Peat and Other Plant Residues of Grand Marais and Lake Tasse, Iberia Parish, Louisiana.

William Rufus Dodson

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PEAT AND OTHER PLANT RESIDUES OF
GRAND MARAIS AND LAKE TASSE, IBERIA PARISH, LOUISIANA

A THESIS

SUBMITTED TO THE FACULTY
OF THE
GRADUATE SCHOOL
OF THE
LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF SCIENCE

BY
WILLIAM RUFUS DODSON

AUGUST, 1936
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Grand Marais is a marsh area in Iberia Parish, Louisiana, that is covered with peat. The formation is of two strata. The upper stratum varies from 16 to 30 inches in thickness, and the lower stratum varies from 2 to 12 inches in thickness. Beneath the top stratum are buried stumps and other evidences of a forest growth having preceded the formation of peat. There are also evidences of physiographic changes which took place at some remote period and which can be partially traced by plant residues. The peat material is composed largely of remnants of plant roots of a plant population differing from that now growing in the marsh though the present plant population may be adding some peat material to the formation. Under present conditions of drainage it is probable that Grand Marais peat will rapidly decompose, and further formation will cease in a very short time.

The peat of Lake Tasse differs somewhat from that of Grand Marais, but it contains many of the same kind of root filaments which make up the major portion of peat in Grand Marais. It adheres to the soil at the bottom of the lake, but it does not cover the entire lake area. A new plant population is now invading the lake from the margins and has formed a second mass of vegetable matter over half or more of the previous formation. The two formations are interwoven, however, and are not stratified. It is probable that peat formation will continue in Lake Tasse until the lake is obliterated.

Peat at Lake Piegnour is now so deeply covered by water that it will not be attached to any new formation that may take place there. It is not apparent that any peat is now being formed in this area.
ACKNOWLEDGMENTS

Grateful acknowledgment is made to Dr. C. W. Edgerton, head of the Department of Botany, for many helpful suggestions, for personal aid in the field, and for laboratory assistance; to Dr. Clair A. Brown, Associate Professor of Botany, for personally accompanying me on field trips, for identifying plants, and for other valuable assistance; to Mr. A. P. Kerr, of the Louisiana Experiment Station and the State Department of Agriculture, for making chemical analyses, and for excellent suggestions; and to Dr. A. P. Dachnowski-Stokes, Physiologist of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, for aid by correspondence and personal interview.

To these and all others who have been of aid, grateful expressions of appreciation are recorded.
INTRODUCTORY

The writer became interested in the peat formation of Grand Marais in 1929, from an economic point of view, as effort was then being made to secure land for the expansion of work of the Iberia Livestock Experiment Farm, of the U. S. Department of Agriculture at Jeanerette, Louisiana, and the tract of land being considered included about 150 acres of peat land of the Grand Marais formation.

In 1930 the property was acquired and became known as "The Annex" to the farm referred to above. In working out a plan for utilizing the peat area, it became necessary to read the literature on peat formations and their utilization in other states and in other countries.

Funds from the regular appropriations for the work of the Experiment Farm were not available for draining the peat land, but when the employment relief work of the Federal Government was begun, a project for the more complete drainage of Grand Marais was undertaken for "mosquito control," and a project was approved for the improvement of the property of the Iberia Livestock Experiment Farm.

Through the Civil Works Administration, the Public Works Administration, and the Civilian Conservation Corps' activities, a standard highway, with a fill of 4-1/2 feet, has been built across Grand Marais. Several miles of drainage ditches have been dug through the peat formation, and the sides of the sloping drainage ditches reveal a continuous profile
view of the peat formation. Through these improvements every part of this section of Grand Marais has become readily accessible for observation, and the studies herein reported have been greatly facilitated.

The work here begun, from economic considerations, led into a number of problems of scientific interest, and, in 1954, when the writer entered the Graduate School of the Louisiana State University to meet the requirements for an advanced degree, it was suggested by Dr. C. W. Edgerton, head of the Department of Botany, that a study of the peat formations of Grand Marais and Lake Tasse be selected as a subject for a thesis. This discussion and record is the result of that work.
DEFINITIONS OF PEAT AND MUCK

Peat is partially decomposed vegetable matter that has accumulated to considerable depths in places that are inadequately drained, and under conditions that permit accretions of dead material, but retard or inhibit decomposition of the plant structures.

Some authorities have arbitrarily set a standard of a minimum thickness of 3 inches which must be attained by a formation before it can be called a peat formation. They designate it muck if it is thinner than the prescribed 3 inches.

The amount of mineral matter that may be mixed with peat formations may vary widely. Fifty percent mineral matter by dry weight and fifty percent volatile matter is probably a very low standard. Some specialists in peat prescribe a minimum of sixty-five percent organic matter before a formation can be called peat.

We shall use the term peat to apply to a formation that seems to be sixty-five percent vegetable matter where it is a part of a general formation without adopting a minimum thickness.

We shall use the term muck to designate a formation that has at a previous period been peat, but has now reached a stage of advanced decomposition in which the structures of the vegetable tissues are no longer discernible.

By much-soil we wish to designate a mixture of much and the underlying soil which results from plowing land that has a shallow covering of muck.
GENERAL STATEMENTS ABOUT PEAT FORMATIONS

Some countries have extensive peat formations. It is estimated that the state of Minnesota has some seven million acres of peat lands. Louisiana has only a few thousand acres. Some formations in cold climates attain a thickness of 25 to 30 feet. Many formations in the United States are very shallow. The peats that we are to study do not exceed a depth of 3 feet. Some peat lands of northern states are very valuable for agricultural purposes while some are almost worthless. Drainage conditions and the character of vegetation forming the peat are important factors.

In chemical composition peat soils are apt to be very high in nitrogen and relatively low or even deficient in phosphorus and potash. This condition is explained by the statement that potash in the vegetable matter is apt to become converted into soluble salts and leached out. Phosphorus constituents are less readily lost, but they do become more or less soluble while nitrogen tends to remain in organic form. When peat formations are drained, and air and nitrifying bacteria find entrance into peat, nitrogen is transformed into soluble compounds.

The very rank growth of paille finne (Panicum hemitomon) which is now growing on the Grand Marais and the peat area of Lake Tasse, estimated to be equivalent to 4 to 5 tons of dried hay per acre per season, is an indication that these lands may be valuable for agricultural purposes if they become adequately drained.

Northern peat from many formations has important commercial values. It is used for fuel. It is used extensively in specialized horticultural work as a component of soils for pot plants, and for mulching around
special ornamentals, such as azaleas. It is compressed into vessels for special uses in hot houses. Peat that is especially free from soil admixture is compressed into insulating material for steam pipes, and an apparently good quality of building board and insulation construction material is made of it.

The shallow formations of Iberia and St. Martin parishes would not likely furnish a sufficient quantity of easily mined material to justify manufacturers of such materials in undertaking the use of this supply of peat for similar purposes.

The advantages of peat lands for agricultural purposes are that the land is level, is not subject to erosion, is generally free from stones and stumps, and is easy to cultivate. The disadvantages are that in dry weather the soil may catch fire, the surface dust may contribute to the discomfort of dust storms, and Grand Marais dust may be irritating to tender skin of human beings. It is of the class of peats called "itchy peat." It contains what is believed to have been silicious spines of fresh water sponges that produce an itching sensation when they come in contact with human skin. It is not poisonous and does not produce sores on the flesh.

The difficulty of drying peat in a humid climate, the shallow formations, and the low price of fuel in south Louisiana will preclude the utilization of peat for fuel in this region. Peat from Grand Marais and Lake Tasse may have a local value as a commercial fertilizer during dry periods where it can be economically transported.

The formations are of scientific interest to the botanist because they have preserved plant remnants and plant products which are important
in telling of conditions existing in past times. They are of interest also to the student of land physiography as they help to reveal important changes in elevation and drainage conditions prior to recorded history. This particularly pertains to Grand Marais as will be seen in further discussions.
NAME AND LOCATION OF AREA STUDIED

Iberia Parish (county) is one of the tier of political subdivisions of Louisiana that borders the Gulf of Mexico, and is situated approximately midway between the Mississippi River and the western border of the state. The latitude is plus thirty degrees N. for the central portion of the parish.

Grand Marais, meaning large marsh, designates a poorly drained area that measures approximately five miles long and three-fourths of a mile wide, situated in the eastern portion of Iberia Parish. It is completely surrounded by cultivated highlands that drain into it. The greater portion of the area is a fresh water peat bog that supports a mixed plant population of a very limited number of species with annual or biennial stems but perennial roots. The surface soil is peat, and beneath the peat are buried stumps, logs, and other remnants of a very different plant population that flourished there prior to the recorded history of the territory. It is highly probably that until quite recently it was a lake with a border region of marsh on three sides. The name was given by the early French settlers of south Louisiana. If one is prompted to inquire why the adjective "grand" was applied to this marsh, when the area is really insignificant as compared to that of the tide water marshes a few miles away to the south, a possible answer may be found in the fact that there are numerous small undrained areas with ponds of a half acre or more on the highland immediately south of the south border of Grand Marais. A comparison of these small marshy areas and ponds with the area designated as "grand" was the thing in mind.
Lake Tasse is a shallow, fresh water lake, about three miles west of New Iberia, covering approximately three square miles. It is elliptical in shape and approximately three-fourths of the margin is bordered with a formation of shallow peat which increases from a few inches in depth at the outer limits to 24 to 30 inches, and again diminishes in thickness toward the center of the lake to a vanishing point. Except in the region near the steep bank on the south shorelines of the lake, this belt of peat is more than a half mile in width and has two extensions to the northeast for a distance of a mile and a quarter, giving a maximum width of two miles from the outer margin of the peat to the open water of the lake. The mean water level of Lake Tasse was lowered about 24 inches a few years ago by the digging of a canal that resulted in partially draining the area.

Lake Peigneur is a shallow, fresh water lake, reniform in shape, about a mile and three-quarters long, and lying ten miles southwest of New Iberia. It is supposed to have been formed by the subsidence of the land surface following a partial solution of the salt dome underlying it. The soil map shows a formation of peat 200 to 300 feet wide on the margin of the lake.

Each peat area requires separate study, as no two areas have the same history, and the plant populations forming the peats have been somewhat different. Our study has been mainly concentrated on Grand Marais and Lake Tasse. The peat formations in Iberia and St. Martin parishes that are not connected with the above three areas have not been studied in detail. From casual observation they do not seem to be of special interest.

