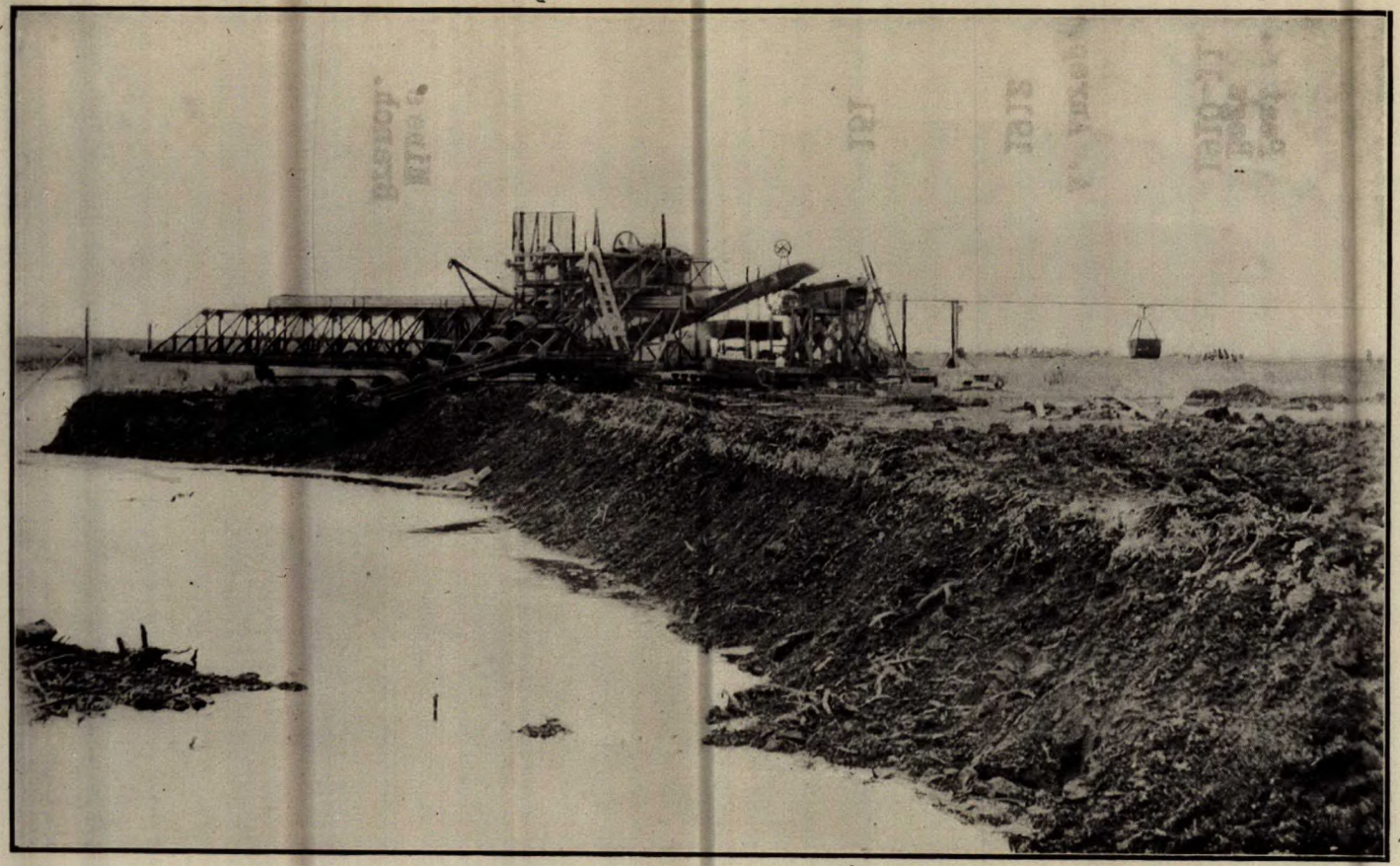

18784 Panoramic view of Alfred Peat Bog and plant, showing the "Anrep" excavating machine in operation, 1912.

CANADA

DEPARTMENT OF M

MINES BRANCH

HON. ROBERT ROGERS, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
EUGENE HAANEL, PH.D., DIRECTOR.

BULLETIN No. 8

INVESTIGATION

OF THE

PEAT BOGS

AND

PEAT INDUSTRY OF CANADA

1910-11

BY

A. Anrep.

OTTAWA
GOVERNMENT PRINTING BUREAU
1912

18784—1½

No. 151

LETTER OF TRANSMITTAL.

To Dr. Eugene Haanel,
Director of Mines Branch,
Department of Mines,
Ottawa.

Sir,—I beg to submit, herewith, a report on the peat bogs and peat industry of Canada; dealing specially with the investigation of certain peat bogs in Ontario and Manitoba, and the preliminary examination of a number of other bogs in the last named Province.

Part I records the operations incident to the manufacture of peat fuel at the Government peat bog and plant, Alfred, Prescott county, Ontario—during the summer season of 1910: supplemented by illustrated descriptions of other manufacturing processes. Part II gives a detailed account of the extent, depth, and quality of the peat on the Holland peat bog, near Bradford, Ontario—as investigated during the autumn of 1910; also detailed particulars of 11 bogs investigated, and a general description of 9 marshes preliminarily examined, in Manitoba.

With a view to contributing to a wider knowledge of the technology of peat fuel manufacture, translations of a number of valuable official documents dealing with recent European practice have been introduced: papers treating, more particularly, on the manufacture of peat powder in Sweden.

I have the honour to be, Sir,

Your obedient servant,

(Signed) **A. Anrep.**

January 16, 1912.

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INVESTIGATION OF THE PEAT BOGS AND PEAT INDUSTRY OF CANADA.

PART I.

MANUFACTURE.

ON THE MANUFACTURING OF PEAT AT THE GOVERNMENT PEAT BOG, ALFRED, ONTARIO, 1910.

A. Anrep.

The delimitation of the bog, analyses of peat, and installation of the plant at Alfred has already been described in Bulletin No. 4, pages 14-18.

The operations during the season of 1910 were as follows: a working area of 1,000 feet wide, by 3,125 feet long (about 72 acres) was laid out on the west half of lot 9, concession VII, Alfred township, Prescott county. During the previous year, the above area was drained on the east side by a main ditch 3,125 feet long, which runs north and south from the road to the railway. This ditch was dug to the bottom, in order to keep the working trench in a fairly dry condition. A second ditch, separated from the main ditch by 1,000 feet, was dug for a distance of 2,800 feet. This ditch is known as the "Parallel Ditch". On the north of the bog and at right angles to the ditches specified, another ditch was dug, which receives the water from the drained part of the field, and empties it into one of the concession ditches, or so-called water course ditches. Between the main and parallel, ditches are dug at intervals of 160 feet. Some of these are covered in; the others are open. The above-mentioned ditches do not drain the bog to the bottom. The depth of the ditches averages from 3 to 4 feet, which is sufficient to keep the surface of the spreading field in proper condition, and at the same time leaves sufficiently solid ground for the machinery and buildings. To prevent the bog from becoming too dry during the summer, and freezing in the winter, the parallel and right angle ditches are not dug to the bottom of the bog. In order to protect the bog from frost penetrating deep into the ground, the water in the bog is dammed up in autumn, after the operation of the plant ceases. Peat which has been frozen generally loses its cohesive properties and easily crumbles to pieces, making it less suitable for the manufacture of peat fuel.

The peat machinery is placed at the north end of the above area, and is operated in the south direction, immediately adjacent to the main ditch, so that the working trench—excavated by hand labour—simply widens it out. The operation is continued in this way until the south end of the main ditch is reached; then the complete peat machine is moved back to the north end. This operation is continued until the area is worked out.

This working line is 3,125 feet long, 20 feet wide, and 9 feet deep, and contains about 20,833 cubic yards of raw peat. Experience has shown that a drained bog containing peat of good quality gives 250 pounds of air dried peat per cubic yard, with 25 per cent moisture; therefore, the above-mentioned working line contains 2,604 tons of air dried peat with 25 per cent moisture.

Thirteen men and three boys were employed at the peat machine. Seven men performed the excavation work: shovelling the raw peat into the elevator which conveyed it into the pulping mill and which in turn delivered the thoroughly kneaded material into the dumping cars. These loaded cars were attached to the moving cable by one man, while another man received the empty cars, and placed them in position for filling. The loaded cars moved out automatically to the field press, where a third man disconnected the cables and dumped the pulp into the field press. In his spare time this man cut the peat crosswise. Two men were employed for spreading out the peat in the field press.

One engineer was employed to attend the boiler and engine; two boys gathered the fuel and carried it in baskets to the boiler; and one boy attended to the levers operating the field press, and the pump.

The field press moved in a right angle to the working trench, leaving behind a strip, 600 feet long by 8 feet wide, of ready shaped peat on the surface of the drying field. About four strips were laid out per day: each strip containing between 7 to 8 tons of air dried fuel.

After a period of from 7 to 10 days, the peat, which was spread out to dry, was turned over—depending upon the weather conditions. The turning was done by young boys, who received 7 cents per 1,000 bricks. (See Plates I and II.)

As soon as the peat was sufficiently dry to be handled, it was stacked in small piles (cubes), at 10 cents per 1,000 bricks. From these small piles or cubes, the finished fuel was stacked, and taken to the store house or to the railway cars, on portable tracks, in cars provided for the purpose. (See Plates III, IV, V, VI.)

The manufacture of peat fuel was begun about the middle of May, and continued for a period of about 50 days.

