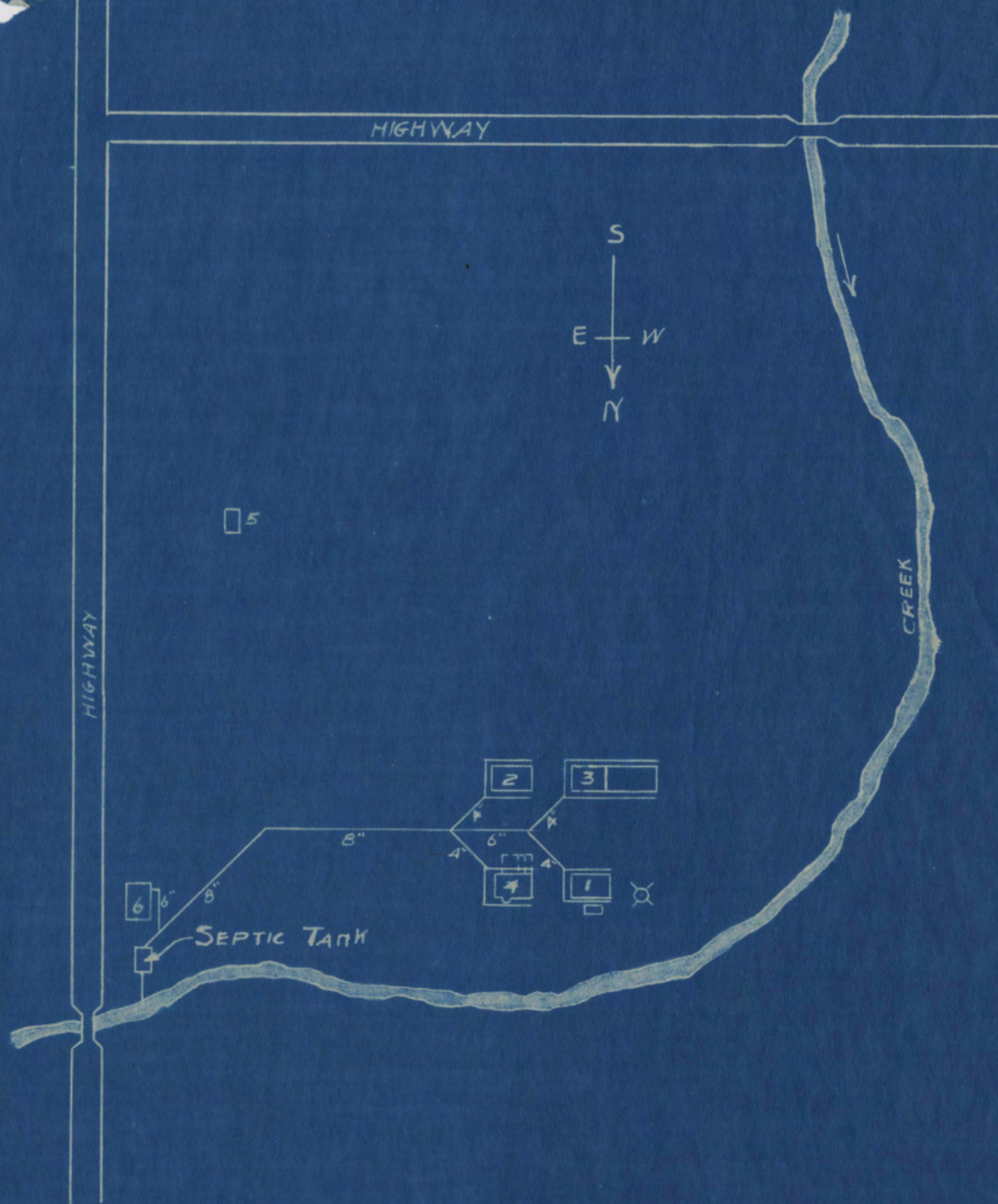
• " WOODEN

— ANCHORS

SCALE—FEET

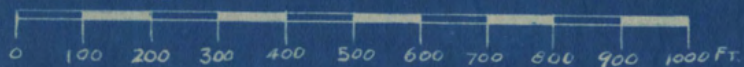




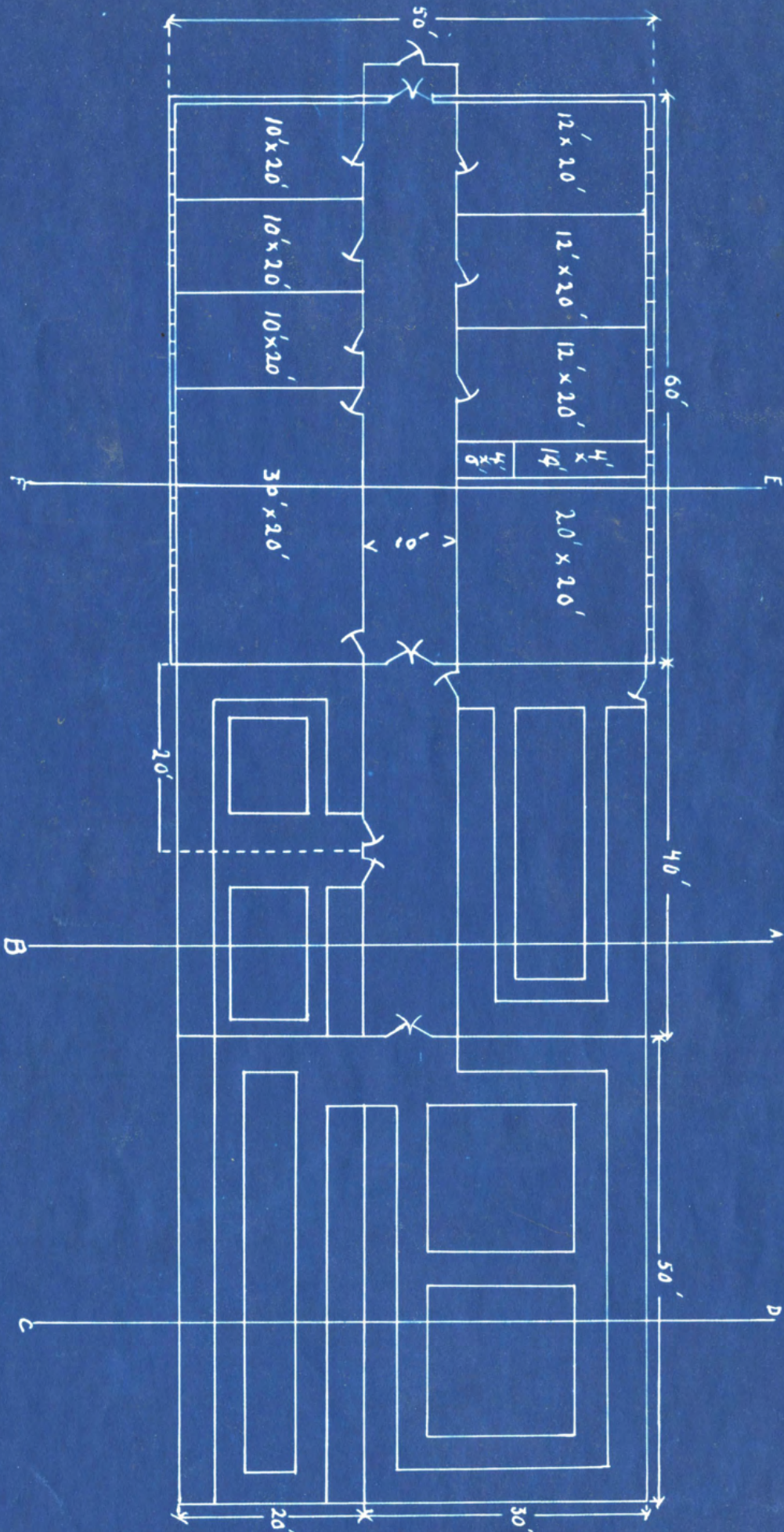


SEWERAGE AND DRAINAGE SYSTEM

SCALE FEET