1 Geology of Iberia Parish, by Henry V. Howe, Ph.D., Director, School of Geology, Louisiana State University, and Cyril K. Moreau, B. S., Bureau of Scientific Research, Minerals Division, Conservation Commission of Louisiana, P. 75.
LITERATURE ON LOUISIANA PEAT

There are no publications dealing specifically with peat formations in Louisiana except the brief summaries and descriptions given in the Soil Survey reports of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture for the several parishes that have thus far been surveyed. The soil survey of St. Martin Parish, issued in 1919, devotes less than a quarter of one page to the peat of that parish. Less than a page is devoted to peat in a similar publication on Iberia Parish issued in 1911.

It is not to be expected that any extended treatment would be devoted to this type of soil in a publication of this nature.
CASUAL REFERENCES TO BURIED PLANT RESIDUES IN ALLUVIAL LANDS

The presence of tree trunks and stumps in areas of alluvial sedimentation are matters of common knowledge to persons who have observed the digging of drainage canals through alluvial deposits and the building of levees or the dredging of canals for reclamation of marsh lands. Men engaged in drilling wells frequently encounter wood and various other plant structures at depths varying from a few feet to many hundred feet below the surface. These are regarded as materials that were once carried by water currents and deposited where subsequent mineral sedimentations covered them, or as structures adherent to the soil surface from growth in place when the land surface was above water level, and subsequent shifts in elevation caused the areas to be submerged and subjected to the deposits of soil-carrying waters. Stumps of trees sometimes furnish evidence of the elevation and depression of land levels, and thus become important witnesses for past history.

Logs of wells bored within the region of south Louisiana, especially in the delta region, abound in notations of encountering wood and fragments of forest growth.

Howe and Menesi, in describing certain features of Iberia Parish, state:

"Cypress swamps were but a short time ago much more extensive in the region of the present lagoon and tidal marsh as is already shown by the dead cypress on Cypremort (meaning: 'Dead cypress') Point, and the fact that there is an extensive area within the waters of Weeks Bay itself where the stumps of dead cypress trees are exposed at times of very low tide."

2 Ibid.
Mr. A. C. Veatch, formerly Assistant State Geologist of Louisiana, writing on the "Great Raft" of Red River, said:

"As the raft advanced it blocked the outlets of the tributary streams and the channels draining the lowlands between the higher front lands and the bordering hills, and by preventing the discharge of the water from them at a level equal to the original low waters of the main channel produced a series of lakes. The timber in these flooded areas soon died and the exposed portions decayed, leaving the stumps as silent witnesses of their former condition."

Dr. G. D. Harris, for many years State Geologist, grows almost poetic in language when he writes as follows:

"In the swamp lands we see that where the sluggish bayous meander their way to the Gulf, they have often laid bare a stratum of cypress and other kinds of stumps and logs, some three or four feet beneath the present surface of the marsh. Drillings show that after passing through perhaps thirty feet of black carbonaceous mud, another stratum of logs and stumps may be encountered. In fact, the deep oil wells show that these same marshy conditions may recur to a depth of 1800 feet or more. Sometimes then, in Pleistocene times that stratum which is 1800 feet down now was at the surface. A depression of that amount in comparatively recent geologic times, and the occurrence of sound roots, stumps and logs beneath broad stretches of marsh-land where now only tall marsh reeds and grasses grow are highly suggestive of the comparative swiftness of crustal movements in southern Louisiana."

In some of the areas of recently reclaimed land the surface soil has contracted and revealed stumps of forest trees that were not visible at the time reclamation was begun. This shrinkage has been brought about mainly by the more complete disintegration of vegetable matter which abounds in the surface soil of these areas.

4 Bulletin No. 6, Geological Survey of 1907.
These phenomena have not seemed to be of greater importance than to record local shifts in surface elevation due to shrinkage produced by changes in conditions of drainage.

The references to shallow peat beds in Iberia and St. Martin and general references to peaty formations in other parishes with materials rich enough in plant fragments to entitle them to classification as peat, have not indicated that these formations had any commercial value, and from that standpoint they have not enlisted the interest of commercial investigators.

Circular No. 290, August, 1932, by the very eminent authority, Dr. A. P. Bachnowski-Stokes, of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, gives a general map of the United States, on which is indicated the regions in which the more important peat lands of the United States are found. This map shows a large part of Louisiana, the entire coast territory of Texas, Mississippi, and Alabama, and nearly the entire state of Florida as regions in which peat lands are to be found. No specific locations of peat beds are discussed, however, and it is evident that the general designation included lands of marsh areas rich in vegetable matter rather than areas where peat beds, as the term is generally understood, were to be found.

Florida is the only state that has issued any bulletins on peat studies. These bulletins treat only of saw grass peat of southern Florida.

We have not been able to find any references to a special study of the peat, buried forest logs, stumps, and sedimentary fragments of plants in Iberia or adjoining parishes in Louisiana, and we are seemingly justified in assuming that such studies have not been reported.
It is believed that data secured in the present study on the remnants of plant growth to be found in Grand Marais and Lake Tasse will afford the first extended report on a peat formation in Louisiana.

Peat is generally studied by using vertical sections or cores, called profile samples, since such a sample may reveal all stages of development of the formation.
DISTRIBUTION OF VOLATILE MATTER IN PROFILE SAMPLES

TABLE I. Results of Analyses of Profile Samples for Volatile Matter and Ash from Grand Marais.

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Samples were collected by W. R. Dodson, and analyses were made by A. P. Kerr.

"Prof." is used as an abbreviation for profile.

"Vol." is used as an abbreviation for volatile matter.

"U. C. L." is used as an abbreviation for upper cleavage layer.

"L. C. L." is used as an abbreviation for lower cleavage layer.

Profile No. 1 is from the middle of the north side of the main formation. No. 5 is from the center, and No. 7 is from the south portion of the main formation. These three samples were taken from about 50 feet west of the north and south road across the Marais. Sample No. 9 is from the central east and probably 2 miles east of Profile No. 5, and No. 11 is from
the central west end probably more than 2 miles west of No. 5. Micro-
scopical examination of the plant tissues, and macroscopic study of the
formation in all parts of the peat area, seem to strongly indicate that
the same plant populations predominated throughout the period of the for-
mation of peat. The principal use of this table at this time is to show
the relative dominance of volatile matter in the different profile samples,
representatives of different portions of the Marais, and to serve as a
reference aid in discussing profile characteristics. Some other phases
of the data will be discussed later.

Samples taken at 4 inches below the surface are generally within the
area that shows a predominance of the dark brown fibrous peat. The major
portion of the roots of growing plants, the more completely decomposed peat,
and the residues of surface burning lie above this line. No profile samples
were taken where recent deep burning has taken place. Underground stems of
living paille finne grass are quite common to a depth of 10 to 12 inches,
but these were discarded from the samples for analysis.

Samples taken at a depth of 10 inches, in any portion of Grand
Marais, exclusive of marginal areas, and exceptions later to be noted,
will represent the purest form of peat. The quantity of pure peat above or
below this level may vary.

It will be seen that profile No. 5 shows the least mineral matter at
a depth of 16 inches, and samples taken through most of the central portion
of the marsh show no evidence of having a higher mineral content, as far as
may be observed by the unaided eye.

Profiles No. 9 and No. 11, which correspond in north and south positions
with profile No. 5, are not expected to be as pure vegetable matter as No. 5,
because it is evident that fire has burned and charred a portion of these profiles to a depth of 10 to 14 inches. Some regions of the western one-fourth or more of Grand Marais show that the peat at a depth of 12 to 18 inches, at the present time, was once partially burned and subsequently covered by peat formation that is free of the evidence of fire having interrupted the accumulation of vegetation. Profile No. 11 shows a higher percentage of volatile matter at a depth of 22 inches than at 16 inches. This is due to partial burning, as evidenced by charred vegetable fibre at a range of 12 to 18 inches, and not to increased sedimentary mineral matter.

Samples taken at 16 inches below the surface happen to fall at the cleavage line of the two strata of profiles No. 1, No. 7, and No. 9. The line of cleavage and its significance form an important feature for discussion under a separate heading.

These samples were taken to include a layer one-half inch thick above the cleavage line for the samples marked "U. C. L." meaning plus the upper cleavage layer, and to include a layer one-half inch thick for samples marked "L. C. L." meaning plus lower cleavage layer. The abbreviations have a similar significance at the depth of 29-1/2 inches, and 51 inches, when the cleavage is located at this depth in profiles No. 11 and No. 5 respectively.

The marked difference in volatile matter in the one-half inch of profile above the cleavage line, and the one-half inch of profile below that line is noteworthy except in profile No. 9. While many samples taken only for macroscopic examination seemed to vary to a considerable degree, we believe the profile samples here recorded are dependable as an average. Profile No. 5 probably represents an average of what prevails in two-thirds
to three-fourths of the total area of Grand Marais. The other profiles
represent the beginnings of the marginal areas. Many variations may be
found from these locations to the border lines.

An impression gained from examination of the samples by the eye,
and by sense of touch, which is emphatic, is that during the period of
peat formation there was little or no introduction of sedimentary mineral
matter from the outside into the composition of the peat formation that
lies above the cleavage line.

The increment in mineral matter, seemingly, has been through the
decomposition of portions of the peaty material, and possibly a small
addition in the form of dust dropped from wind currents. The evidence
convinces one that the accumulation of peat of the upper stratum has been
one uninterrupted period of accretion, except by the interruptions of
surface burning, and in most of the area this has not been serious until
the later stages of peat formation. We can find no impressive evidence
that periodic overflows of sediment laden waters have been a factor in
building up the peat formation of Grand Marais. The theory will be later
advanced that the peat of this formation is very largely composed of the
remnants of plant roots, and the residual products of decomposition of
roots and rootlets of aquatic plants. It is necessary to anticipate this
conclusion here, so as to facilitate an explanation of the profile study.

In most instances the section of a profile in the deeper peat area,
representing a block from 4 to 18 or 18 inches below the surface, is composed
very largely of crinkled filaments of light brown colored vegetable tissue
that seemingly have grown into the positions they occupy, and the peat has
been formed from within and below a floating mass rather than by accretions at the top of a growing mass of peat. Samples of peat from the section of the profile here designated scarcely soil the hands when one handles it.
A profile sample of Grand Marais peat, taken to a depth of 48 inches from the region intermediate between that of profiles No. 1 and No. 5, was submitted to Mr. A. P. Kerr, Chief Chemist of the Fertilizer and Feed Stuffs Laboratory, which is operated by the Louisiana Department of Agriculture and Immigration and the Louisiana Experiment Station.