The following amount was realized:—

24 tons,	900 lbs.	sold to	Public Works Department.
141 "	400 "	" by	C. C. Ray Co. for domestic use.
61 "	1424 "	" by	Mines Branch for domestic use.
160 "		" by " "	(To Fuel Testing Plant.)
98 "	1000 "	sold at the bog.	
9 "		by	Mines Branch to Germany.

Total 794 tons, 1724 lbs.

While the plant was in operation, the following work was also carried on:—

(1) Continuation of drainage of Alfred peat bog—which was not accomplished during the season of 1909: consisting of four open ditches, each 1,000 feet long, 2 feet wide at the top, and 1′-4″ at the bottom, by 3 feet deep, which amounted to 741 cubic yards.

(2) Levelling the surface of bog. Two-thirds—about 47 acres of the ground—were levelled and cleared from trees, trunks, and brush.

(3) Erection of buildings: peat shed for storage of dried peat, 200 feet long, 22 feet wide, and 18 feet high; platform for loading the peat into railway cars. See Plates IV, V, VI.
(4) Building of railway siding, 500 feet long.

The capital expenditure on the erection of the peat plant and the cost of manufacturing peat at Alfred, Ontario, will be prepared in separate report by Mr. B. F. Haanel, Chief of Fuel Testing Division, Mines Branch.

BOTANY OF ALFRED PEAT BOG.

A number of photographs were taken of the different botanical plants in the Alfred peat bog, which show the constituent organic growths from which the peat has been formed. (See Plates VII to XVI).

Sphagnum moss has been the chief factor in the formation of the Alfred peat bog.

Well humified sphagnum intermixed with other plants: for instance, *pulectricum juniperinum*, *eriopherum*, and other aquatic plants, produces a fairly good fuel.

Inasmuch as sphagnum moss contains a very small amount of inorganic material—growing as it does on watery ground containing little nourishment—it gives a comparatively small percentage of ash when burned.

Ontario Peat Bogs: Comparative Analyses of Peat.

The following table gives the chemical composition of dry peat from the different bogs investigated in Ontario:—

TABLE I.

The Following Table Shows the Analyses from the Different Peat Samples Collected in Ontario.

No. of samples from each bog.	Peat from	Composition of peat.	Analyses of peat (absolutely dry).						
			Volatile matter.	Fixed carbon.	Ash.	Phosphorus	Sulphur.	Nitrogen.	Calorific value, B. T. U. per lb.
1	Mer-Bleu, Ontario.....	Sphagnum more or less mixed with eriophorum.....	65·90	24·22	10·88	.....	.....	.....	8821
2	" "		67·57	25·35	7·18	0·026	0·314	1·40	9021
3	" "		68·40	25·00	6·60	.....	.....	.....	
4	" "		63·22	24·86	11·92	.....	.....	.....	8805
5	" "		68·76	25·73	5·51	.....	.....	.....	9126
6	" "		68·73	26·27	5·00	0·024	0·317	1·13	9441
7	" "		69·49	26·04	4·47	.....	.....	.....	9301
1	Alfred, Ontario	Principally formed by sphagnum	68·13	26·56	5·31	0·029	0·292	1·23	8730
2	" "		68·72	24·22	7·06	0·022	0·375	1·92	9058
1	Welland, Ontario.....	Sphagnum mixed with carex, eriophorum, and hypnum.	67·14	26·48	6·38	0·027	0·317	1·13	9118
2	" "		70·90	24·84	4·26	0·024	0·248	1·74	8596
3	" "		70·53	24·28	5·19	.....	.....	.....	8667
1	Newington, Ontario	Sphagnum slightly mixed with aquatic plants.	66·75	25·77	7·48	0·028	0·530	1·85	8721
2	" "		67·07	26·27	6·66	0·030	0·494	1·80	8465
3	" "		68·84	26·65	4·51	.....	.....	.....	8877
4	" "		71·32	24·44	4·24	0·032	0·345	1·63	8336
5	" "		69·54	26·75	3·71	.....	.....	.....	9102
6	" "		65·77	27·30	6·93	.....	.....	.....	8210
7	" "		66·97	26·70	6·33	.....	.....	.....	8312
1	Perth, Ontario.....	Sphagnum mixed with hypnum.	70·34	25·35	4·31	0·030	0·405	1·66	9067
2	.....		71·51	24·60	3·89	0·027	0·334	1·94	9148
1	Victoria Road, Ontario.....	Hypnum mixed with sphagnum.	69·52	25·18	5·30	.....	.....	.....	8649
1	Brunner, Ontario.....	Principally hypnum.....	64·09	25·16	10·75	1·73	0·303	0·035	8850
1	Komoka, Ontario.....	Sphagnum mixed with carex....	60·90	18·52	20·58	1·63	1·34	0·087	7490
1	Brockville, Ontario.....	Carex slightly mixed with eriophorum and aquatic plants.	66·70	21·75	11·75	2·41	0·90	0·038	8173
1	Rondeau, Ontario.....	Carex mixed with remains of grasses and aquatic plants.	61·00	22·90	16·10	2·77	0·73	0·049	7914
1	Alfred, Ontario: part of bog.	Sphagnum slightly mixed with hypnum and eriophorum.	68·23	26·00	5·77	1·76	0·218	0·033	9005

(*a*) Turning of peat blocks, government peat bog, Alfred.

(*b*) Turning of peat blocks, government peat bog, Alfred.

PLATE III.

Piling of peat cubing, government peat bog, Alfred.

(*a*) Loading of dry peat into dumping cars, government peat bog, Alfred.

(*b*) Transportation of peat from the drying field to sheds, for stacking or shipment, government peat bog, Alfred.

PLATE V.

Stack of peat, government peat bog, Alfred.

(*a*) Triangular shed for storage of dried peat, government peat bog, Alfred.

(*b*) Siding and platform for loading of peat into railway cars, government peat bog, Alfred.

PLATE VII.

Sphagnum fuscum von gallesceu:
(Peat litter moss).

PLATE VIII.

Chamaedaphne calyculata (cassandra calyculata).
(*Leather leaf.*)

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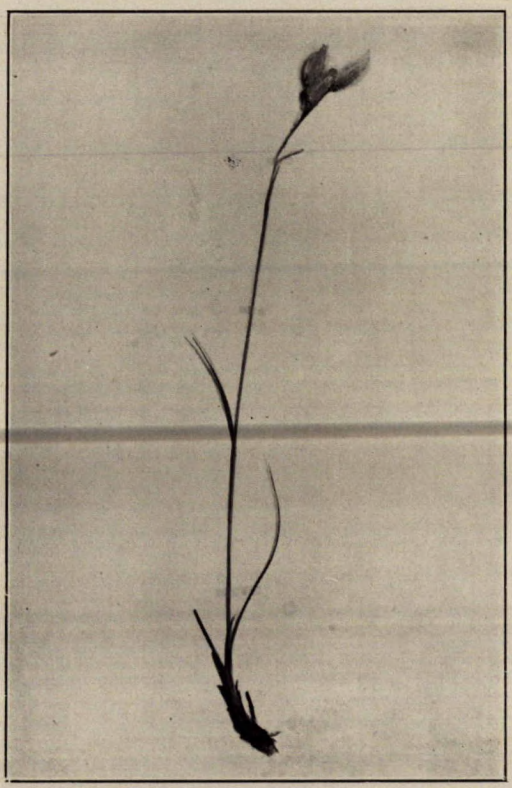
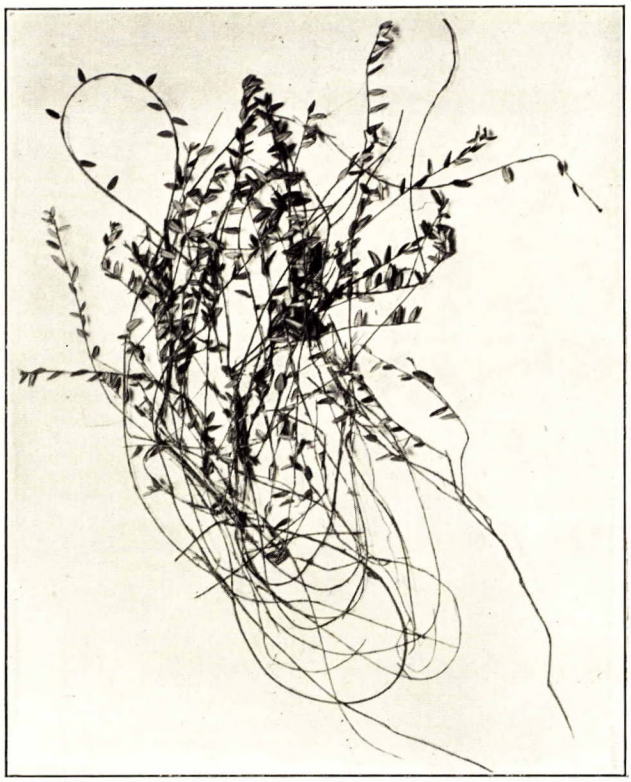
PLATE IX.