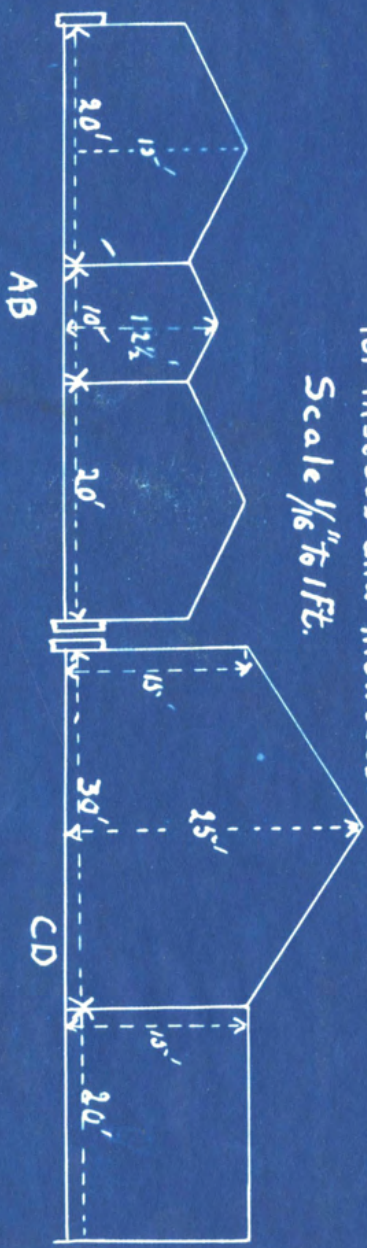
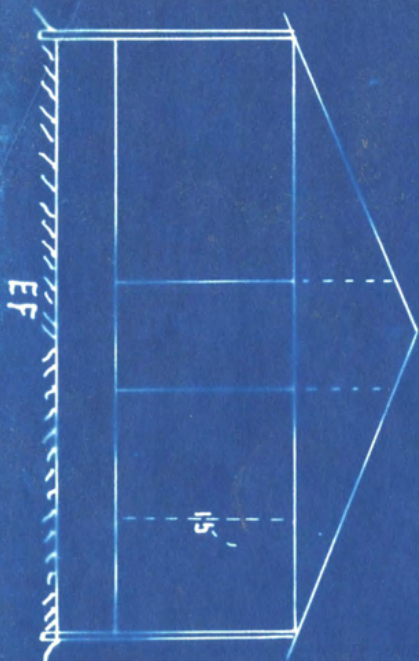






Plan for Laboratory and Vivaria
for insects and molluscs.

Scale $\frac{1}{16}$ " to 1 ft.



DEPARTMENT OF ZOOLOGY.