Samples were taken from portions of the profile that were apparently representative of each variation in composition. These samples fell at depths of 4, 12, 18, 30, and 48 inches from the soil surface. The results are as follows:

### Sample No. 1 (4 inches)

<table>
<thead>
<tr>
<th>Component</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile matter</td>
<td>75.45</td>
</tr>
<tr>
<td>Silica ($SiO_2$)</td>
<td>21.85</td>
</tr>
<tr>
<td>Iron and Aluminum ($Fe_2O &amp; Al_2O_3$)</td>
<td>1.28</td>
</tr>
<tr>
<td>Calcium Oxide ($CaO$)</td>
<td>.65</td>
</tr>
<tr>
<td>Magnesium ($MgO$)</td>
<td>.25</td>
</tr>
<tr>
<td>Potash</td>
<td>.08</td>
</tr>
</tbody>
</table>

**Agricultural Analysis**

- **Nitrogen**: 2.07
- **Phosphoric Acid**: .12
- **Potash**: .08
- **pH**: 4.00

### Sample No. 2 (12 inches)

<table>
<thead>
<tr>
<th>Component</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Volatile matter</td>
<td>86.75</td>
</tr>
<tr>
<td>Silica ($SiO_2$)</td>
<td>9.25</td>
</tr>
<tr>
<td>Iron and Aluminum ($Fe_2O &amp; Al_2O_3$)</td>
<td>5.20</td>
</tr>
<tr>
<td>Calcium Oxide ($CaO$)</td>
<td>.51</td>
</tr>
<tr>
<td>Magnesium ($MgO$)</td>
<td>.18</td>
</tr>
<tr>
<td>Potash</td>
<td>.08</td>
</tr>
</tbody>
</table>

**Agricultural Analysis**

- **Nitrogen**: 2.74
- **Phosphoric Acid**: .10
- **Potash**: .08
- **pH**: 4.00
### Sample No. 3 (18 inches)

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile matter</td>
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</tr>
<tr>
<td>Silica ($SiO_2$)</td>
<td>32.50</td>
</tr>
<tr>
<td>Iron and Aluminum ($Fe_2O_3 &amp; Al_2O_3$)</td>
<td>7.66</td>
</tr>
<tr>
<td>Calcium Oxide ($CaO$)</td>
<td>46</td>
</tr>
<tr>
<td>Magnesium ($MgO$)</td>
<td>21</td>
</tr>
<tr>
<td>Potash</td>
<td>07</td>
</tr>
</tbody>
</table>

### Agricultural Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>2.20</td>
</tr>
<tr>
<td>Phosphoric Acid</td>
<td>0.99</td>
</tr>
<tr>
<td>Potash</td>
<td>0.07</td>
</tr>
<tr>
<td>pH</td>
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</tbody>
</table>

### Sample No. 4 (30 inches)

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
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<td>Volatile matter</td>
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</tr>
<tr>
<td>Silica ($SiO_2$)</td>
<td>66.00</td>
</tr>
<tr>
<td>Iron and Aluminum ($Fe_2O_3 &amp; Al_2O_3$)</td>
<td>7.20</td>
</tr>
<tr>
<td>Calcium Oxide ($CaO$)</td>
<td>31</td>
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<tr>
<td>Magnesium ($MgO$)</td>
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</tr>
<tr>
<td>Potash</td>
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</table>

### Agricultural Analysis

<table>
<thead>
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<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
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<td>Potash</td>
<td>0.06</td>
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<tr>
<td>pH</td>
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</tr>
</tbody>
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### Sample No. 5 (48 inches)

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<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile matter</td>
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<tr>
<td>Silica ($SiO_2$)</td>
<td>69.30</td>
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<tr>
<td>Iron and Aluminum ($Fe_2O_3 &amp; Al_2O_3$)</td>
<td>10.80</td>
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<tr>
<td>Calcium Oxide ($CaO$)</td>
<td>2.20</td>
</tr>
<tr>
<td>Magnesium ($MgO$)</td>
<td>28</td>
</tr>
<tr>
<td>Potash</td>
<td>08</td>
</tr>
</tbody>
</table>

### Agricultural Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>0.25</td>
</tr>
<tr>
<td>Phosphoric Acid</td>
<td>0.05</td>
</tr>
<tr>
<td>Potash</td>
<td>0.08</td>
</tr>
<tr>
<td>pH</td>
<td>5.30</td>
</tr>
</tbody>
</table>
PHYSICAL DESCRIPTION OF GRAND MARAIS PEAT

A profile sample of peat, taken within a few feet of the location of the sample sent to Mr. Kerr, was sent to Dr. A. P. Dachnowski-Stokes, Physiologist of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, for examination and suggestion. He had previously discussed this formation with the writer. The following letter is of interest in describing this profile.

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF CHEMISTRY AND SOILS

WASHINGTON

April 20, 1936.

Mr. W. R. Dodson,
Louisiana Experiment Station,
Jeanerette, Louisiana.

Dear Mr. Dodson:

Your profile section of the "Grand Marais" peat area arrived in good condition and I wish to report to you the following regarding its features:

0 - 2" Very dark brown largely decomposed organic residue strongly acid in reaction (pH. 4.0).

2 - 10" reddish brown coarsely fibrous grass-sedge peat, consisting of the roots and rhizomes from cane (Arundinaria sp) and sedges. The material is poorly decomposed, porous, light in weight, more or less crumbly, and strongly acid in reaction (pH. 4.0). The admixture of fine grained material consists mainly of rootlets in an advanced degree of decomposition.
10 - 21" Brown fibrous partly decomposed grass-sedge peat; it contains an admixture of organic residue derived from aquatic vegetation. The material is strongly acid in reaction (pH 4.0) and separates readily from the plant remains below it. Seeds of smart weed (Polygonum sp.) are present in small amounts.

21 - 25" Dark grayish brown, partly fibrous grass-sedge peat, somewhat plastic, and containing a moderate amount of clay in its lower level. The reaction of the material is near (pH 7.0).

25 - 31" Dark gray to grayish black clayey organic residue, sticky, relatively impermeable, and neutral in reaction. The percentage of clay increases with depth but a sharp demarcation line is noticeable between the organic residue and the underlying clay at from 24 to 26 inches below the surface. The clay at lower depths is mottled with yellow spots and contains a few rhizomes of grass-like reeds (Arundinaria sp.).

Trusting that the profile description of the Grand Marais peat may be of some services, I remain,

Very truly yours,

A. P. Dachnowski-Stokes,
Physiologist.
STRATIFICATION OF GRAND MARAIS PEAT

The major portion of the Grand Marais area where peat is at this time distinguishable from muck shows two strata in the formation. Except in occasional instances the strata are distinctly separated by a thin layer of vegetable filaments that is not penetrated by the remnants of the vertical plant structures that constitute the dominant component of the peat. Mann and Kalbe do not make any reference to the stratification of peat in their write-up of the soils of Iberia Parish. The line of cleavage between the strata is so marked that one cannot understand why they should not have made some mention of it. There is no interwoven peat tissue connecting the two strata. Recent root growth from plants on the soil surface penetrate this separating layer without showing any evidence of having encountered a growth inhibiting substance. New root growth at this depth, however, is not abundant, but sometimes these new roots may be sufficient to hold the sections of the profile sample together when the profile is removed.

Upper Stratum

Analyses of different portions of the top stratum do not generally show an increasing amount of mineral matter mixed with the peat as the depth increases. On the contrary, the purest vegetable matter, or the highest percentage of volatile matter, in the profile of sample No. 5 is at a depth of 16 inches. We believe this analysis closely represents the average of the major portion of Grand Marais proper, exclusive of the regions that are near the margins of the peat formation. In the region that shows the highest percentage of volatile matter we find the least
evidence of recognizable leaf and stem structures. In some samples the wrinkled filaments and the brown granular material that does not show plant cellular structure under the microscope, but is seemingly of plant origin, make up almost all the mass. The percentage of ash in profile samples No. 1, No. 5, No. 7, and No. 9 are within the range of that of pure vegetable matter. In looking over Mr. Kerr's records of analyses of paille fine grass, the first four records show 5.50, 7.30, 8.30, and 8.30 percent of ash. This means that the ash constituent of the dominant plant which grown on peat today is about the same as the ash constituent in the best peat. The ash constituent of a few common grasses as given in Feeds and Feeding, by Henry and Morrison, are quoted for comparison: Bermuda grass, 7.6%, carpet grass, 10.2%, crab grass, 8.5%, Johnson grass, 7.5%.

Profile No. 11 does not show as high a maximum of volatile matter as is shown in the other profiles. Samples taken at depths of 10 and 16 inches showed some burned material, however, a sample could have been taken above 10 inches or below 16 inches which would have been free of burned constituents and probably would have shown higher volatile matter. It will be noted that in this sample the volatile matter was higher at a depth of 22 inches than at 16 inches. We believe a profile sample may be easily selected in any portion of the main body of peat, free from effects of activities of crayfish and rats, from which a section 10 to 12 inches or more in depth can be taken, that represents only residues of pure vegetable matter. Certainly, there could have been no considerable admixture of mineral soil with the vegetation forming the peat, or else the ash constituent would be higher in these analyses.
In some portions of the peat bed the composition has been modified by partial burning, but there is no general evidence that the formation has been seriously modified by fires. Fire damage is mainly limited to the top layer and to the damages of recent years. Only in the western portions, and in marginal areas, do we find that peat formation was interrupted by fires, to be followed by a super-imposed formation of clean vegetation. This is very important when we try to form a mental picture of just how the peat was formed.

The Lower Stratum

The upper portion of the lower stratum is quite firm with a smooth compact surface into which are imbedded an occasional plant seed or fragment of stems or leaves, but for the most part it is like a firm soil surface that has been swept clean of trash. The amount of plant tissue present decreases rather rapidly with increased depth. Where it is present in sufficient quantity to meet our definition of peat, the filaments are crinkled and of the same general appearance as in the upper stratum except that they are not so brown in color and they are less plaited or crinkled.

The amount of blue clay increases rather rapidly at greater depths, and the formation takes on the characteristics of a normal sedimentary formation with an admixture of fragments of bark, limbs, and twigs of forest trees, leaves, etc., that constitute a variable percentage of the formation, though seldom as much as 20 percent.

Line of Cleavage

The line of cleavage between the upper and the lower strata is so distinct that in the thicker formation one may make a vertical cut through
the upper stratum around any sized block desired and lift out the entire block without molesting the upper surface of the lower stratum, thus revealing the contour that the lower stratum would have if all the upper stratum were removed. The writer has removed blocks of the upper stratum measuring 18 by 36 inches, without difficulty, by digging a trench on two sides of the block and cutting the two ends with a long knife, then pushing iron rods through the block to serve as hand lifts, while four men raised the block out of the hole. In the work of draining the Experiment Station land in Grand Marais several miles of ditches were dug to a greater depth than the cleavage layer between the strata, and the line marking its location showed distinctly on the sloping banks of the ditches. When the first dry weather came after the ditches were dug the exposed surface of the peat above the cleavage layer contracted more than it did further back with the result that the triangular edge of the upper stratum curled upward and separated from the lower stratum leaving an open crack ranging from a half inch to two inches wide depending upon the extent of the drying. Contour lines were thereby revealed in all portions of the area that was ditched which enabled one to visualize the true contours of the surface of the lower stratum. This showed that the surface of the lower stratum was in miniature an undulating land surface of hills and valleys, mounds and sink holes, and level areas.