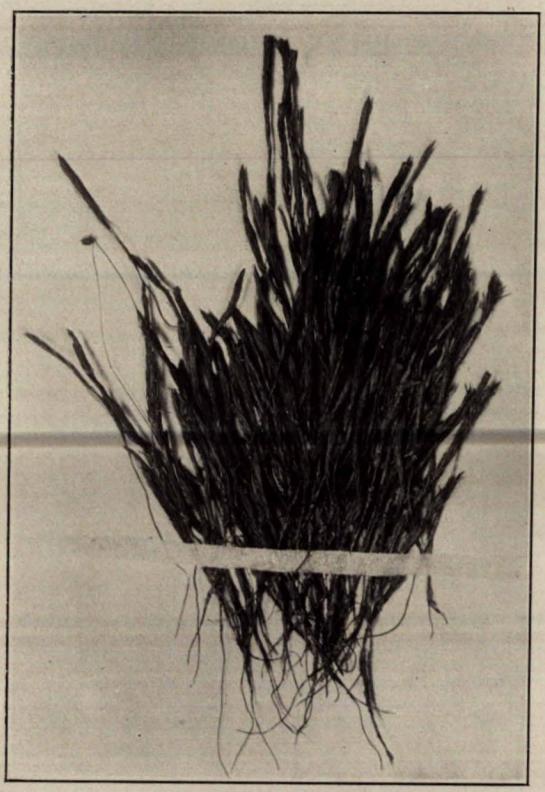
Eriophorum angustifolium, Roth.
(*Meadow down.*)

PLATE X.



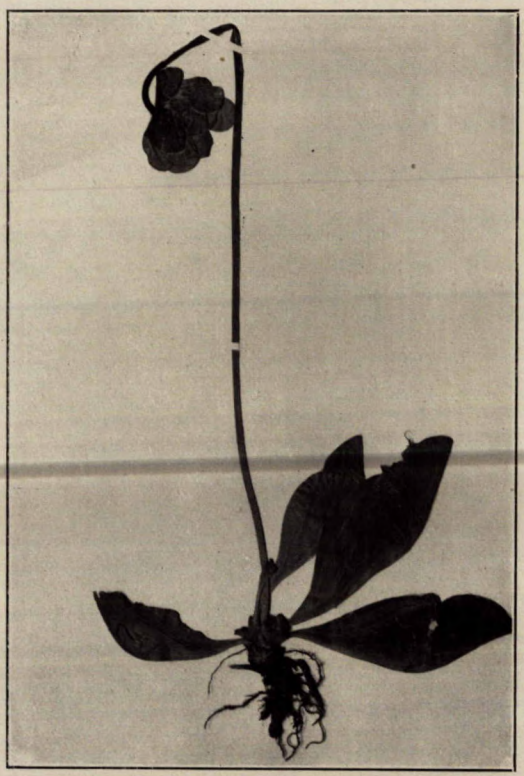
Vaccinium oxycoccus:
(*Small cranberry.*)

PLATE XI.



Polytricum juniperinum
(*Cup moss.*)

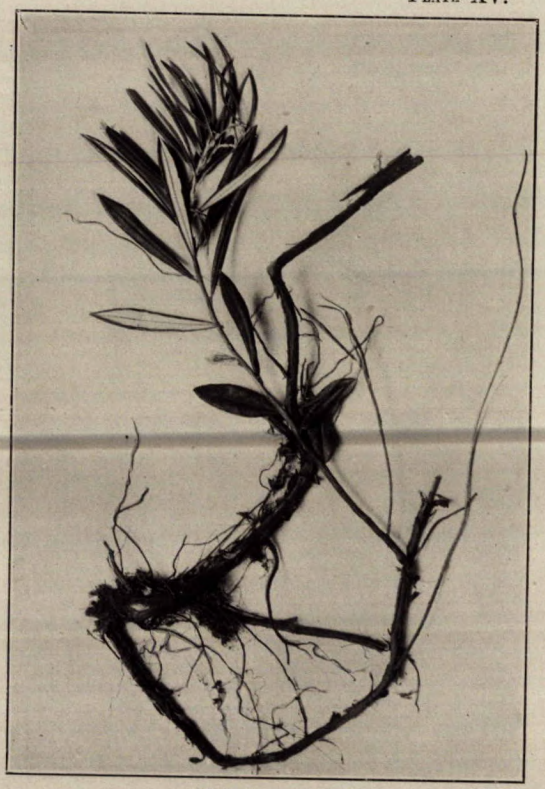
Ledum latifolium:
(*Labrador tea.*)



Sarracennia purpurea—with a flower:
(*Pitcher plant.*)

PLATE XIV.

Sarracennia purpurea:
(*Pitcher plant.*)



Kalmia glauca:
(*Swamp laurel.*)

PLATE XVI.

Kalmia angustifolia:
(*Sheep laurel.*)

NOTES ON SPECIAL APPLIANCES FOR THE MANUFACTURE OF PEAT FUEL.

Lincoln Excavating System at Farnham, Que.

A Lincoln excavator for digging the peat automatically, with an improved spreading device and with an Anrep pulper, was installed and tried during the summer of 1910 on the Farnham peat bog, which is traversed by the Central Vermont railway, about 40 miles from Montreal.

During my visit at Farnham, which lasted about two days, I had only the opportunity to see the peat plant in operation for not more than two hours. This was too short a time to obtain any definite figures.

Machinery Equipment.

A platform resting on caterpillar rollers, directly on the surface of the bog.

The excavator peat machine, gasoline engine, and the peat forming apparatus are all mounted on the same platform. (See Plate No. XVII).

The excavator is placed on the long side of the platform, and parallel to its length. To regulate the depth of the working trench, it can be moved up and down. It digs a perpendicular ditch, about one foot wide.

The excavated peat is conveyed by means of a belt elevator to the pulper; after the peat is thoroughly pulped, it is delivered into a receptacle about 15 feet long, which is placed across the back of the platform.

In this receptacle is placed a dividing, endless screw, which evenly distributes the peat pulp to both sides and spreads it on the surface of the bog, where it is formed and cut.

The object of this peat plant, as well as all other peat plants supplied with a mechanical excavator, is to replace hand labour as much as possible by machinery.

From my observation and from the statement received from the assisting peat engineer, Mr. Carlsson, the capacity of the above-mentioned plant was between 20 and 25 tons per day, employing a working staff of three men and one boy, and using about 30 gallons of gasoline per day as fuel.

This plant somewhat resembles the Dobson's excavating and spreading device, both being supported by caterpillar rollers, travelling direct on the surface of the bog, and excavating a narrow trench alongside the working line, and spreading the peat pulp on the surface of the bog close to the plant.

The Dobson's apparatus is quite adaptable on a well drained bog surface, which is strong enough to support the weight of the machine, when the peat mull is to be produced for briquette manufacturing, but using the same method with improved construction for manufacturing air-dried peat on a large scale, the principle employed is not correct. Machine peat fuel can not be produced from frozen peat, since such peat loses its cohesive properties; this is the case when a long working line is required. During the season the Lincoln machine will excavate about one foot in breadth; this trench would be exposed to frost the succeeding winter. Supposing that on each running foot of the 15 ft. wide drying field 55 pounds are dried, then the daily production of 25 tons would require per day $\frac{25 \times 2{,}000}{55}$ or about 910 feet = 303 yards. If the peat takes only 30 days to dry, the length of the field will be 30 times 303 = 9,090 yards, or more

than 5 miles long. During a rainy summer, the drying field would be considerably longer. This would require unproportionately long working lines, which would cut up the peat bog and drain it too much.

In using a similar method in a climate like that of Canada with its severe winters, and where different degrees of humification of the peat bogs have to be taken into consideration, the walls of the excavator trench would freeze to a greater depth than 1 foot, that is to say, the frozen material would be wider than the working trench, and a large proportion of the raw material in the bog be destroyed. In Russia, where the winters are somewhat similar to the Canadian, and where, usually, the working trenches are about 20 feet wide, the frozen peat is intermixed with peat which has not been exposed to frost, and in this way there is obtained in most cases a peat with sufficient cohesive properties. This, however, could not be done in the case of the narrow trench described above.

The Lincoln excavator cuts a vertical wall. These walls are apt to break frequently on account of the pressure of the heavy machinery, and even when the bog is drained the walls of the trench are left uneven. This causes interruption during the repeated operations of the bog. Loss of time and material is the result.

If roots and fibres which are not decomposed are heavily intermixed in the peat layers, then the surface of the bog has a sufficient endurance for the rollers and also support enough to keep the vertical excavated walls from breaking down. Such bogs, however, are very hard on machinery and are very difficult to operate.

To prevent the frost entering deep into the peat layers, the peat, after it is drained, should not contain less than 85 per cent moisture and in the autumn the trenches should be filled with water, so that only the surface is dry. Peat containing 88 per cent of moisture can advantageously be worked by machinery.

Further difficulties arise in connexion with the transportation of the dry peat to the sheds or railway, on account of the unproportionately long drying field, which is more than 5 miles long.

German Type of Combined Excavating and Spreading Machine.

Dr. Wielandt, in Oldenburg, Germany, has also worked on the development of these principles of combining excavator and spreading device for manufacturing machine peat fuel.