8

10

12

14

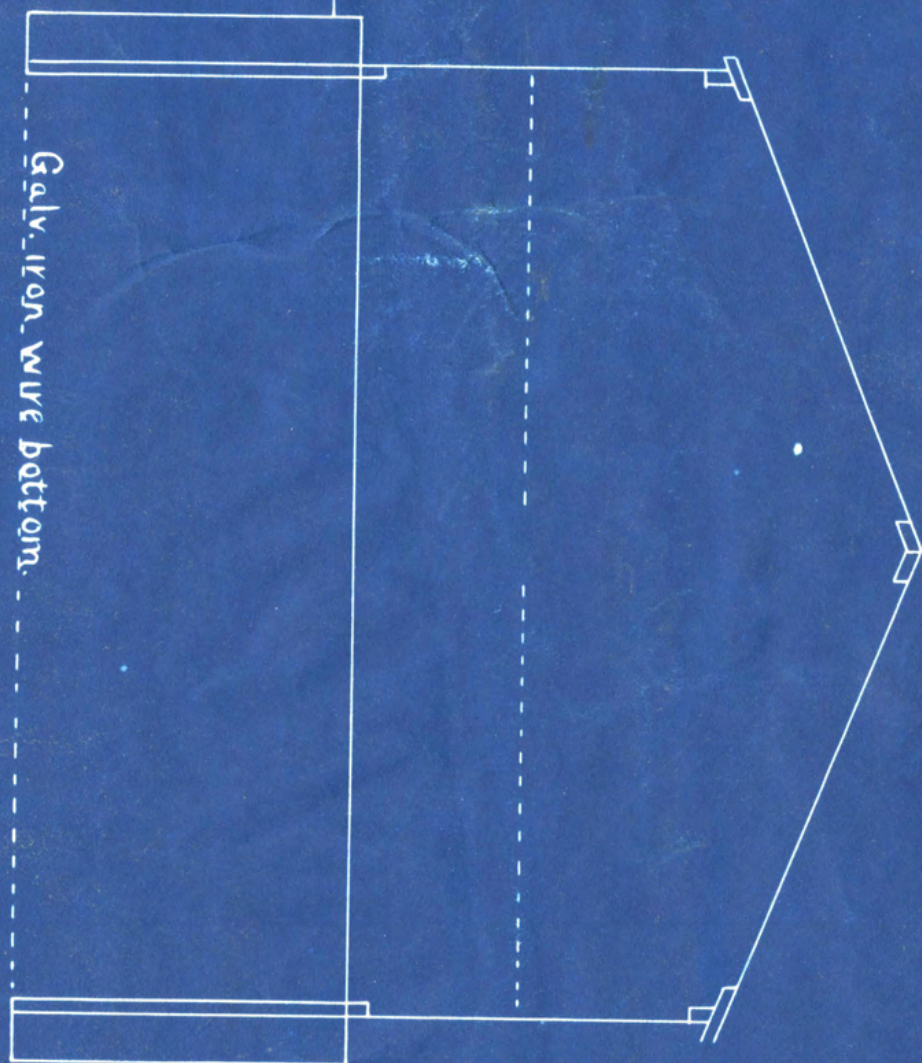
16

18

Section 1115
Provisions and Regulations
for the Population of New York

DEPARTMENT OF SOCIAL

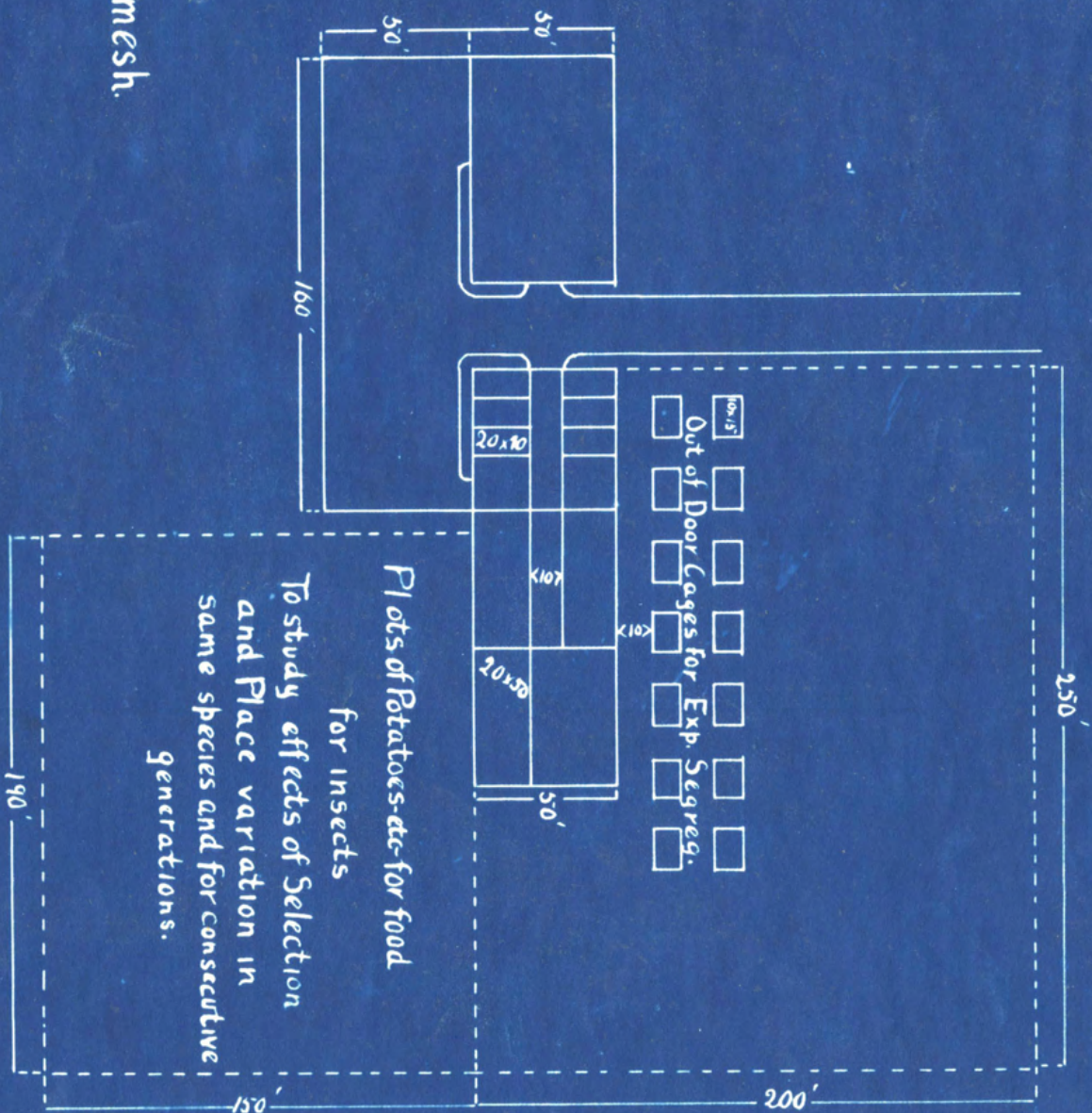
Out of Door Cage (D)
For large select segregation Exp.
10' wide 15' long.



DEPARTMENT OF ZOOLOGY.

Mr. Maclean
Supr. Bldg. Seams

Fence to be 6' high.
Galv. iron. Poultry netting 1" mesh.
Bottom Board.