This kind of surface formation may be seen where shallow water can be observed on sand or mud bottom. This surface varies in elevation as much as a foot in a lateral distance of two feet in extreme cases, and frequently varies as much as six inches in a lateral distance of six to twelve inches. This explains why a contour sample may split apart at a
A sharp angle as is seen in one of the accompanying photographs. (Page 89.) A contour sample may strike the side of a sink hole or a mound and thus give the appearance of having the strata sit at a sharp incline.

Top of Lower Stratum Formerly Land Surface

The top of the lower stratum or the mineral formation a little below the peat, seemingly, was the land surface prior to formation of the upper stratum of peat. It is necessary, therefore, to consider other important data before we can properly formulate a theory to account for the conditions enumerated.
NORTHWEST AND WEST SHORE LINE FOREST

Forest growth prior to the complete formation of the upper stratum of peat has left its most impressive record on the west and northwest border area of Grand Marais in the form of numerous cypress logs that are yet in a good state of preservation. The thickest forestation covers approximately 20 to 30 acres. The region of numerous buried logs begins on the property of Mr. R. H. Smith, extends westward into Orange Grove Plantation, and southward more than halfway across the west border of the present peat area. The presence of these buried logs marks approximately the limits of the area that has two strata of peat formation, and only the upper stratum is found where the logs are most abundant. The depth to which the logs are buried increases toward the south and east.

In examining the relationship of logs and peat tissues in this region, one feels assured that peat was formed before the logs found their present positions there. That is, they fell upon a bed of peat. Also, that the peat-forming vegetation grew over them, and enveloped them without the intermingling of sedimentary mineral matter to any appreciable extent. Some of this growth took place after the sap of the cypress logs had reached an advanced degree of decomposition because these filaments that form the peat have penetrated the areas of soft cell formation in the annular layers of wood tissue and have helped to split off or loosen the annular layers of sap wood sometimes forming matted masses between the more highly lignified portions of the annular rings. They also penetrate the wood tissue following the medullary rays in the sap wood. They are present in holes made by wood boring insects. Where the bark of trees is partially preserved the filaments are abundant in the region of the cambium layer. This growth extending into every opening is evidence that these
filaments are the remnants of roots that penetrated every opening where plant food might be available.

The relationship of logs to peat indicates that some peat was formed on the land surface before the cypress trees fell. The mass under the trees is compact as if it was compressed by the weight of a log. The majority of the logs have the remnants of roots attached showing that the trees were blown down. The lower roots of the trees are in the soil beneath the butt end of the log.

As drainage has been improved decomposition and consequent shrinkage in volume of the peat has progressed resulting in a subsidence of the general surface elevation. Less shrinkage has taken place where the logs lay thus revealing their outline by ridges in the peat and muck.
PLANT RESIDUES OF THE SOUTH MARGIN OF GRAND MARAIS

The south marginal region of Grand Marais is of special interest because of the plant residues found there. These residues afford interesting evidence of some of the things that have transpired in the history of the area. Two points will be discussed; namely, the peat that is buried by soil eroded from the high land, and the residues of burned logs and massed vegetation.

Buried Peat

On the south shore of Grand Marais in a lateral distance of some 300 feet the steep bank rises to an elevation of about 1 1/2 feet above the level of the peat formation. The abutment of the peat formation against this bank is covered by soil that has been eroded from the higher level. The point of contact is not at the present level of the peat in the Marais, but is some 24 inches higher. It seems that we must assume that this peat was formed when the water level was at least two feet above the present elevation of the top of the peat formation, and as the water was withdrawn and the peat formation sank the peat was left tilted at an angle of about one foot of elevation in 40 feet of lateral distance. Since that time the peat has been covered with soil eroded from the adjacent bank to a depth that varies according to the distance from point of original contact. One may dig through the soil and locate the stratum of muck that has resulted from the decomposition of the peat. In some instances the plant tissues may still be recognised.

The writer explored two areas where there were ridge-like elevations parallel to the shore line. They were composed of very black porous soil,
and were 12 or more inches above the general level. Peat in normal conditions was preserved beneath them. These ridges or elevated areas were within the region of the shore line of the marsh or lake and were surrounded by soil washed down from the high banks. The only plausible explanation that we can offer for these phenomena is the assumption that at some period of flood water stage of the lake drift vegetation was massed here and it eventually decayed and formed a mat that excluded the air and prevented the decomposition of peat while it was being broken down into muck in the surrounding region.

Burned Logs, Driftwood, and Peat

Another extraordinary feature of the south shore of Grand Marais is the prevalence of the residues of burned peat and burned mineral soil, or soil that was rich in organic matter but not rich enough to be classed as peat.

When Grand Marais peat with little or no sedimentary mineral matter burns under natural conditions, combustion progresses as a smoldering fire and leaves an ash that is soft to the touch. When peat that has a high content of sedimentary mineral matter in it burns, it leaves an ash with hard granular particles. When wood is burned in contact with Grand Marais peat that has had mineral soil mixed with it, the residue of burned soil is like fragments of brick. If the fire burns briskly, the burned soil fuses into larger masses than result from a slow fire. The burning of brush and logs in clearing portions of the Experiment Station land gave ample evidence of these facts.
Along the south shore line there is an abundance of burned soil of the character described above. This cannot be satisfactorily explained by assuming that it is a remnant of burned peat alone. We believe that it was formed from the burning of logs and drift material that had been partially covered with soil washed down from the high bank nearby. Deposits of burned soil here range in thickness from 3 or 4 inches to as much as 14 inches. One may trace these burned areas in some places as much as 40 or 50 feet, with a width of 2 or 3 feet, and a depth of 6 to 8 inches, seemingly conforming to what would result from the burning of a log of that length. In other places masses of burned soil, broken into variable sized fragments as hard as pieces of building brick, are found in formations too thick and with more fusion of soil than can be attributed to the burning of peat alone. It is our belief that these conditions can be satisfactorily explained by assuming that logs and drift wood were carried to this shore when the water level was at a height capable of bringing this about.

We were not able to find remnants of stumps in this area to indicate that trees grew there. In a few instances burned areas conformed to the shape that we would expect from the burning of a stump, but excavations did not give supporting evidence of the markings of soil differences where roots should have been. Without exception, as far as our observation went, these areas of burned soil and peat were underlaid with an area of black charred peat or muck which gradually merged into the dark brown muck that had scarcely passed the stage of decomposition which would differentiate it from peat. In some instances the characteristic crinkled filaments of peat material may be clearly recognized.
We believe this evidence should convince one that there was first a formation of peat, the lower portion of which conforms to the lower stratum in the central area. Then, drift material found lodgment upon this foundation and was later partially covered with sediment. Subsequently, in a dry period probably after the water subsided, this combustible material burned, and the resultant heat converted the soil into brick fragments.

Very recent burning of buried logs in the western borderline, where the mining of logs for fence posts has been practiced, has left depressions partly filled with ash and burned soil which are comparable to what we have described on the south shore. Some logs are burned in this manner in the western portion of the formation each fall and winter season when the Marais grass is burned.
GRAND MARAIS BAYOU

The uniformity of peat formation on the north side of the Grand Marais area was broken by a physiographic situation that was seemingly unrecorded. It was known only to a very limited number of people, and they did not attach any importance to their observations. There is within the boundary lines of the marsh area, the remnant of an ancient bayou more than a mile long, with typical natural levees that attained an elevation of more than three feet at their maximum height. The crest of these levees does not carry any peat. It looks as though they were two long narrow peninsulas at the time of the formation of the main body of peat of Grand Marais. They are surrounded by a peat formation except at their eastern extremity. Here the north bank levee connects with land higher than the marsh level. The connection of the south bank levee with land higher than the marsh area is not so clearly defined as the natural contours are partly obliterated by construction work in the digging of the Bussey Canal and a plantation railway roadbed.

We have christened this remnant of a stream "Grand Marais Bayou." While this is a christening delayed until after its death and partial obliteration, it seems essential to have a name for what is left of this water course that completed its service before it was discovered by our present civilization. It differs from the normal Louisiana bayou mainly in that it is now somewhat difficult to tell exactly where it begins and where it ends.

Barring consideration of the extremities, it exhibits the typical natural levees, tortuous course, almost uniform width and depth of stream bed, etc., that we find characteristic of a normal bayou of alluvial land.
When we study the remnants of plants that are to be found in the stream bed and on the levee banks, we find that they tell a new story that complicates the history of the entire area and makes it difficult to explain some observations that otherwise did not suggest any uncertainty as to their interpretation.

A map (prepared from data secured with chain and compass) is presented which shows the course of the stream. Graphs will also show the elevations of levees and stream bed as tied up with a bench mark of the U. S. Coast and Geodetic Survey. This bench mark is one of a series of accurately determined elevations above mean sea level. The tide gauge for determining mean sea level is on Weeks Island, about twenty miles distant. This bench mark is located within a few hundred feet of the east terminus of Grand Marais Bayou. An accurate and official level to start with, therefore, was at hand.

The stream bed of this bayou in the portion that may be regarded as the level bottom is fifteen to twenty feet wide. The inside banks of the levees rise at a very gentle angle as will be seen from cross-section maps, but are steeper than the outside grades. The measurement from crest to crest of levees is one hundred feet or more. The lower portion of the bed is covered with mud seemingly of recent deposit, and varies in thickness from one to three or more inches. In some portions of the bed remnants of peat and a considerable amount of charred peat are to be found underneath this mud. There is generally present a layer of yellow to brick red burned soil and charred vegetable matter from one to three inches in thickness. Underneath this material there is frequently two to four inches of very black charred vegetable matter, mostly of charred peat, closely resembling what one may secure now by burning peat from the marsh when it has just
enough moisture in it to burn with a smoldering combustion. Under this formation we generally have a thin layer of mixed mineral sediment and vegetable matter. Below this layer of mixed materials we find the yellowish clay subsoil characteristic of the region. The elevation of the soil at the bottom of the stream bed is very little less than that of the deeper peat formation of the marsh, indicating that the stream did not scour out its bed more than a few inches below the natural level of the area it traversed, and that the bayou was one of short period of activity, or that the current was not swift. There is at this time very little vegetation growing in the stream bed except grasses and water weeds.