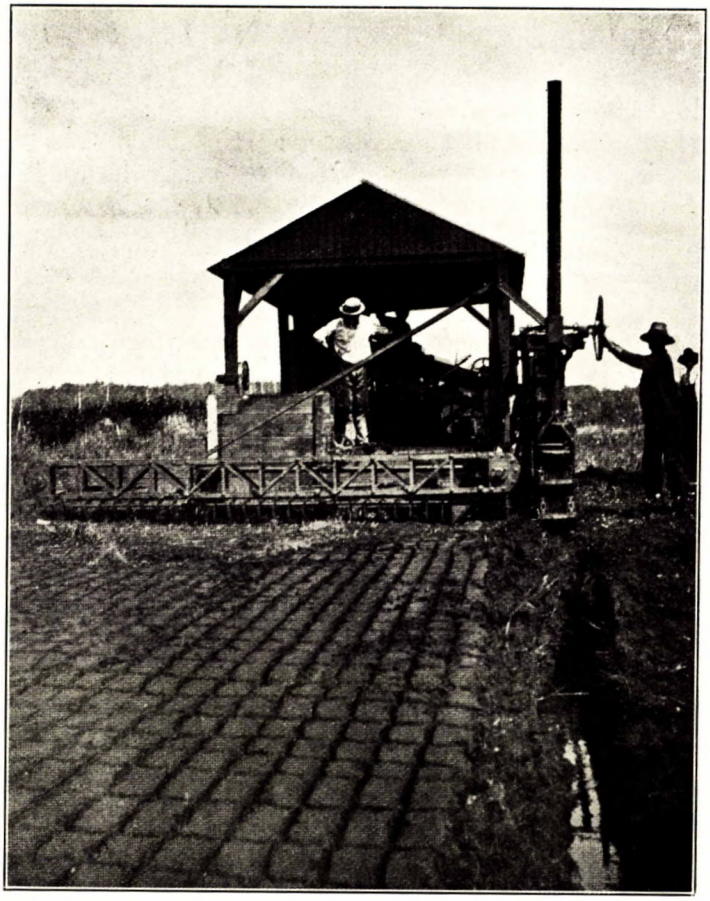
This apparatus is supposed to excavate a trench about 4 feet wide, with a stated production of 30 tons air dried peat per day, and a working staff of only one man.

The experiments were carried on for three years, without obtaining any economical results. (See Plates XVIII and XIX.)

The Ekenberg Wet-Carbonizing Process..

An extensive peat plant is under erection at Dumfries, Scotland, where Dr. Ekenberg's wet carbonizing process is employed.

In Sweden, Dr. de Laval, and Mr. Alf. Larson are experimenting in their laboratory, trying, on a large scale, to solve this problem by diminishing the moisture content of the wet-carbonized peat below 50 per cent. So far, no information in connexion with the results can be obtained.



Lincoln peat machine : in operation.

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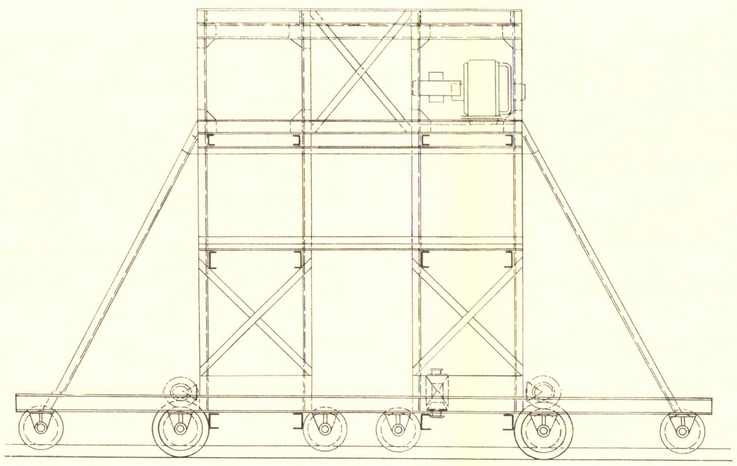


A. Anrep
Helsingborg 1911.

FIG. I.—GENERAL OUTLINE OF THE ANREP EXCAVATING MACHINE

To accompany Bulletin No. 8,
"Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

The Anrep Excavating System.

Mr. A. Anrep, Sr., of Helsingborg, has lately invented a new digging and conveying apparatus for excavating peat mechanically (See Fig. 1.) and in connexion with this, he improved his mascerating mill; cable device for the transportation of the pulped peat to the spreading and drying field, and designed an improved spreading apparatus for forming the pulped peat into uniform bricks on the surface of the bog.

The object of the new peat machine is to increase the production, diminish the cost of labour, and to operate effectively on any kind of peat bog, whether firm or soft.

The excavator consists essentially of the combination of a platform resting on three parallel rails on the surface of the bog, and a bucket excavator mounted on a carriage and movable on rails set obliquely across the back of this platform. The three rails carrying the platform run longitudinally with the trench, and are so placed that, the outside rail is about on the centre line of the trench, while the innermost one is some distance beyond the inner edge.

The platform is provided with a conveying trough extending in the path of the traverser for taking up and conveying the excavated peat into a hopper.

Through this hopper the raw peat is discharged into the peat mill, where it is thoroughly kneaded. From the mill the homogeneous peat mass is conveyed, by means of a belt, through a conduit into the dumping cars, and in these is transported by cable, on an endless track, to the spreading grounds.

The new cable device is somewhat similar to the system used at Alfred; except that it provides for the automatic lengthening or shortening of the tractional cable, with the shifting of the circular track, and with the advance of the excavator.

The field press is very similar to Jacobson's; with the exception that it is reversible.

On the front of the frame are placed three heavy, wooden drums, with a tongue attached to the central one.

These drums are intended to level the surface of the bog, as well as to be used for turning the spreading and forming apparatus. By pressing down the tongue, the back of the apparatus is raised from the ground; and the whole spreading machine can easily be turned completely round and placed in position to work back over the field and spread the peat in the opposite direction.

It is provided with a worm device, which spreads the peat mass evenly in the box.

Behind the worm device, a large wooden drum is placed across the frame for smoothing the surface of the spread peat. The long and slender knives which cut the peat easily, follow the surface, and do not tear up the edges of the spread peat bricks. This apparatus is connected to a cable, which follows the outside of the track as a means of actuating the cable alternately in both directions.

A loop and pulley arrangement with counterweight attached, automatically compensates the lengthening and shortening of the cable and keeps it at the proper tension.

To operate this plant, a 40-45 H.P. electric motor is required; or, if necessary, a locomotive boiler can be substituted. The stated production

capacity is from 60-80 tons per day (ten hours' work), employing a working staff of 10 men and 1 boy. Division of labour as follows:—

1 man, attending to the excavator,
2 men, loading and coupling on the cars.
2 men, uncoupling the cars and spreading the peat in the field press.
1 machinist, attending to the electric motor.
1 boy, assisting the machinist by turning one end of the levers.
2 men, levelling and moving the tracks on the field.
2 men, levelling and moving the tracks at the plant.

This excavator will be seen in operation on the Alfred peat bog during the summer of 1912.

"Doering Consortium."

Mechanical Extraction of Moisture from Peat.

In Russia, a large company is being organized: the so-called "Doering Consortium," Moscow. They claim to have solved the process of extracting the moisture content of raw peat down to 50 per cent by mechanical pressure.

(1) Plant to manufacture peat for domestic fuel in brick form:—

The stated production of this plant with a pumping device, 4 moisture separating presses and a forming apparatus, is 80 tons per day (ten hours' work), employing a working staff of 28 men. The cost of a complete plant, not including the purchase of the bog, is stated to be approximately $43,000.

(2) Plant to manufacture peat into briquettes, with a capacity of 120 tons in 24 hours, is as follows:—

Excavator and rolling stock, $25,000.
Machinery for separating moisture out of the raw peat, $35,000.
Briquetting plant, $200,000.
Total = $260,000.

So far, no such plants are under erection, hence no definite figures or results can be obtained.

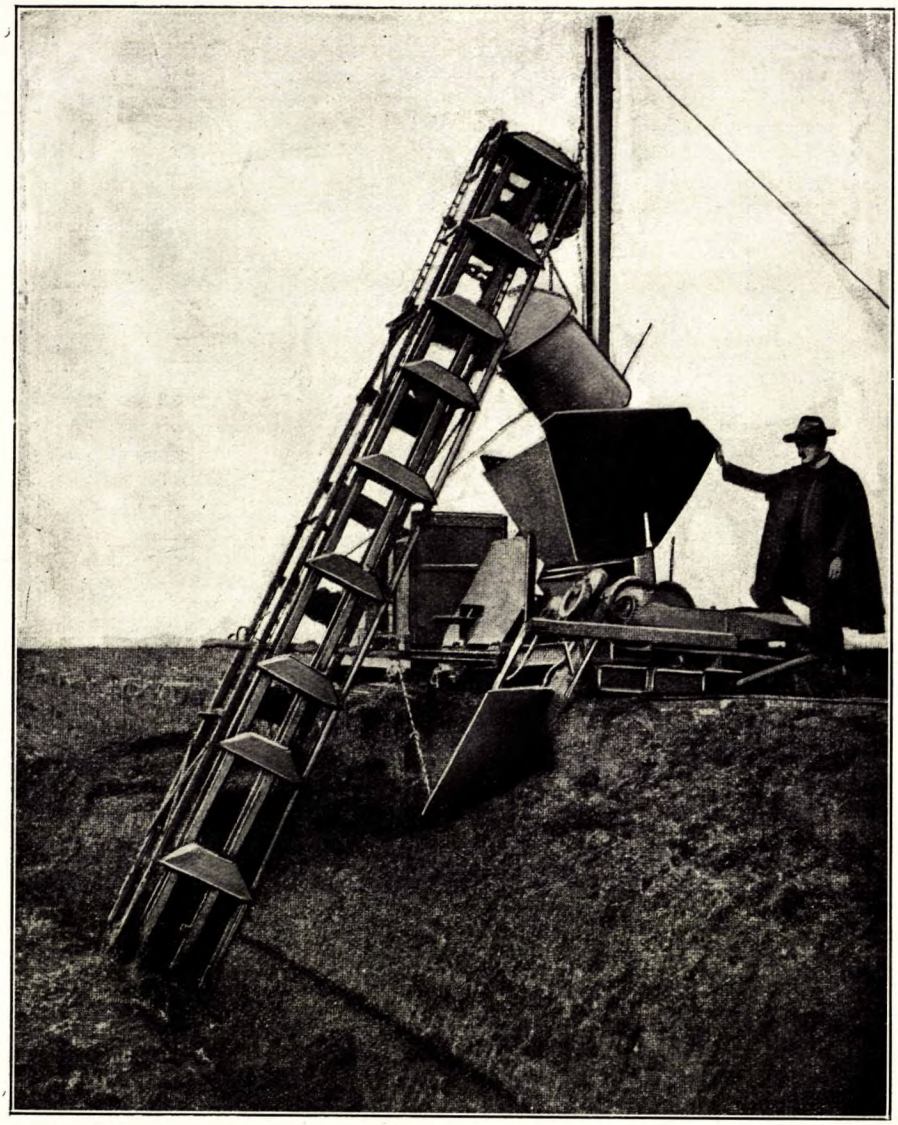
The Impracticability of Drying Peat by Means of Hot Air.