DEPARTMENT OF ZOOLOGY.

Scale
1/64" to 1 Foot.

Section 1000

Section 1000

Section 1000

Section 1000

Section 1000

Section 1000

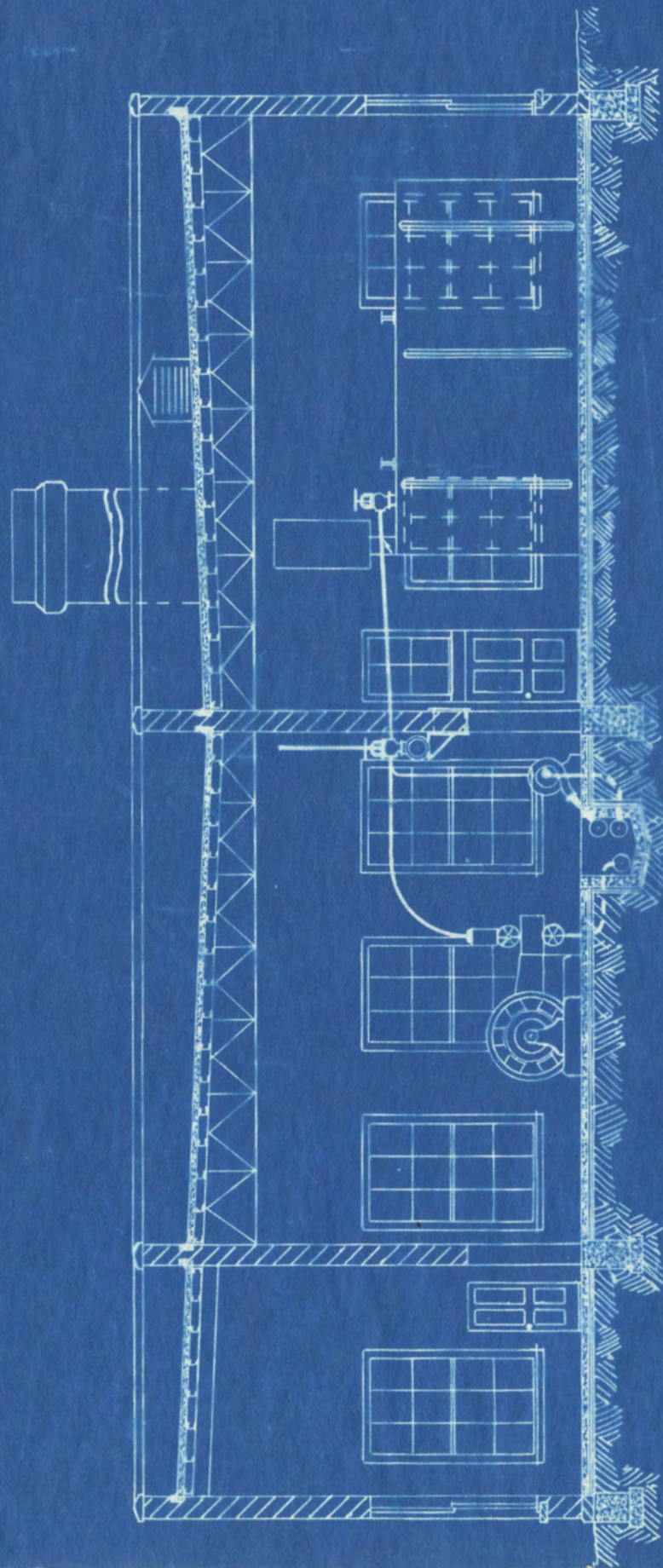
Section 1000

Section 1000