In some places there are willow trees growing in the old channel, but none of them are more than twenty-five to thirty years old. We have been unable to find stumps of trees in the channel, however, examination has by no means been exhaustive over any considerable area. Occasionally there are masses of very hard brick-red burned soil, such as are produced by burning logs and stumps in contact with this type of soil and muck, or soil and peat. It is probable that this stream channel held enough water to prevent the growth of willow trees until within the last 55 years. It has been that long since "Dredge Boat Canal" was dug, and it may be that this accounts for the facts on willow growth. On the other hand the formation of peat within the channel was not just like that of the marsh area proper. Possibly the channel was better drained in dry weather than the marsh area, and peat formation was interrupted by fires.

When one follows this stream bed westward, from where the Experiment Farm road crosses it, the levees are found to decrease in elevation with respect to the stream bottom until they are finally lost in blending with
the general level before reaching the west boundary line of the Annex of the Experiment Farm, or at a distance of about 3000 feet from the road referred to above. For about one half this length they are covered with muck soil, showing that peat was once formed on them. At this western terminus of the levees, the channel is not filled, but opens into a wide depression which represents the lowest level of the Marais at that region.

Following the bayou bed eastward from the road crossing referred to above, there is a slight increase in the relative height of the levees as compared to the bottom of the stream bed, but the distance from crest to crest of levees remains about the same. There is no peat formed on the higher portions of these levees, though they are not as high as the elevation of the south bank where peat and hillside meet.

Before the stream reaches the middle of the Loisell plantation, the levees increase in breadth, materially increasing the area that is free of peat formation. It is here especially that the formation should be called Iberia Clay. One can hardly justify an assumption that more than an inch or so of vegetable matter ever covered the soil surface here.

The course of the stream is very tortuous toward the eastern end, making horse shoe turns, and finally is lost at the intersection with the old railroad dump about 100 yards from the Loisell drainage canal, and 200 yards south of the Southern Pacific main line tracks. The direction of the course at this terminus is almost directly toward Bayou Teche.

In this region, too, there are several areas of soil sufficiently drained to afford good cultivable fields, which have been planted to corn for years. These fields have a very black surface soil of shallow depth,
but present no other recognizable physical evidence of ever having been covered with any peat formation. There is no yellow or clay-red soil fragments to indicate that vegetable matter comparable to a covering of peat has been burned in these areas. Just outside these areas, we find sooty black soil, with a high percentage of charred material and this blends gradually into the remnants of peat in the lower level.
ANCIENT FOREST IN NORTH CENTRAL AREA

That a forest of cypress and tupelo gum once flourished in the area now constituting the north central portion of the peat land of the Iberia Livestock Experiment Farm is amply evidenced by the presence of stumps, remnants of logs, and cypress knees. These timber residues lie buried to a depth of 2 to 4 feet below the surface of the peat covering them, and external evidence of their presence is to be seen. One must dig or probe to find them. There are many stumps, only a few logs, and occasional cypress knees. The cypress knees are not very large and not very high. They may protrude somewhat into the upper stratum of peat, but never through it.

Since cypress knees are regarded by botanists as agents for bringing free oxygen of the air to the submerged roots of cypress trees, their abundance and their height may be taken as an important indication of the drainage conditions of the region in which they grew. The indications here are that the region was fairly well drained when the cypress trees were growing as the knees are neither numerous nor tall.

It is generally accepted as true that the tops of cypress knees grow to a height somewhat greater than the prevailing water line may be for any prolonged period of the year. It is with this belief that this information is dependable that it is cited as one of the evidences that peat would not have been formed here when forest trees were living. Judging from the number of stumps encountered in digging drainage ditches, it appeared that the region of their greatest abundance was in a belt a few hundred feet south of the region of the growth of willow trees south of Grand Marais Bayou. By probing with steel rods, stumps and cypress knees were located and their
places marked in measured areas. These indicated that a dense forest had been in this region. We dug out the overlying peat and soil from enough of the woody obstacles to our probes to give some confidence in judging as to whether we were probing a stump, a cypress knee, or a log.

From surveys made mainly by probing small areas at long intervals we were convinced that this belt of forest trees extended through the whole east and west length of Grand Marais; certainly in a belt running parallel to Grand Marais Bayou for its full length, and probably on west to connect with the buried forest logs of the west end. (The expense of probing prohibited the exploration of larger areas.) The tops of the stumps have the same general level as the bottom of the upper stratum of peat. Probably the stumps were preserved from decomposition below this level by the same conditions that started the peat formation. In other words, when the peat formation began decomposition of the stumps was checked or stopped. The peat formation then covered them and in the course of time eliminated all external evidence of their existence.

We must assume, as a part of a theory to account for the facts observed, that the area between the south natural levee of Bayou Teche and the bluff-like bank of the south side of Grand Marais was sufficiently drained at one time to favor the development of a normal forest growth of cypress and tupelo gum comparable to that of the Atchafalaya basin; that in the course of time the channel of drainage was obstructed and caused the creation of a lake, thereby flooding this forest growth and causing the death of the trees; that the tree trunks decayed and fell, or were blown down; that the stumps, being covered with still water, were preserved; that the formation
of peat was inaugurated and gradually progressed until it covered the stumps to a depth that obliterated all surface indications of their existence.

Whether or not some of these tree trunks drifted to the bank of the south shore, or to the levees of Grand Marais Bayou, and were eventually burned there is mere speculation with no assuring evidence that this was the case except that we cannot otherwise account for the disappearance of the tree trunks from the region of the stumps, and we cannot find absolute evidence that there have been stumps in the region where we believe logs have been burned. The greatest difficulty in making such a theory plausible is that we must get the logs floated to the banks before the formation of peat in the space between the stumps and the shore lines, and yet we must account for the existence of peat beneath the logs at the time they were burned.

If the areas of burned soil were the result of the fire of burning logs, certainly the logs got there after a portion of the peat was formed as charred peat and muck and unburned peat or muck existed at this time beneath these masses of burned soils.

An alternative hypothesis would be that the formation of peat began with the flooding of the area and progressed to some extent before the tree trunks had completely decayed, and that there may have come a period of flood that carried these logs, or logs from elsewhere, to their resting places on the shallow margin of the lake and upon the shallow formation of peat. This would tend to support an hypothesis advanced elsewhere to account for the line of cleavage between the strata of peat.
The soil map of Iberia Parish does not show any break in the continuity of the peat formation of the entire area of Grand Marais. The map presented of Grand Marais Bayou, and the description of its natural levees, make it evident that these levees constitute a peninsula of land which extends into the area of peat formation for a distance of more than a mile. This narrow peninsula, with Grand Marais Bayou in the middle of it, has its base just west of the Bussey Canal, and its terminal point west of the road across the marsh in the Experiment Station land. There is approximately 100 acres of land properly classed as peat on the north side of this peninsula. There is a plantation road following this peninsula to the south side of the south levee of Grand Marais Bayou which does not cross any peat except in the bottom of the stream bed of the bayou.

It seems evident that if one had been on the ground during the period of most active peat formation, he could have walked on solid soil along this peninsula from where bench mark No. M4 of the U. S. Coast and Geodetic survey is now located to a point a few hundred feet west of where the present Experiment Station road crosses Grand Marais Bayou. He would have then had a peat formation surrounding him except for the space of the narrow levees of the bayou. On the north side, it would have been about 900 feet wide, and on the south side about 2000 feet wide. Probably at that time no distinction could have been made in the characteristics of the formation on the 100 acres, more or less, lying north of the peninsula and the main body of the formation south of the peninsula. Today they are not alike. The peat on the north side is gone.

* Page 77.
Ash and burned soil covering the surface indicate that it has been burned. Approaching the area from the north side at any point east of the Experiment Farm property except within the narrow limits above described, one encounters the muck soil and muck of the same general characteristics that are on the remainder of the margin of the north side and the two ends of the Marais.

As it is very fertile, farmers have encroached as far as possible with the cultivation of corn on this muck soil. Next to the cultivated area is a belt of almost impenetrable blackberry briars and some willow trees. Then comes the burned area. The soil here seems to be very deficient in available plant food if it is judged by the lack of vigor of vegetation upon it. It evidently was burned down as deep as combustion could be sustained by the vegetable matter present leaving a reddish-brown to yellow layer of ash and burned soil underlaid by bluish to yellow mottled clay. The upper regions of the subsoil show imprints of roots that have been there, but they have disintegrated. Burned soil that we believe marks the location of tree trunks and stumps is to be found in many places.

There is an area of 5 or 6 acres located about the middle of Loisell plantation, on the north side of this burned area, that may possibly indicate a former tupelo gum pond or a forest of cypress trees. The areas of hard burned fragments of soil are sometimes in circular areas as though they may have been formed from a burning stump. If these circular areas of burned soil represent the former location of stumps, conditions in the few explorations that we were able to make have eliminated other evidence of roots outside the burned area. It is hard to believe, with absolute confidence, that traces of decayed roots could be
obliterated. On the other hand, there are areas that one encounters in probing the soil, where, instead of finding a soft soundless resistance to the steel probe, one hears a grating sound and feels resistance against the probe as though it had been thrust into fine gravel. Digging in these places reveals burned soil in the form of hard fragments that we believe would not be produced by the heat of burning peat alone.

We believe that the evidence is pretty strong that here, too, was a forest area comparable to the forest that is now positively evidenced by the presence of buried stumps south of Grand Marais Bayou. We are not able to make a plausible explanation of how the stumps disappeared in one area and still have been preserved in the other. The disappearance of the peat seems to be explained by the evidence that at some time in the recent past the peat may have been burned.

The present growth of willows in the burned region is not more than 25 or 50 years old. A deadly disease prevails among them at this time, and it is possible that the age of the willow trees has been limited by diseases, and there may have been many generations of them without any old trees.

In discussing the physiographic features of the region, we find it necessary to deal in terms of several hundred years duration. If the main body of a stump had been burned, even 50 or 60 years ago, and earth worms were as abundant as they are now, it is possible that they could have destroyed tree roots as rapidly as decay progressed.
VEGETABLE TISSUES OF GRAND MARAIS PEAT

It has already been stated that we believe the crinkled filaments forming a large part of Grand Marais peat are residues of incompletely disintegrated roots. The straight filaments found in the deeper parts of the formation are found to be of the same cellular structure as the crinkled ones when microscopic examination is made. The crinkled filaments become straight when they are disentangled and soaked in water where they are free to expand.

In the deeper subsoil beneath the peat, the filaments are in a vertical position. As we examine sections of the profile it is not easy to assuredly define their position. If we cut blocks from the profile of the dimensions, say, of 1/2 inch by 2 inches, and carefully disentangle the mass in a bowl of water, we readily find that when such a block is cut with the long dimension vertically we get many filaments that are as long as or longer than our block. When we cut a block of the same dimensions with the long dimension horizontally, we get comparatively few filaments that are very much longer than the short dimension of the block, and the longer ones are only as long as a diagonal of the short dimensions might account for with some allowance for a meandering course of a downward growing root.