Inasmuch as during the last twenty years, large sums of money have been spent in Canada and the United States in vain attempts to economically dry peat by means of hot air, I hereby submit the following statement showing why such processes are utterly impracticable.

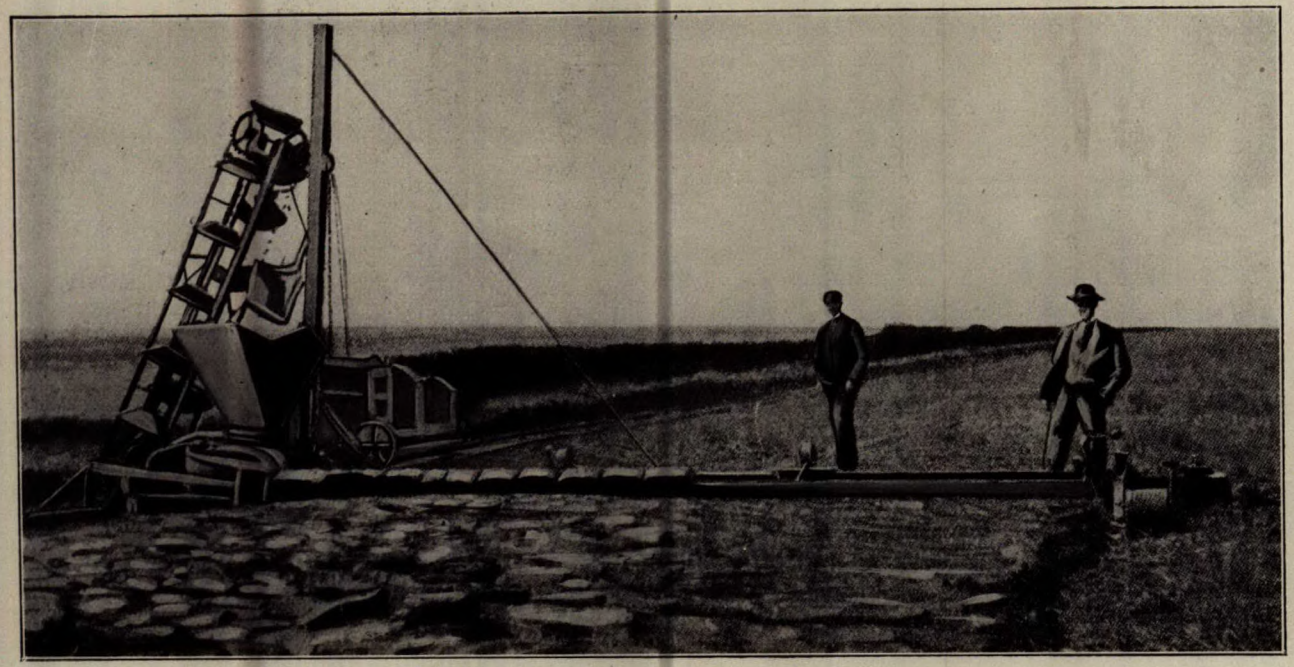
Assuming that we have 1,000 pounds of raw peat containing A per cent of water and B per cent of peat substance, and the peat to be dried by means of hot air to 10 per cent of water, then the quantity of peat resulting $= \times = \frac{100}{9}.B$ pounds and the quantity of water evaporated =

$$Y = 1000 - \frac{100}{9}.B \text{ lbs.}$$

To effect this drying, let it be supposed that we use as fuel, peat containing 10 per cent water. The calorific value of such peat averages 8,100 B.T.U. per lb. Taking the efficiency of the drying apparatus as 80 per cent, then 6,480 B.T.U. are utilized per pound of fuel. Since 1,118 B.T.U



Dr. Wielandt's peat machine.



Wielandt peat machine, showing spreading apparatus.

is the quantity of heat necessary to raise one pound of water from 60° F. to 212° and convert it to steam, then the amount of fuel consumed =

$$Z = \frac{1118.Y}{6480} \text{ lbs.}$$

The following table was calculated for 1,000 pounds of raw peat of various percentages of water content:—

TABLE II.

A.	B.	X.	Y.	Z.	Net output.
%	%	lbs.	lbs.	lbs.	(X-Z lbs.)
90	10	111	889	154	*
80	20	222	778	134	88
70	30	333	667	115	218
60	40	444	556	96	348
50	50	556	444	77	479
40	60	667	333	57	610
30	70	778	222	38	740
20	80	889	111	19	870
10	90	1,000	0	0	1,000

*Shortage of 43 lbs.

The foregoing table shows clearly that the peat can not be dried economically by artificial heat.

NOTES ON SPHAGNUM, PEAT BOGS, AND THE VARIOUS USES TO WHICH THEY ARE BEING APPLIED.

THE CAUSE OF DEAD SPHAGNUM BOGS.

Peat-men have on several occasions brought to my attention the fact that they have in their experience met with dead bogs without knowing the cause of them. The following description of such bogs may, therefore, prove of interest.

Frequently, there appears on the surface of a growing bog a special kind of hepatica plant which prevents the sphagnum moss from further growth. Small holes are formed which are at times filled with water. As the water rises, smaller or larger parts of the surrounding sphagnum are disintegrated, and thus killed by degrees. This also occurs where winter roads run through the bogs. The roads usually kill the sphagnum on the surface and gradually form wide and deep channels filled with water, which in time form quaggy grounds. The Rondeau peat bog, Rondeau, Ontario, is an example of this.

Sphagnum fuscum is a kind of moss which can, least of all, endure to be covered with water; and where this does take place—as for instance

in some parts of the peat bog at Brockville, Ontario—the moss dies very rapidly. The water disintegrates the moss, which at last forms a loose mass. This disintegration occurs sometimes on such a large scale that ponds are formed on the surface of the bog; and at times these get so large as to form lakes of considerable size. This can be seen in some parts of the Newington bog, Ontario.

It is characteristic of quaggy holes that the bottom is usually formed of a loose mire or mud. (See the description of Brockville bog, Ontario, Bulletin No. 4).

Sometimes bogs die on account of too much drainage: the upper layers of the moss dry, and hence are deprived of the moisture necessary for its existence. Sphagnum mosses absorb moisture from the damp atmosphere; but this alone is not sufficient to maintain life.

Fires do much harm to drained sphagnum bogs. During dry seasons the fire penetrates deep into the upper layer of moss and checks further growth. This can be especially noticed on some parts of the Brunner bog, Ontario.

On the Manufacture of Peat Paper.

The following is a translation of an article on the microscopical investigation of peat paper samples, by Emil Haglund—from '*Svenska Mosskulturforeningens Tidskrift*', January, 1911, pages 81-89.

The question of manufacturing paper out of peat, especially out of unhumified sphagnum moss, has been raised many times. The inquiry has usually ended, however, with some small experiments. Scientific men in the paper industry do not seem to have had very much confidence in the results of these experiments; and this lack of confidence as will be shown was well founded.

The consistency of peat is such that, it cannot be expected to make strong and durable paper without the employment in its manufacture of complicated and extensive machinery necessary for the cleaning, bleaching, and drying of the peat. This makes the finished product so expensive that it can hardly compete with the prices of the material now on the market.

At the Mosskulturforeining (Swedish Peat Society) museum is to be found a considerable collection of peat paper samples from different places. Some time ago several samples made from Irish peat were added. Comparison of these samples with those previously collected, caused an investigation to be made: to ascertain if they were made of peat.

Some of the tests of the strength of paper hereafter mentioned have been made according to the American standard by Engineer A. Skeppstedt at the Munksjo paper-works—to whom I am indebted, and have to thank, for valuable written information. Several historical abstracts concerning foreign manufacturing have been taken from "Osterr Moorzeitschrift." Herr Schreiber for many years gave short accounts of the different paper manufacturing firms and processes. Careful note was made of the length of time each firm lasted before going into bankruptcy, and of the losses entailed in each case.

(I) *Pasteboard*, manufactured at the Munksjo paper works in 1890, for experimental purposes, proved to be very loose, slightly glazed, thin, and golden brown in colour, with dark stripes. Thinner paper was also produced. It had a tensile strength of about 15 English pounds, weighed 190 grams per square meter, and was 0·32 mm. thick.

Microscopic investigation. The main part of the material consists of unhumified, perfectly hyaline (glass-like) sphagnum moss. The leaves are unfractured, and show, occasionally, distinct pores; but with a dissolved glass-clear substance. The stems are often quite long, and extend right across the field of view at 80 times enlargement. The woody texture in these is whole, but the bark may be lacking. However, there is to be found perfect bark structures with distinct retort shaped absorption cells.

Eriophorum vaginatum appears in dark strips up to 1 centimetre long, 0·1–0·8 mm. wide. This, at the enlargement seems to consist of bast elements from leaf sheaths. It is also found with brown striped bast threads, and between these hyaline (glass-like) epidermis cells; fine roots of carex occasionally occur. Fibres of spruce, sphagnum spores, and spruce pollen, are found in small quantities.