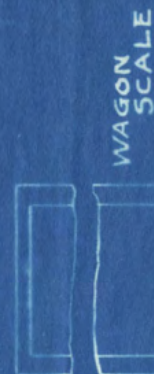
Section 1000

Section 1000

DEPARTMENT OF AGRICULTURE



SECTION

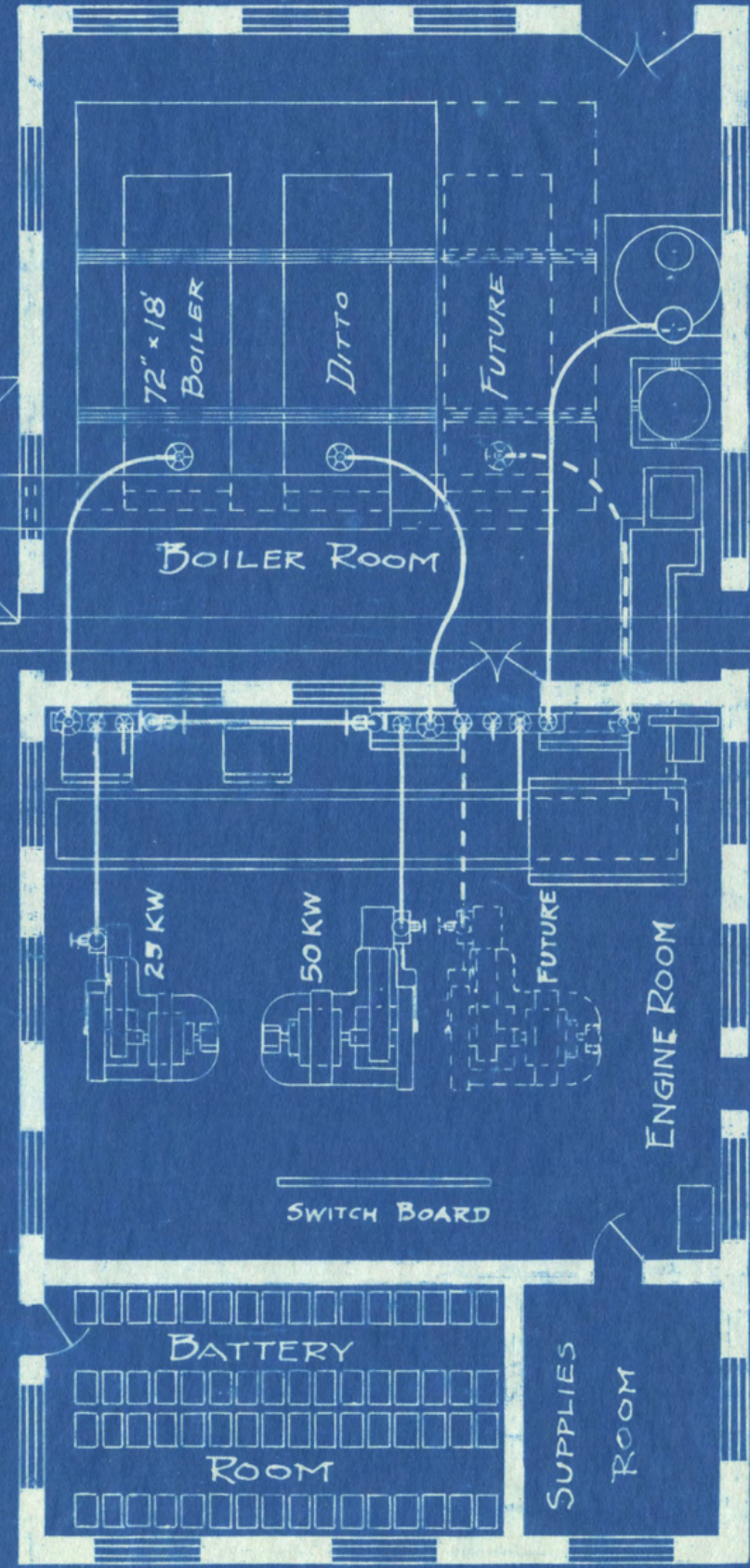
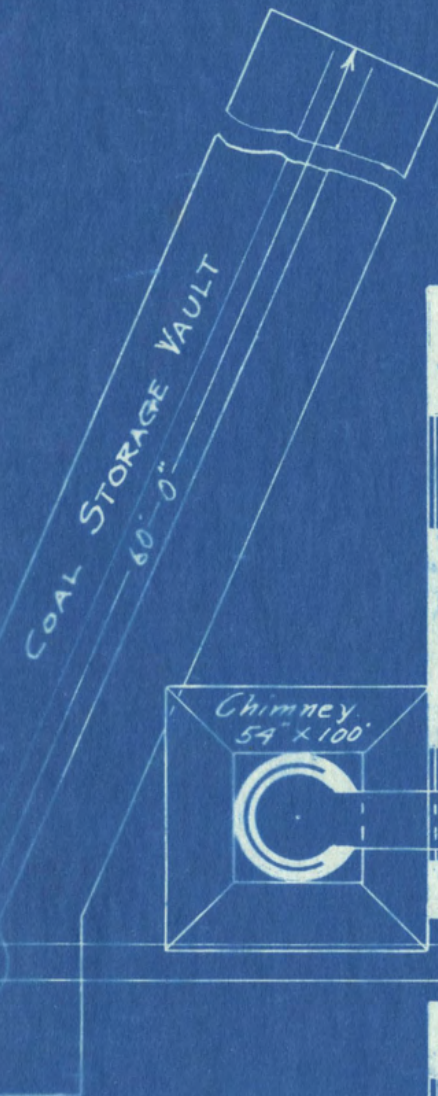