That these filaments are the remnants of roots also seems probable from the fact that they penetrate every crevice of stumps, logs, and chips of wood that are sufficiently decayed to permit a root to enter. Paille fimen roots of living plants are sometimes found doing the same thing now, but paille fimen roots of recent growth are distinguishable from the filaments of peat. Another evidence that these filaments are roots is that not
infrequently we find portions of peat in which the tissue is not limited to the cortex cells but shows much of the structure of the entire tissue which is so much like the roots of living species of *Sagittaria* that we believe a species of *Sagittaria*, possibly *Sagittaria latifolia*, was a contributor to the building of the mass of peat of Grand Marais and Lake Tasse.

There are no *Sagittaria* species growing in abundance in Grand Marais now, but these root structures are fairly numerous and it seems that they have probably been accumulating continuously by penetrating the previous peat formation. If this presumption is true, we would have roots of varying ages within the same region and some would be more completely disintegrated than others.

We have not been able to find peat tissues that we think are from the one species of *Arundinaria* that grows wild in south Louisiana. We cannot say it is not there. A photomicrograph is presented later which shows some of the tissues of the roots of our present growing *Arundinaria*. These may be compared with pictures of peat filaments made with the same lenses and the same length of bellows of the camera.
THEORIES TO ACCOUNT FOR THE FORMATION
AND PRESERVATION OF PLANT RESIDUES OF GRAND MARAIS

Theories that may be offered to account for the formation and preservation of plant residues, such as forest stumps, logs, peat, etc., in the Grand Marais region, seemingly, must start with a consideration of the stumps, as they are fixed in place, and we know that they grew in the position we now find them. While there is a possibility that changes in elevation of land surface may have lifted them up or let them down to some extent, their position with respect to each other has not been materially changed, and probably their position with respect to bayou levees or other elevations or depressions of land surface that would influence distribution of forest population is relatively the same as it was at the time of tree growth since we have no evidence of great geological disturbances in this region.

So we begin our theories with the picture of a forest principally of cypress (*Taxodium distichum*) along the depression back of the south levee of Grand Marais Bayou, and of mixed forest growth covering the main body of land extending back to the bluffs on the south border of the alluvial formation that geologists now call "the escarpment."

We suspect that Grand Marais Bayou was just one of many small bayous that were formed in the alluvial regions of south Louisiana, and that it was almost obliterated by the development of the natural south levee of Bayou Teche, but that is not as important as is the fact that it was a limiting factor in establishing the boundary of the cypress forest that is one of the important subjects of our study. We know that the area
was fairly well drained, and the stumps, cypress knees, and roots of stumps give us assurance that we do not have to speculate as to how they got there. They grew where they are now, and the wide annular layers which are very readily seen show that they grew vigorously. Photographs of some of these stumps are a part of the pictorial exhibits which are submitted with this written statement. (See pages 82 and 82a.)

A second stage of development was reached when the drainage channel of this area was blocked and the area now known as Grand Marais became a lake. As a shallow lake the bottom became wave-washed into the undulating surface that is now the cleavage line between the two strata of peat.

A third stage of development provides for the invasion of peat producing vegetation encroaching from the shore line toward the center adhering to the soil and the formation of the first or bottom stratum of peat.

We must then provide a fourth period of development by presuming a dry time during which the upper surface of the peat was burned away, and the surface of the land was left smooth, but having a layer of peat formed from roots that were not burned.

A fifth period of time in the history of the formation must then be assumed in which there was a change in the elevation of the region, or in which the drainage obstruction was elevated, so that the area was reflooded to a height greater than the previous water level, and a new formation of peat began and formed a floating mass covering the entire area.

The sixth period is then assumed to have resulted in the drainage of the lake so that the floating blanket of vegetation settled upon the first
stratum of peat and left the clearly marked cleavage line between the two formations as we have them now.

It may seem that an important weakness in this theory is the necessity of assuming so many marked variations of conditions. Another weakness is that the residual effects of burning do not seem to be adequate to support the theory.

Another theory, simplifying the assumptions, would deviate from the first theory. Beginning with the third stage we could presume that a substantial peat development had been attained as a floating mass with some plant roots extending through the layer of water and penetrating the surface soil beneath. When a freshet or an overflow of Bayou Teche threw a great volume of water in the basin and the floating mass had sufficient buoyancy to break the slender roots that extended to the bottom of the lake the formation was left as we find it now. Then, the lake was drained and the floating mass settled and formed the surface stratum of peat.

A difficulty in the way of this theory is the statement of resident citizens of the region that Grand Marais was a lake within the time of their recollection. Mr. Silvio Broussard, Postmaster of New Iberia, can remember killing ducks in Grand Marais when it was a lake. Mr. St. Paul Bourgeois says that water stood in Grand Marais throughout the year within his recollection. Others testify in a similar manner, so we may believe that not more than 40 years ago there was open water covering Grand Marais.

We know that the amount of peat present now has not been formed as a floating mass since that time. It seems that the peat was most likely at the bottom of the lake in somewhat the same form as peat is now at the bottom of Lake Tasse.
We must then go back to a more ancient period to account for the formation, and assume that the peat was at the bottom of the lake with open surface water forming a portion of Grand Marais at the time of the settlement of south Louisiana by French and Spanish people. We can assume that as the lake was gradually drained by the several canals that were cut from the margin of Grand Marais into bayou Teche, a new plant population encroached from the margins until the entire area was covered. We may assume that roots of these plants penetrated the old peat bed, lived their normal life period, and died and became a part of the peat formation. These plants may have been of the same genera as the original plant population, but they were gradually crowded out by paille finne grass which finally came to be the dominant plant of the marsh.

We find that paille finne grass has roots that penetrate very deep into the peat formation. These roots when dead become a part of the peat formation, but they do not become crinkled as are the tissues of the main body of peat. We do not find evidence that paille finne roots contributed in any large way to the formation of the original mass of peat.

When these investigations were begun in 1929, one could rarely detect an offensive odor in the peat of any portion of the Marais. Most samples had no odor at that time. Now, many samples have an offensive odor, indicating that rapid decomposition is in process. Microscopic examinations of tissues that seem to be new do not always give information which satisfies us.
The peat formation of Lake Tasse has not been given the detailed study that has been devoted to Grand Marais as it does not seem to invite so much attention. We did not find evidence of stratification comparable to that of Grand Marais. If there is evidence of former forest growth in the lake area, or about its margins, we did not find it. Our investigations were not extensive, but they included probeings in four regions of the east and north sides from the margin to as far in toward the water as one could advance on foot.

Lake Tasse peat is somewhat like Grand Marais peat in that it contains a large amount of root remnants that seemingly have the same cell structure as the dominant filaments in Grand Marais peat. It differs in that the formation is not so deep, and it contains much more vegetation in the form of large leaves of water plants and long pieces of stems of what seems to be rank grasses and sedges. We have not tried to make a microscopic study of these coarse plant residues.

The most striking observation made regarding the peat of Lake Tasse, and one that may be of great importance in helping to interpret the facts as applied to Grand Marais, is that the primary peat formation of Lake Tasse is a dead mass of submerged vegetation that has no connection at the present time with living plants except where the floating mass of vegetation has encroached from the banks in very recent years and sent plant roots down to it. From the Spanish Lake Club House one may go by boat eastward until he reaches the area of good peat formation, get out of the boat in water that is two and a half to three feet deep and wade 500 feet or more further toward the center of the lake than the floating mass of vegetation extends,
walking all the while on a fairly firm lake bottom of peat. This peat has a thickness of some 18 inches at the edge of the mass of floating and living vegetation. (See photograph of a man wading on peat bottom in Lake Tasse, Page 100.) The peat adheres to the bottom of the lake. The water level of this lake is about two feet lower than it was up to about 1925 when a canal was dug that crossed part of the margin of Lake Tasse with the result that it partially drained the lake. Citizens say that ten years ago there were no lilies floating about the club house, and only a fringe on the south bank of the lake for a long distance to the east of the club house. There has been a steady increase in the width of floating hyacinths and other vegetation that makes up the mat of green growth that now floats on the water, and which may ultimately cover the entire lake. Photographs of this floating mass are to be found on pages 88 and 101.

On the margin that is next to the open water of the lake, this material is composed largely of water hyacinths and consists of leaves, stems, matted roots, and partially decomposed vegetable matter. It forms a light floating blanket, the surface of which may be two to four inches above the water level. It is almost like a floating soil, and vegetation other than hyacinths soon find lodgment and grow in it, thickening the mass by accretion of roots, stems, and leaves. The most numerous of these plants are _Sagittaria lancifolia_, _S. platyphylla_, _Typha latifolia_, _Pontederia cordata_, _Panicum hemitomon_, and a species of _Polygonum_. All of these produce roots that not only help to compose the floating mass, but penetrate it and hang suspended in the water and help to float it. No doubt if one were to find access to the formation further toward the land side, he would find similar roots penetrating the soil or underlying peat.
This condition may have prevailed as a large part of Grand Marais when a freshet caused the floating mass to break away from its root attachments to the soil, and provide at a later time the line of cleavage between the two strata of peat in Grand Marais.

When paille finne grass becomes established on the floating mass it soon forms a mat of interwoven roots and rootstocks which is rigid enough for one to walk upon. This mat is so unlike the fabric of Grand Marais peat that one feels sure that nothing like this constituted the peat formation there.

A photograph of a fabric of paille finne roots and stems, superposed on the peat formation of Lake Tasse is shown on page 90.
The conditions that prevail now at Lake Tasse may be interpreted as representing a period of transition from a time when peat was formed as a mass of vegetation that was attached to the soil and composed largely of one or more species of Sagittaria to a period when the roots of paille finne grass will be the dominant constituent. Paille finne grass produces two types of roots. One type remains in the aerated portion of its supporting soil and produces many fibrous rootlets. The other type penetrates the underlying formation of peat and that are constantly saturated with water. They will probably not decay further when they die than to become pickled as peat. These roots are, seemingly, now adding material to the peat previously formed. The grass is crowding out other vegetation and seems destined to become the dominant plant following the formation of the floating mats of other plants. If this process continues, it seems probable that peat formation may be continued in the Lake Tasse region, on which paille finne grass dominates, and that encroachment by floating vegetation upon the open waters of the lake may continue until the entire surface is covered and the lake will cease to show any open water surface. Lake Tasse may then be a solid peat formation. If the drainage conditions are not modified, it may increase in thickness as long as paille finne grass finds enough moisture to enable it to flourish, since the roots penetrating the formation will cause it to expand from inside growth rather than from accretions on the surface.