It can readily be seen that pasteboard of the above quality cannot possess much strength. The leaves and stems of the sphagnum mosses contain very little of the thread or bast elements which are required for manufacturing paper. The filtering capacity of the leaves is extremely small, and decreases as they disintegrate. Even the stems which contain wood substance have a small quantity of fibre. The wood substance is composed of only a few cells and thick layers of weak and short wood cells with little substance. Inwardly the stem assumes the texture of pith and outwardly of bark (airbags.)

The binding elements in this case are the added wooden substances and eriophorum, while the sphagnum can only be considered as a filler, and as such, it is for most purposes unsuitable.

sphagnum found in the paper is usually in a disintegrated form and in that state is about the same as the ordinary peat mull with a large absorption capacity for water. As it readily absorbs many times its own weight of moisture and releases it with difficulty, the drying process is very difficult and expensive owing to the amount of artificial heat required.

A daily production of 12 tons of peat with 50 per cent sphagnum moss would require 60 tons of raw peat, but as it weighs 10–14 times more than the dry peat, it would be necessary to remove 54 tons of water daily. Most of the water has to be removed by artificial heat as only a very small amount is released by mechanical pressure. It would thus be necessary on many of our paper machines to increase the number of cylinders, increasing the working and erection expenses and requiring an enlargement of space. It will be seen that sphagnum moss is hardly suitable as a filler in manufacturing paper.

(II) *Pasteboard* from Lindefor's paper factory is almost straw-colour and consists of different thicknesses—from 0·39 mm. to over 2·0 mm. The weight of the first-mentioned thickness is 300 grams per square meter and contains, according to the statements issued by the factory, 40 per cent sphagnum moss and 60 per cent woody substance.

The sphagnum moss consists mostly of absolutely unhumified hyaline leaves of different varieties, with a small amount of stems. These retain the bark-texture while the leaves are generally whole. Eriophorum vaginatum is less frequent.

As in the previous case, the sphagnum moss is little disintegrated, but on account of the large quantity of added wood fibres, it possesses greater strength. It is impossible to see the peat in the pasteboard with the naked eye; this can be distinguished only after microscopic investigation. It is noteworthy that the paper is of a light yellow colour; foreign peat paper is always of a dark colour.

It may seem from the above data that the results of these tests were successful. However, owing to the great capacity which peat has for absorbing water, and the great expense entailed in removing the same, the experiments were not continued. This pasteboard was manufactured according to Dr. Beddie's patent in Berlin.

The process is as follows: the raw peat is cleaned, first by mixing it in the machine with a weak solution of alcohol for removing the humus substance; it is then disintegrated in specially constructed machines and finally in most cases bleached. The bleaching process, it is claimed, is very difficult and costly—much more so than in the case of wood fibre. Hence it has been shown that Sphagnum moss, even with the addition of a large amount of wood fibre, can not be used economically in the manufacture of paper.

Pasteboard manufactured by Engineer Ludwig Franz in Admont, Steiermark, is of a dark, grey-brown colour, and is of several thicknesses. The thinnest quality had a tensile strength of 40 English pounds, weighed 400 grams per square metre, and was 0·54 mm. thick. Pasteboard 2·05 mm. thick had a tensile strength of 130 English pounds.

A. Cardboard: The surface is covered with minute fibres, which are not visible to the naked eye. The quantity of peat added is, in comparison, the same as in the Lindefors pasteboard. However, the Austrian sphagnum moss is more uneven than the Swedish; it is more humified and contains other kinds of peat residue, Eriophorum Vaginatum heather, and different kinds of carex. It seems that manufacturing was continued longer, which may be seen partly from the appearance of the cardboard and from the microscopic structure. Sphagnum leaves, humified to a certain degree, occur in smaller parts; unhumified pieces are often whole and hyaline (glass-like); the stems are very short and in many instances I have found the bark structure unfractured, the spirals of the absorption cells may also be very clearly noticed and even the spores of the sphagnum moss are well preserved.

Eriophorum occurs in considerable amount and occasionally may be found as single fibres, but more often several fibres are gathered together in a flat, comparatively wide streak. Between the fibres occur parts of hyaline, epidermie, wave-shaped cell walls. The impurities found, consist of leaves of golden maidenhair, "Polytrichum commune," Jungermannia and some bark cells of heather, "Colluna vulgaris"; carex is found in the form of single, fine root branches. The fibres are composed chiefly of spruce and fragments of bark of the same plants are to be found. The fibres are bedded in pulp consisting of pith particles.

The sphagnum moss may also in this case be considered only as a filler, while the remaining peat substances, as for instance, eriophorum, heather, and carex, contain more or less of fibrous material, which contributes to the strength of the paper. Lumps without structure may be noticed, which, no doubt, originate from peat. These have no value, only making the paper dark and rendering the bleaching more difficult.

B. Pasteboard from the same place seems to be of the same composition as the above, the difference being so little that it is not worth while referring to it.

In 1902 a banker—Mr. Jellinks—and a few others started to manufacture paper at the factory in Admont, situated high up in the Steiermarks Alps. At the beginning the work was performed in an honourable manner, but later on it was in operation only when the shareholders were expected to visit the plant. In 1904 it ended disastrously and the bank lost over a million kronor.[1]

In 1907 Engineer Ludo Franz started the operations anew, but shortly after he also was obliged to give up.

The situation of the factory was unfortunately chosen. The bog contained too little eriophorum peat. It was calculated that the wasted peat could be used as fuel, but on account of the heavy rainfall the drying was not successful. Lignite also proved to be an expensive fuel, but it was cheaper than using peat, even the peat litter factory employed lignite as fuel.

V. Thin paper, manufactured in October, 1897, by the firm, Karl A. Zschorner & Company, Vienna, contained, according to printed statements, 75 per cent of peat. It had a tensile strength of 10 English pounds, had a weight of 105 grams per metre, and was 0·13 mm. thick.

[1] 1 krona = 27 cents.

The quantity of sphagnum moss is considerable, leaves mainly occur, which are usually disintegrated and dark in colour. It may be noticed that the peat has not been fully humified; the particles of stems are rare, and when found the layer of bark structure is lacking.

Eriophorum occurs in a considerable amount. It is found partly as hyaline, epidermic, wavy-shaped cell walls, partly flat and sometimes in strips. The fibres are of a brownish colour, and when enlarged 80 times it may be noticed that they are of a spiral shape and striped in a longitudinal direction with plainly visible cell walls at the ends.

The additional wooden substance is stated to be 25 per cent, but it seems to vary in different samples, sometimes being more. An inconsiderable quantity of pine and spruce pollen, heather-bark, leaves of mosses, and single, fine roots of carex is to be found.

Some of the paper is coloured in different shades: reddish, blue-grey, brown and yellow-brown; the two first mentioned colours have been exposed to daylight (not sun) which made them fade on the outside.

Concerning the strength, it is, as mentioned above, only 10 English pounds, while the Munksjo pasteboard of the same weight has a strength of 60–65 English pounds. It is doubtful for what purpose this paper could be employed, as it is unsuitable for wrapping paper.

Zschörner started his manufacturing in 1895. He and two other manufacturers exhibited samples of peat paper at the World's Exhibition in Paris. Shortly after the firm became bankrupt and the two other manufacturers also failed during the same year.

VI. Finally, I have also investigated a paper of English manufacture. The samples received here consisted of a series of postcards, partly coloured and partly autotyped. The paper is loose and of the same grey-brown colour as the Admont paper. For this reason, the heading stating that the paper was manufactured from the old Irish soil from peat out of the Allan bog, could easily be believed. However, despite several investigations made by me, I was unable to find any peat substance in the paper. Usually all the samples from the other manufacturers contained considerable quantities of sphagnum moss, at least some vegetable substance was shown. Wooden and cotton fibres were principally found, consequently there is no peat, either as filler or fibre. If some of the dark, structureless lumps originate from intermixed peat, it could only add to the colouring of the paper; for the rest, the heading "Peat paper" is a fraud.[1]

Besides the above-mentioned experiments, several other attempts have been made to manufacture peat paper, but they are of little interest, as the manufacturing was never carried past the experimental stage.

The first on record was in 1772, when a German clergyman, J. C. Shaffer, "Doctor der Gottesgelahrtheit und Weltweisheit," gave an account of an attempt to manufacture paper out of peat.

In 1906 and 1907 this was a live question in Sweden; numerous investigations of peat were made in different parts of the Province of Småland.

This work was carried on very secretly and it was supposed that an English-American Syndicate was behind it. Eriophorum bogs were looked for; the author of this article was also asked to investigate some bogs in the Varnamo district. As the results were dependent on the amount of eriophorum the bogs contained, I wish to refer you to some of the following investigations.

During the investigations, it was shown that it was impossible to obtain by drilling, satisfactory results concerning the percentage of Eriophorum, even if 4–5 holes were drilled in a surface of 3 square metres. Sometimes a hole would be put down in the centre of an eriophorum knoll and the drill would be filled with eriophorum. Sometimes it would be put down on the side of a knoll and tear a part of it, which came out with the drill. Ditches were dug instead, and from these walls sections were taken, which were, for practical reasons, not more than 2 decimetres square. The fibres were afterwards assorted by hand and weighed. A few results are given below.

Profile I. A column of peat, 4 decimeters square at the bottom, was divided in pieces. All noticeable fibres were assorted as carefully as possible, and dried in a drying oven, and the attached sphagnum moss discarded by rubbing in the hands and sifting. If any sphagnum moss was left, it did not affect the results, because through sifting a few fibres were lost.