WAGON SCALE

POWER PLANT

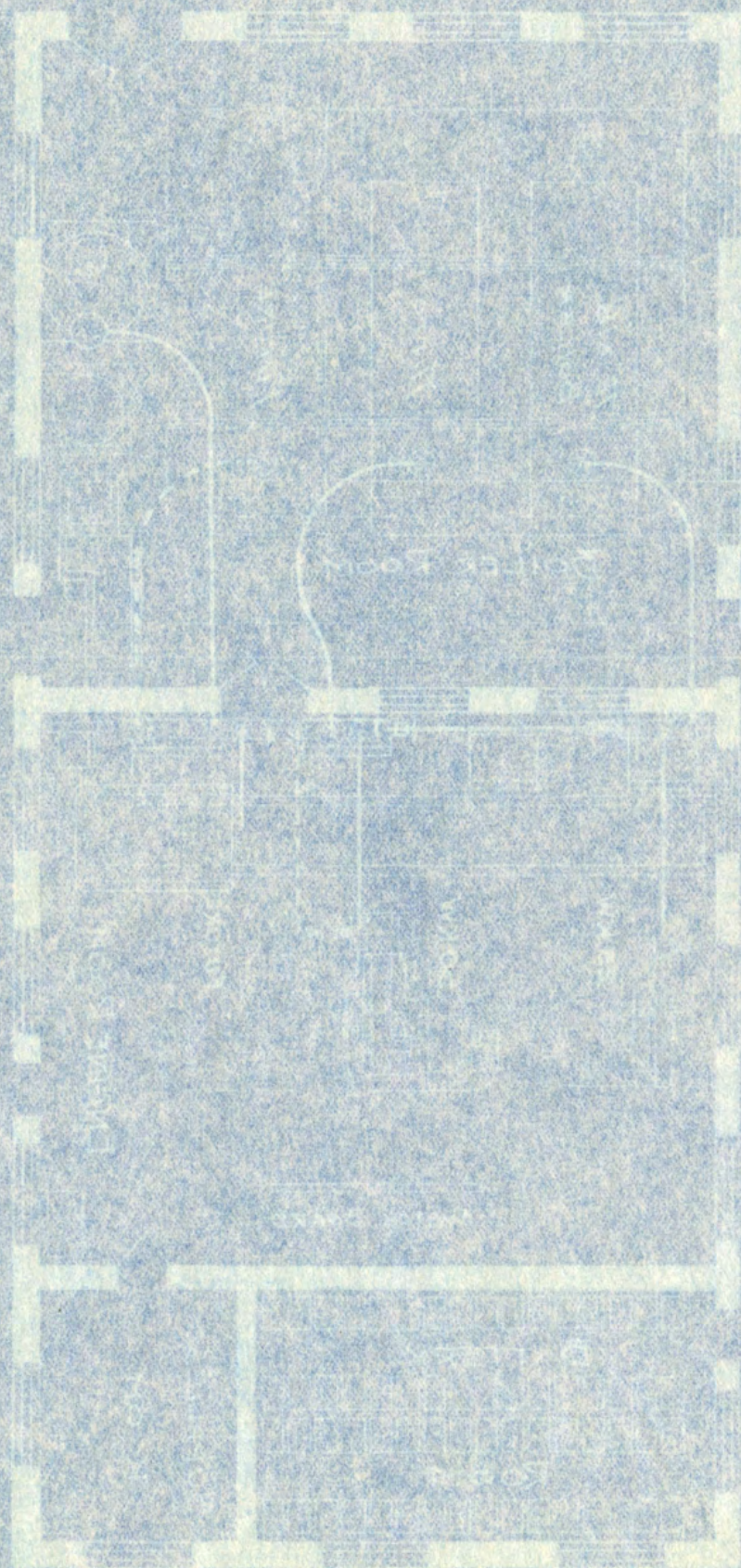
PRELIMINARY LAYOUT
OF
FOR
PROPOSED BIOLOGICAL FARM
UNIVERSITY OF CHICAGO
CHICAGO

Scale $\frac{3}{32}'' = 1 \text{ Ft.}$ Sept., 1907.