The opposite course of development will probably take place in Grand Marais. Since the drainage is such that the peat will be saturated with water only periodically, it will disintegrate and shrink in volume and
gradually become muck and muck soil if it does not catch fire and burn the combustible material. If that happens, the soil may be almost worthless for agricultural purposes.
PEAT OF LAKE PIEGNEUR

Six years ago the water line of Lake Piegneur was raised about 50 inches by the construction of a dam across its outlet for the purpose of increasing the depth of water in the lake. The result increases the difficulty of studying the peat formation at the margin of the lake. We were unable to find peat, using the term to mean 65 percent vegetable matter, where we expected it to be. We found only mud which was rich in vegetable matter and had possibly fifty percent by dry weight of mineral. We were able to find peat only in a very restricted region in the south-eastern portion of the lake. It was very similar to the peat of Lake Tasse and we did not have an opportunity to study it carefully.

At the present time there is a formation of floating vegetation on this lake which differs from that of Lake Tasse in that it is composed largely of alligator weed. The marginal growths on the west and north sides of the lake differ in that the dominant plant is a very coarse grass known as water millet (Zizaniopsis miliacea) that has its roots firmly grown into the soil.

It is the same species of grass that now chokes "Dredge Boat Canal," and grows abundantly on the banks and in the edges of Bayou Teche and other streams of the region. It forms a very dense growth that excludes hyacinths and other floating material. While there is now a floating mass of alligator weed between this grass and the open water of the lake, we believe it will resist the encroachment of its territory by floating material. The conditions here are that the grass probably was established before the lake level was raised and the change did not kill any of the grass. Whether or not it will form peat remains to be seen. At present, there is no peat beneath its roots. Whether or not the alligator weed will form peat, also
remains to be seen. No vegetable cells in Grand Marais peat were found which closely resemble the cells of the roots of this plant. We do not believe it helped to form the ancient peat of either Grand Marais or Lake Tasse.

If peat continues to be formed in Lake Piegneur, it will be as a new formation not in contact with the old formation. The peat that can be located now is four feet or more beneath the water surface, and the roots of the present floating mass contain no plants that produce roots that might penetrate this distance.
GEOLOGICAL FORMATIONS OF THE ELEVATED BOUNDARIES
OF GRAND MARAIS AND LAKE TASSE

We secured information on the geological formations of the region from "Geology of Iberia Parish," by Henry V. Howe, Ph.D., and Cyril K. Morese, B. S. From page 62 of this publication we quote the following:

"Aside from Weeks, Avery, and Jefferson 'islands,' the most prominent relief feature of Iberia Parish is a northward facing 'escarpment' from 10 to 15 feet high, which follows the shore line of Lake Tasse directly into the city of New Iberia, there disappearing, but beginning again about three miles southeast of the town. It continues eastward on the south side of Grand Marais to within about two miles of the eastern parish line, where it again disappears.

"This 'escarpment' is the southeastward continuation of a 'bluff' which enters Lafayette Parish from the general direction of Opelousas to a point about three and one half miles northeast of Carencro. From there it follows the western border of the valley of Vermilion River to Lafayette, then leaving Vermilion River, it follows the western border of Bayou Tortue to Lake Tasse in Iberia Parish. This 'escarpment' is considered to mark the western border of the Mississippi delta and marks the line of separation between the delta deposits and the Hammond and Pensacola terraces. It cuts both terraces and hence must have been formed by the Mississippi either during the last half of the Wisconsin glacial advance or by lateral migration accompanying the formation of the present delta at some time since the last glacial stage."

Quoting again from the same publication, page 65, we have the following:

"The highest lands to the north of the 'escarpment' are the immediate banks of Bayou Tche, from which, except for low narrow ridges, there is a gentle slope in each direction. To the north of the bayou this slope extends either to Coulee Portage (Little Bayou) or Lake Fausse Pointe, and on the south to the Grand Marais or Lake Tasse. An examination of the soil map of Iberia Parish discloses that Bayou Tche, must, at some fairly late date in its history, have overflowed its banks and the waters have passed through the gap in the 'escarpment' southeast
of New Iberia and likewise have passed around the end of the 'escarpment' in the neighborhood of Jeanerette, as there are several small patches of Bayou Teche sediment spread over the surface of the Pensacola terrace which radiate from these points.

Summarizing the geological information we can give the following as the probable explanation of how the highlands surrounding Grand Marais basin were formed: The south bank is the 'escarpment,' with an elevation 8 to 12 feet higher than the marsh. The north margin is the extreme portion of the natural levee of Bayou Teche. The west end is the sedimentary fill resulting from Bayou Teche breaking through the 'escarpment' east of New Iberia. The east end is a fill resulting from a break in the south levee of Bayou Teche just west of Jeanerette.

If the physiographic geologists will permit us to assume that the overflow just east of New Iberia took place first, and also permit us to assume that there may have been one or more periods of unusually high water in Grand Marais after the fill took place west of Jeanerette, we will then be supplied with all the necessary physiographic conditions necessary to meet the requirements of either of the theories advanced to account for the forest stumps, logs, and peat of Grand Marais.

A probable history of the area, deducted from botanical observations, supplemented with the knowledge gained from physiographic geologists, is now restated in brief form.

After the overflow east of New Iberia a forest growth covered the area between the south levee of Bayou Teche and the 'escarpment.' Grand Marais Bayou levees exercised the normal influence of such formations in distributing cypress and willow trees to the lower less drained areas and gum and other forest trees to the slightly higher levels. Then the overflow
and fill west of Jeanerette blocked the drainage of that portion of the valley that lies west of the fill and formed the undrained area that we now call Grand Marais. The trees were killed by the standing water, and peat formation began. The stumps decayed to a level somewhat below that of the surface of the water, or to a level where there was an inadequate supply of free oxygen to support the organisms of decomposition. From this point of development on to the present status, weather conditions alone may have determined what took place. One theory involves a dry period, and the cessation of peat formation, followed by inundation of the basin and a new period of peat formation as a floating mass that later was dropped to the bottom of the lake. Then the lake became drained through man's intervention. The other theory presumes a continuous period of peat formation with a floating mass of vegetation, similar to the present growth in Lake Tasse, that became partially anchored to the bottom of the lake by long roots that hung from the bottom of the upper mass. Then came a flood period in the basin and the buoyancy of the mass broke the anchoring roots, and left the lower stratum of peat attached to the soil. Subsequently, the water receded and the floating mass was deposited on the lower stratum. When the basin was again filled with water the peat did not float. This was the status when civilized man appeared on the scene.
APPENDIX A

Photographs
1. Small marsh area, on high land, south of the western portion of Orange Grove Plantation. Dominant plant population is *Typha latifolia*, and a coarse grass known as water millet (*Zizaniopsis miliacea*).
2. A small marsh area bordering the Forty Arpent Road, south of Grand Marais. The coarse grass dominates here. This is the grass that obstructs drainage in "Dredge Boat Canal." It occupies the west and south margins of Lake Piegnour, but is not conspicuous in Lake Tasse population.
A reproduction of a portion of the soil survey map of Iberia Parish giving location of areas discussed.
4. Line of cleavage between the two strata of peat of Grand Marais. Photograph is taken at approximately a right angle to the bank of a ditch with a forty-five degree slope. The ruler at the bottom of the ditch is an 18 inch measure. The surveyor's rod on top of the bank is several feet long. The cleavage line runs from "A" to "B."
5. Same view as No. 4. Some features of the formation are clearer than in No. 4, but the ruler was left out so both prints are preserved. This section was selected because it shows a characteristic that cannot be clearly explained. To the right, at the end of the surveyor's rod, is a mass of differentiated peat. At the left end of the rod is another mass which is slightly different. When these formations are dug out, they are found to be of nearly equal dimensions, right and left, back and front. It is possible that at one time they may have been nests for animals and subsequently were filled with peat.
Another section of the cleavage line. A large stump is seen in the foreground. A portion of another stump which had been removed rolled down the bank and was not noticed when the picture was taken. It shows prominently with inverted position on the edge of the larger stump. The black line from a peg in the ditch bank was a steel measure to the camera which was set to take a portion of water at the bottom of the ditch.
7. To the right is a side view of a profile of Grand Marais peat where the cleavage line is at a moderate angle. The roots sticking up are paille finne roots that have penetrated the lower stratum. The peat filaments are plainly visible as little ribbons on the side of the profile. On the left is a surface of the section turned to face the camera and exhibit the velvety mass of filaments that make the cleavage line. The fine white marks are rootlets from plants now growing in the upper stratum of peat.
A closer view of a profile of Grand Marais peat. The line of cleavage is seen at a much sharper angle than in No. 7. This sample was taken on the margin of a pocket in the lower stratum of peat.
9. Part of a willow log imbedded in the lower stratum of peat in Grand Marais. Shows filaments of peat which have penetrated the wood.
10. Part of the area at the west end of Grand Marais where cypress logs have been unearthed and converted into fence posts. Posts are stacked for drying.
11. The ditch in the foreground which is filled with water is a depression from which a cypress log was removed and converted into fence posts. The tree trunk was more than 50 feet in length. Posts stacked for drying are seen in the center and right of the picture.
12. Two cypress logs lying at right angles revealed by shoveling away the covering of peat and muck. The surface of these logs was about eight inches below the surface of the peat. The log in the center background shows the expanded base of the tree giving evidence that the tree blew over.
15. Taken at right angles to the road ditch on the south bank of Grand Marais. Figures "1" and "2" mark the residue of burned soil which we believe marks the place of two logs. This is a cross section. The course of the burned formation of No. 1 was uncovered for a distance of 20 feet, and it maintained practically the same cross section of burned area for that distance.
A closer view of log No. 1 (in the previous photograph) brings out at the bottom more clearly the layer of charred peat just outside the area of burned soil.
15. A closer view of log No. 2 (photograph No. 15). The right and left margins of the picture are to be disregarded as they were not scraped to form a new surface when the picture was taken.
Map of Grand Marais Bayou.