0–20 cm. contained partly unhumified bast.	Weight of peat	10·5	grammes.
	humified fibre	97·3	"
20–60 cm. clean, beautiful fibre		57	"
60–80 cm. " "		98·5	"
80–110 cm. " "		38·8	"
	Total	302·1	grammes.

A column of one metre deep contains $10/11 \times 302{\cdot}1 = 274{\cdot}6$ grammes fibre, and if the area is 1 decimetre square 68·7 grammes, or per cubic metre, 6·87 kilograms.

Each hectare[2] of 1 metre's depth contains 68·7 tons eriophorum fibres.

Profile II. Investigated the same way as above:—

0– 20 cm	90	grammes air-dried fibre.
20– 65 cm	123·9	" "
65–100 cm	64	" "
Total	277·9	grammes air-dried fibre.

[1] A short time ago Dr. Hallessy of the Irish Geological Survey stated in a letter to the Director, H. v. Feilizen, that the manufacture of peat paper was discontinued 4 years ago. This will explain why the addition of peat in the paper is doubtful.

[2] 1 hectare = 2·47 acres.

According to the same calculation, one hectare[1], with one metre's depth, contains 69·5 tons o air-dried fibre.

The depth of the peat layer was 1·8 metres.

PROFILE III.

0– 10 cm. unhumified fibre	4·1	grammes	air-dried.
10– 30 cm. fibre	76·2	"	"
30– 60 cm. fibre	104·0	"	"
60–110 cm. fibre	85·9	"	"
Total	270·2	"	"

This territory contains 61·5 tons of fibre per hectare[1], 1 metre deep.

As the samples were taken from different places, the figures ought to give a good representation of the quantity of eriophorum in a very large Smålandish peat litter bog (peat litter = unhumified sphagnum).

The contents of clean and beautiful unhumified eriophorum are not so scarce, but calculating that 1 cubic metre of air-dried peat weighs 80 kilograms (1 kilogram = 2·2 lbs.), then the content of eriophorum is not more than 8 per cent, which has to be assorted out of 800 tons sphagnum moss.

The surface of the bog was fairly rich in growing eriophorum. It may be calculated that one knoll will produce 25 grammes of bast, and 12–16 knolls were observed on 1 square metre. However, there were large mire holes without eriophorum, so that the average will be about 6 knolls; consequently, 60,000 knolls per hectare[1], or 15 tons of air-dried fibres. It is true that in the west of Sweden very deep layers of eriophorum fibres occur, which are comparatively free from sphagnum moss, but it is more ripe and requires additional labour and expense in order to get rid of the humified particles, therefore, this kind of peat is out of the question.

From the above description it will be understood that sphagnum moss is hardly suited to the paper industry, even as a filler, and it is too expensive to make clean eriophorum fibre, which has the same strength as the wooded substance.

This question has been taken up, with several intervals, since 1700. Even although it is quiet at present we shall hear about it before long.

[1] 1 hectare = 2·47 acres.

PART II.

INVESTIGATIONS OF CANADIAN PEAT BOGS.

The method of investigation has already been described in Bulletins 1 and 4.

ONTARIO.

Description of the Holland Peat Bog.

This bog is situated immediately east of Bradford, in West and East Gwillimbury and King townships, Simcoe and York counties, Ontario; and runs in a north and south direction (See Map No. 113), covering more or less of:—

Lots	34-35	cons.	VI,	township	King.
"	33-35	"	VII,	"	"
"	2- 7	"	I,	"	West Gwillimbury.
"	3- 7	"	II,	"	" "
"	7-14	"	III,	"	" "
"	12-16	"	IV,	"	" "
"	13-17	"	V,	"	" "
"	17-18	"	VI,	"	" "
"	17-18	"	VII,	"	" "
"	18-19	"	VIII,	"	" "
"	19-23	"	IX,	"	" "
"	21-23	"	X,	"	" "
"	22-24	"	XI,	"	" "
"	22-24	"	XII,	"	" "
"	23-24	"	XIII,	"	" "
"	3-11	"	I,	"	East Gwillimbury
"	7-14	"	II,	"	" "
"	11-14	"	III,	"	" "
"	14	"	IV,	"	" "
"	8-16	"	III,	"	" "
"	10-26	"	II,	"	" "
"	22-40	"	I,	"	" "
"	122-135	"	I,	"	" "

The total area covered by this bog is approximately 14,641 acres. Of this area:—

9,030 acres have a depth of less than 5 feet, average depth of 3′-0′ approximately.

4,025 acres have a depth of 5 feet to 10 feet, average depth of 7′-0″ approximately.

1,025 acres have a depth of 10 feet to 15 feet, average depth of 11′-0″ approximately.

506 acres have a depth of 15 feet to 25 feet, average depth of 20′-0″ approximately.

The volume of the peat contained is:—

43,705,200	cub. yds.	in an area with depth	of less than 5 feet.
45,455,537	cub. yds.	" "	5 feet to 10 feet.
18,104,574	cub. yds.	" "	10 feet to 15 feet.
16,326,933	cub. yds.	" "	15 feet to 20 feet.

That portion of the bog lying between King and Broad creeks, and to the north of King creek, on the eastern shore of the Holland river, is very well suited for the manufacture of machine peat. It is well humified, has a satisfactory depth, and a level and smooth surface, and can be worked along a line of about 1 mile long, each way. This part of the bog has a higher average depth than the rest, with a lower ash content, and a higher calorific value (See analyses Table III). The peat of the remainder of the eastern portion of the bog, and that portion of the western part lying south of the Grand Trunk railway in the townships East and West Gwillimbury, is fairly well humified, and with proper treatment, this part of the bog can be utilized for the manufacture of peat fuel: as, however, the average depth is not more than 5 feet, it would require a considerable area to produce a large output; since it would necessitate frequent moving of the machinery, and of the transportation appliances; entail loss of time and labour, and consequently, increase considerably the cost of the fuel.

The southern part of the bog consists mainly of carex, and the remains of grasses, which to a certain extent—in some places—are intermixed with sphagnum. In the northern part of the bog hypnum is occasionally found; while the bottom layer of the bog is intermixed with aquatic plants. Several hundred feet on each side of the Holland river the bottom formation is from 1 to 2 feet deep, formed of mire, or mud, which is intermixed with shells, insects, seeds, nuts, and sand, washed from the hard ground down the stream into the river.

The northern part of the bog is shallow, and less decomposed. Very little of this part of the bog could be worked with machinery, but a portion could be utilized for domestic purposes by cutting the peat by hand; while the remainder could be used for agricultural purposes.

A thorough drainage of this bog will involve a large expenditure of money, on account of its low situation, and due to the fact that it is flooded in the springtime; but considering the value of the land that could be recovered, land which at present is practically useless, or of a low value, and taking into account the improvement that would result to the surrounding farming land in consequence of the drainage, the undertaking would eventually be a paying proposition. Special areas for manufacturing peat fuel could be laid out, and the surface of these drying fields could be drained by pumping the water from the main ditches into the river. This would involve extra expense.

The surface of the outside edges of the bog is absolutely free from trees, and the peat is practically free from logs, roots, and stumps.

Deducting the 9,030 acres with a depth of less than 5 feet, and allowing for the decrease in depth through the drainage, we have left:—

4,025 acres, with an average depth of approximately 5 feet.
1,025 acres, with an average depth of approximately 9 feet.
506 acres, with an average depth of approximately 18 feet.

Having a total volume of 61,641,981 cubic yards.

Allowing that one cubic yard of the drained bog would furnish 200 pounds of dry peat substance, the total tonnage of dry substance available would be 6,164,198 tons of 2,000 pounds, or, 8,218,931 tons of peat fuel, having 25 per cent moisture.

TABLE III.

Analyses of Peat.

(Absolutely Dry.)

Volatile matter.....	59·5	63·2	63·4	64·3	59·6	64·6	66·8	63·5	65·0	65·4	53·0
Fixed carbon.....	21·2	24·6	23·0	23·5	23·1	20·2	24·2	26·2	24·5	24·1	18·5
Ash.....	19·3	12·2	13·6	12·2	17·3	15·2	8·8	10·1	10·5	10·5	28·5
Phosphorus.....	.....	0·050	.....	.....	0·69	.....	.....	0·67	.....	.....	0·147
Nitrogen.....	.....	2·7	.....	.....	2·3	.....	.....	2·7	.....	.....	2·5
Calorific value B.T.U. per lb.	7610	8350	8080	8390	7790	7950	8380	7980	8250	8510	6720

The content of ash in some cases is very high; but in some parts of the bog this is not excessive, and the calorific value is satisfactory.

The bog is very well situated both as regards shipping facilities and market, being only about 42 miles from Toronto. The Grand Trunk railway crosses the bog in the middle, while the Canadian Pacific railway passes it on the south side.

TABLE IV.

Investigated Peat Bogs in Ontario, during 1908-9-10, and 11 (See Map No. 152).