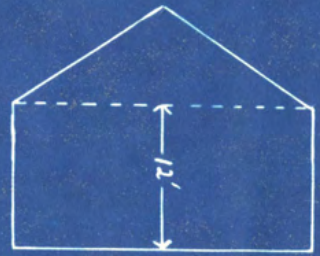


PLAN

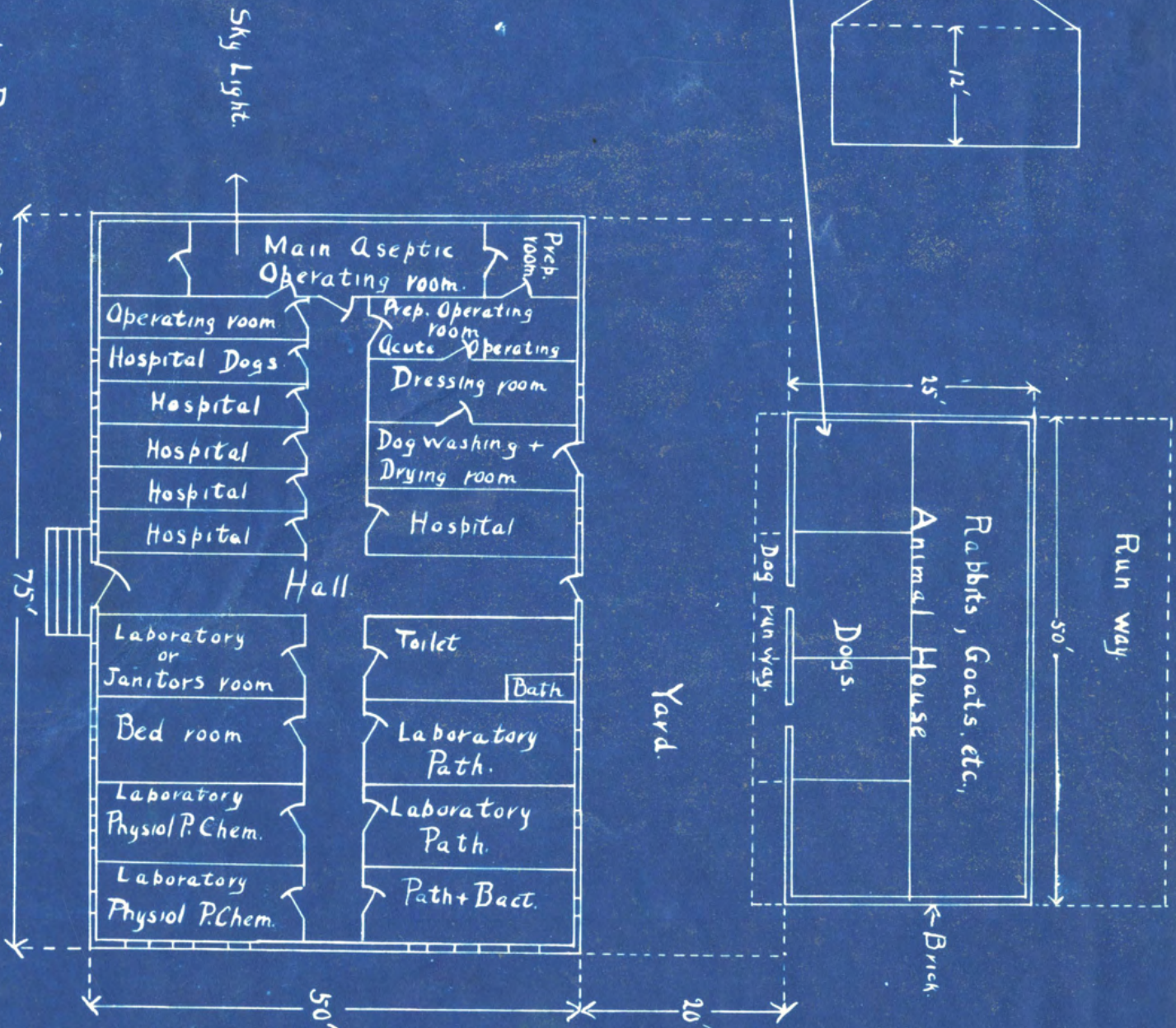
HEATING APPARATUS.



Light - 10 Lamps. Heat to 70° F
Hot and cold water
Height - 12 ft.



1st Story with Basement 7ft high. 1st Story 10ft in clear.
Basement cemented. House plastered with hard plaster. Heated. \$1200 to \$1500.



Plan for Laboratory of Experimental Medicine, i.e.,
Physiology, Physiological Chemistry, Pathology and
Bacteriology, and Experimental Therapeutics.

Scale $\frac{1}{16}$ in. = ft.