Photostat of map is reduced so that the scale is 1 inch equals approximately 550 feet. Small figures on the map designate elevation above sea level. Elevation of road near south end is 20.3 feet above sea level. Iberia and St. Mary Drainage Canal bank is 7.9 feet, etc. It will be noted that the highest point recorded is 10.4 feet on the south levee of the bayou, while the bayou bed is 8.0 feet. These figures were taken at random from a topographic survey, running levees parallel to boundary lines, 300 feet apart.
17. This shows the fill of the new road across Grand Marais in the property of the Iberia Livestock Experiment Farm where it crosses Grand Marais Bayou. The men on the left and right extremities of the picture are on the banks of the bayou. The two men in the middle of the picture are standing on the margins of the bed of the stream.
This view of Grand Marais Bayou at the eastern boundary line of the Experiment Station land shows the type of vegetation that covers the stream bed and its banks. The banks here are 26 inches above the level of the stream bed.
19. View of Grand Marais Bayou taken from the Experiment Station road. The coarse grass shown in the center background is the species which dominates the west shore line of Lake Piegmeur and some of the depressions near the Forty Arpent Road and is choking the channel of *Dredge Boat Canal.*
This shows the character of growth that prevails in a narrow strip between the south levee of Grand Marais Bayou and the main body of peat formation south of it.
21. Ditch at side of Experiment Station road across Grand Marais. Three cypress stumps are seen in the foreground, and a small group of stumps are seen in the center background. The stump on which the surveyor's rod is resting is approximately 7 feet in diameter.
Cypress stumps in one of the drainage ditches. The tops of these stumps were several inches below the cleavage line between the strata of peat.
22. A close-up side view of the large stump shown in No. 21.
23. The cypress knee in the center comes within about four inches of the line of cleavage between the two strata of peat. It is noted that the line of cleavage takes a marked dip slightly to the left of the top of the cypress knee and is imperfectly defined immediately above it.
24. This photograph was taken to show the surface layer of brownish yellow ash and burned soil that covers the area between the north levee of Grand Marais Bayou and the muck region of the north margin of the Grand Marais area. The surface of the ditch bank was not cleaned for sufficient space to cover the full width of the picture.
25. This view shows fragments of a cypress stump in the side of a ditch bank and in the center the top of a cypress knee. The line of cleavage makes a decided upturn to go over the knee apparently indicating that the upper stratum of peat settled over the knee and around it.
26. Ditch bank section of a burned area on the south shore of Grand Marais. The light area near the surface is composed of burned soil and burned peat. The deeper formation in the middle probably marks the place where a large root was burned.
27. A view from the board walk of the Spanish Lake Club House showing the floating mass of vegetation that borders the shore line of Lake Tasse or Spanish Lake.
28. A profile sample of peat from Lake Tasse region that is overgrown with paille finne grass. Part of the peat has been washed away so as to reveal the deep penetrating paille finne roots.
29. A closer view of the same profile as No. 28. It has been washed more to reveal the dense mat of roots and stems in the upper portion of the profile.
Two root stalks of paillé finna. The one to the left produces the surface roots with many rootlets that remain in the aerated portion of the soil. The one on the right shows the smooth penetrating roots that have a few branches and live in the region that is constantly saturated with water.
Lotus (Nelumbo lutea) forms an isolated colony in Lake Tasse. The roots are fixed in the bottom of the lake. They show no evidence of forming peat.
Floating masses of vegetation on Lake Tasse that have found anchorage in the bottom of the lake so that they no longer move from place to place.
33. A mass of mixed vegetation on the northwest border of the open water of Lake Tasse. Paille finne grass in the center, and cat tails to the left, are shown. They are mixed with hyacinths, sagittarias, and other species.
Floating mass of mixed vegetation in Lake Tasse that is fixed to the shore formation by the matted mass of vegetable matter, but seemingly is not yet anchored to the bottom by the roots of the plants.
35. Plants that are now growing that are most likely to contribute to peat formation. Reading from right to left:

1. Water hyacinth (*Piaropus cressipes*)
2. *Sagittaria latifolia*
3. Cat-tail (*Typha latifolia*)
4. *Sagittaria lancifolia*
5. Pickerel weed (*Pontederia cordata*)
Mixed vegetation growing over the peat in Lake Tasse. Water hyacinths are completely surrounded with Sagittarias and Pontederias.

View from elevation of approximately ten feet looking toward Spanish Lake Club House in the distance at the right. Sagittarias are being crowded out by paille finne grass.
38. From elevation of ten feet showing encroachment of shrubbery on margin of peat formation in Lake Tasse.

39. Near the margin of floating vegetation looking toward the highland from Lake Tasse. Large leaves are Sagittaria.
40. View from an elevation of ten feet looking toward Spanish Lake Club House shown in the distance to the left of the center. Palea finne almost predominates to within about fifty feet of the edge of the open water of the lake. A dense mat of roots and root stocks afford firm base on which to walk.

41. View from a short distance from the shore looking toward the highland showing areas where Sagittarias constitute the dominant plant population.
42. This shows a man standing on the firm formation of peat at the bottom of Lake Tasse, approximately three hundred feet from the margin of the floating vegetation on the border of the lake.

43. A detached mass of water hyacinths that is grounded in thick mud. Plant roots are beginning to anchor the mass by penetrating to the bottom of the lake during a period of dry weather.
44. A detached mass of mixed vegetation in Lake Tasse. The dead stems showing white in the picture are a representative of the Oenothera family of a previous year's growth. The surface of the new soil in this cluster is fully three inches above the water surface.

45. A view in Grand Marais where paille finne grass constitutes about seventy-five percent of the plant population. Note the growth of willows in the background.
46. A swamp area south of Jefferson Island. Cypress trees (Taxodium distichum) beginning to die after six years of submergence of the roots. Samples of peat were secured from the bottom of the lake a hundred feet to the right of the trees on the right hand side of the picture.

47. Cattle grazing on the north margin of Grand Marais where profile sample No. 11 was secured. The surface here is sufficiently firm to furnish a good firm sod for grazing.
A P P E N D I X B

Photo-Micrographs
EXPLANATION OF PHOTO-MICROGRAPHS

Samples of the vegetable structures that are discernible in the peat formation were prepared for photographic work by boiling samples in ten percent potassium hydroxide for five minutes. After the specimens were well washed they were dissected with needles and a low power binocular in order to display the cell structure to the best possible advantage. It was hoped in this way that we could determine the variety of vegetable tissue composing the peat. The specimens were then mounted in ten percent glycerine and photographed. The same combination of lenses with a fixed length of bellows was used in all the photographic work. A magnification of 110X was used. There may be a little variation in apparent size due to imperfect focusing.

It was deemed sufficient to give a set of pictures resulting from the examination of specimens of a profile comparable to the samples which were used for chemical analyses.

Pictures 48 - 55 inclusive are from specimens selected at random from profile No. 1.

Pictures 54 - 57 inclusive represent other types of vegetation found.

It was deemed advisable to show a complete set of pictures from profile No. 11, representing the west end of the Grand Marais peat, for comparison with profile No. 1.

Profile No. 9 is from the east end of Grand Marais.

Pictures 71 - 90 inclusive are a group of miscellaneous ones.
48. Profile No. 1, depth 4 inches.

49. Profile No. 1, depth 10 inches.
50. Profile No. 1, depth 16 inches including the upper cleavage filaments.

51. Profile No. 1, depth 16 inches with the lower surface of cleavage.
52. Profile No. 1, depth 81 inches.

55. Profile No. 1, depth 81 inches. Below the line of cleavage.
53A. Profile No. 1, in blue mud deeper than 31 inches.

54. Profile No. 1, depth 16 inches, with upper cleavage stratum.
55. Profile No. 1, below line of cleavage.

56. Profile No. 1, between 14 and 16 inches, and above the cleavage line.
57. Profile No. 1, in blue mud below peat.

58. Profile No. 11, depth 6 inches.
59. Profile No. 11, depth 10 inches.

60. Profile No. 11, depth 18 inches.
61. Profile No. 11, depth 22 inches.

62. Profile No. 11, from the upper stratum of line of cleavage.
63. Profile No. 11, from the lower stratum of line of cleavage.

64. Profile No. 11, depth 16 inches. Shows first marked variation of cellular structure.
Profile No. 11, from the lower stratum of line of cleavage.

Profile No. 11, from another specimen of the lower stratum of the line of cleavage.
67. Profile No. 9, depth 6 inches.

68. Profile No. 9, depth 6 inches.
69. Profile No. 9, depth 10 inches.

70. Profile No. 9, depth 16 inches, including the upper stratum of the line of cleavage.
71. Profile No. 7, depth 6 inches.

72. Profile No. 7, depth 6 inches.
74. Profile No. 7, depth 16 inches.

75. Profile No. 7, depth 10 inches.
75. Profile No. 2, depth 6 inches.

76. Profile No. 2, depth 11 inches.
77. Profile No. 2, depth 16 inches.

78. Filaments from a cypress log west end of Grand Marais.
79. Filaments taken from the bark of a log from west end of Grand Marais.

31. From a living specimen of *Sagittaria platyntha*. Lake Tasse.

83. *Juncus effusus*, Lake Tasso.

84. A rank grass known as water millet.
85. *Pentaderia*. Species uncertain
Drainage ditch - Grand Marais.

86. *Faire finne grass* (*Panicum hemitomon*). Tissues disintegrated by boiling in potassium hydroxide.

68. *Nelumbo lutea* or lotus from Lake Tasse. Tissues disintegrated by boiling in potassium hydroxide.
69. Polycomum sp. smart weed.
Lake Tassie.

60. Sessile leaved felabane.
Krigeron sp.
BIOGRAPHY

William Rufus Dodson was born near Belton, Texas, July 17, 1867. He received his elementary education in the public schools of Arkansas, and at Clark's Academy in Berryville, Arkansas. He received his Bachelor of Science degree from the University of Missouri in 1890, and his Bachelor of Arts degree from Harvard University in 1894. In 1898, he did special work in the Graduate School of the University of Michigan, and in the biological laboratories of Parke, Davis and Company at Detroit, Michigan. He is a member of Phi Beta Kappa.

His teaching experience includes that of public school teacher in Arkansas; assistant professor of Botany at the University of Missouri, 1890-1893; laboratory assistant in Botany at Harvard, 1894; professor of Botany and Bacteriology at Louisiana State University, 1894-1905.

Other work in science and related activities has been done as Botanist and Bacteriologist of the Louisiana Experiment Station, 1894-1905, Assistant Director of the same station, 1905-1905; Director 1905-1916, and again 1920-1928; Dean of the College of Agriculture, Louisiana State University, 1912-1918, and again 1920-1928; Superintendent of the Iberia Livestock Experiment Station of the U. S. Department of Agriculture, 1928-1938. During the World War he was on leave of absence and had charge of the food production campaign in the southern states and served as head of the Agricultural Relations Section of Food Administration under Herbert Hoover. He was awarded a gold badge for valuable services in the World War.

In 1898, Mr. Dodson was married to Minnie Pettengill, of Centralia, Missouri. There are four living children of this marriage, three of whom are graduates from the Louisiana State University.

On May 1, 1936, Mr. Dodson returned to the Louisiana State University as a special Agronomist.
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