The names of the peat bogs.	Locality.		Approximate total area.	Volume of workable peat.			Partial analyses of absolutely dry peat.				Remarks.
	County.	Township.		Tons of fuel with contents 25% moisture.	Tons of litter with contents 20% moisture.	Cubic yards.	Fixed carbon %	Volatile matter %	Ash %	Calorific value.	
Mer Bleu	Russell	Gloucester and Cumberland.	5,004	5,125,665	.....	38,442,494	25·00	68·40	6·60	9126	Principally formed of sphagnum.
Alfred	Prescott	Alfred and Caledonia.	6,800	9,369,360	.....	70,270,200	26·56	68·13	5·31	8730	Principally formed of sphagnum.
Welland	Welland	Wainfleet and Humberstone.	4,900	4,106,197	.....	30,796,480	24·28	70·53	5·19	8667	Formed of hypnum, eriophorum, and sphagnum.
Newington	Stormont	Osnabruck, Roxborough, and Cornwall.	3,800	6,208,864	.....	46,566,478	26·27	67·07	6·66	8465	Principally formed of sphagnum.
Perth	Lanark	Drummond	3,800	5,126,030	.....	38,445,222	24·60	71·51	3·89	9148	Formed of sphagnum, hypnum, and eriophorum.
Victoria Road	Victoria	Bexley and Carden.	67	53,659	.....	402,441	25·18	69·52	5·30	8649	Principally formed of hypnum mixed with sphagnum.
Brunner	Perth	Ellice	2,288	1,172,130	.....	8,790,979	25·16	64·09	10·75	8850	Principally formed of hypnum.
Komoka	Middlesex	Caradoc and Lobo	900	253,831	.....	1,903,733	18·52	60·90	20·58	7490	Formed of remains of sphagnum and carex.
Brockville	Leeds	Elizabethtown	1,400	1,694,129	.....	12,705,969	21·75	66·70	11·75	8173	Formed of remains of sphagnum and carex.
Rondeau	Kent	Harwich	1,571	1,047,544	.....	7,856,581	22·90	61·00	16·10	7914	Principally formed of carex.
Holland	Simcoe and York.	West and East Gwillimbury and King.	14,641	8,218,931	.....	61,641,981	26·20	63·50	10·50	8510	Principally formed of carex.
Coney Island	Coney Island	Lake of the Woods.	25	32,267	.....	242,000	.....	.....	.....	.....	Principally formed of sphagnum.
Crozier	Rainy River district.	Crozier	355	.....	518,291	6,912,223	.....	.....	.....	.....	Principally formed of sphagnum.
Fort Francis	Rainy River district.	McIrvine and Crozier.	1,700	891,205	.....	6,684,040	28·9	62·4	8·7	8910	Principally formed of sphagnum.
		Total	47,251	43,299,812	518,291	324,748,598					

MANITOBA.[1]

Lac du Bonnet Peat Bog.

This bog is situated about 60 miles east of Winnipeg, or 4 miles west from Lac du Bonnet, Manitoba, east of the principal meridian (See Map No. 157), and covers more or less of section 35, township 14, range 10, and section 2, township 15, range 10. The total area covered by this bog is approximately 249 acres.

180 acres have a depth of less than 5′–0″, average depth 2′–5″.
69 acres have a depth of less than 10′–0″, average depth 5′–0″.

The volume of the peat contained is:—

In an area with a depth of less than 5′–0″, 701,800 cubic yards.
" " more than 5′–0″, 556,600 "

The peat in the middle part of the bog is fairly well humified, but is of poor quality, on account of the fact that the bog, in its beginning, had not a great depth and was poorly drained, so that the frost penetrated deep into the bog; hence the peat, in most places, has lost its cohesive properties. The area of the middle part of the bog is comparatively small, and since it is cut up by ditches, unsystematically laid out, it is not likely that it can be used for the manufacture of machine peat fuel.

The peat in the rest of the area around the margin of the bog is very shallow, and heavily overgrown with alder and spruce, intermixed, in some parts, with balsam and young poplar.

After the bog is thoroughly drained the peat will probably settle down about one foot. (This is less than the average bogs settle; on account of the fact that the bog is already partly drained). Deducting from this the 180 acres which have an average depth of about 2′–5″, and allowing for the decrease in depth through drainage, we have left 69 acres with an average depth of approximately 4 feet, having a total volume of 445,280 cubic yards of peat.

Supposing that one cubic yard of the drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry peat substance available is 44,528 tons—of 2,000 pounds—or 59,371 tons of peat fuel, with 25 per cent moisture.

This bog is principally formed by sphagnum moss, and in some parts carex may be found, except around the margin, where the peat is mixed with other aquatic plants. In some parts of the bog there are stumps and trunks.

Analysis of peat (absolutely dry).

Fixed carbon	25·0	per cent.
Volatile matter	59·4	"
Ash	15·6	"
Nitrogen	1·4	"
Phosphorus	0·069	"
Carbon-hydrogen ratio	0·42	"

The surface of the bog has been burned over, which accounts for the fact that the content of ash is comparatively high, while the calorific value is satisfactory. By a systematic and thorough drainage of this bog, a

[1]The investigations in Manitoba were conducted with the able assistance of Messrs. H. A. H. Robinson, J. H. Hooper, and H. J. Collier.

considerable amount of farming land would be recovered, which at present is practically valueless. This bog is traversed by the Canadian Pacific railway. It is held under lease by the Inter-west Peat Fuel Company, Winnipeg, Manitoba, which, some years ago, erected a plant to manufacture peat briquettes. The result must have been unsatisfactory, since no work has been done for the last two years. Several tons of briquettes were made, but after a short time the work was discontinued. Part of the machinery was removed, the remainder being left on the ground.

Transmission Peat Bog.

This bog is situated about 18 miles from Point Dubois, Manitoba, east of the principal meridian (See Map No. 158), and covers more or less of sections 19-21, township 15, range 12; sections 28-30, township 15, range 12.

The total area of this bog investigated is, approximately, 1,375 acres. The above area has a depth of less than 5 feet.

The volume of peat contained is:—

In an area with a depth of less than 5′–0″, 10,648,888 cubic yards.

This bog is mainly formed by sphagnum moss, intermixed with carex, aquatic plants, leaves, spruce cones and needles, sticks, roots, and trunks.

This bog is comparatively shallow, and the peat poorly humified, and of an inferior quality, hence it can be expected to yield only a very light fuel. However, it is not likely that this bog can be utilized and turned into machine peat by methods at present known.

The surface of the bog is heavily wooded with spruce, poplar, alder, and other soft wood trees.

If, however, the surface were cleared from wood, the above-mentioned bog could be utilized, and peat manufactured for domestic purposes, then we would have, allowing for the decrease in depth through drainage, 1,375 acres, with an average depth of approximately 3′–4″, or 7,022,840 cubic yards of peat. Assuming that one cubic yard of the drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry substance available is 702,284 tons—of 2,000 pounds—or 936,379 tons of peat fuel, with 25 per cent moisture.

Analysis of peat (absolutely dry).

Volatile matter	56·8	per cent.
Fixed carbon	24·2	"
Ash	19·0	"
Nitrogen	1·6	"
Phosphorus	0·047	"
Fuel ratio, fixed carbon—volatile matter	0·43	"

If the bog was thoroughly and systematically drained, the land could be recovered and utilized for agricultural purposes; at present it is practically valueless.

The City of Winnipeg Power Construction railway passes through the middle of the bog.

Corduroy Peat Bog.

This bog is situated about 14 miles from Point Dubois, Manitoba, east of the principal meridian (See Map No. 159), and covers more or less of section 25, township 15, range 12. The total area covered by this bog is approximately 100 acres, with an average depth of 4 feet.

The volume of peat contained is:—

In an area with a depth of 4 feet, 649,037 cubic yards.

Allowing for the decrease in depth through drainage, we have left a total volume of 322,666 cubic yards peat. Calculating that one cubic yard of such drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry peat substance available is 32,267 tons—of 2,000 pounds—or 43,023 tons of peat fuel with 25 per cent moisture.

The peat is mainly formed of sphagnum moss, intermixed with other aquatic plants. It is poorly humified and is not suitable for the manufacture of machine peat fuel, as the area is comparatively small and shallow. Not much will be gained by a systematic drainage, as the surrounding ground is of rocky formation and could not be used for agricultural purposes. This peat bog is, therefore, practically valueless.

Boggy Creek Peat Bog.

This bog is situated 12 miles from Point Dubois, Manitoba, east of the principal meridian (See Map No. 160) and covers more or less of:—

Section 24, township 15, range 12.
" 19 " 15 " 13.
" 24 " 15 " 13.
Sections 29-32, township 15, range 13.

The total area covered by this bog is, approximately, 661 acres of the following depth:—

216 acres have a depth of less than 5 feet, average depth: 4′-0″.
406 " " " 10 " 7′-8″.
39 " " more than 10 " 10′-8″.

The volume of the peat contained is:—

In an area with a depth of less than 5 feet, 1,372,592 cubic yards.
" " 5 to 10 feet, 5,021,769 cubic yards.

More than 10 feet, 671,147 cubic yards.

This bog is principally formed by carex, and the remains of grasses and aquatic plants; in some parts eriophorum may be found. The peat is fairly well humified, hence by thorough and careful drainage it would furnish a fairly good but light fuel.

In some parts of the bog the surface is heavily grown over with young spruce and alders, and around the margin poplar and jack-pine occur.

The so-called 'Boggy creek' runs through this bog in a south and north direction.

The bog is well situated as regards transportation facilities, since the middle part is traversed by the City of Winnipeg Construction railway.

Deducting the 216 acres with a depth of less than 5 feet, and allowing for the decrease in depth through the drainage, we have left:—

406 acres with an average depth of, approximately, 5′-8″.
39 " " " 8′-8″.

with a total volume of 4,257,049 cubic yards of peat.

Assuming that one cubic yard of such drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry substance available is 425,705 tons of 2,000 pounds, or 567,607 tons of peat fuel, with 25 per cent moisture.

Analyses of peat (absolutely dry.)

	No. 1.	No. 2.
Volatile matter	65·0 per cent	53·0 per cent.
Fixed carbon	26·7 "	18·4 "
Ash	8·3 "	28·6 "
Nitrogen		2·5 "
Phosphorus		0·060 "
Calorific value: in calories per gram	4850	
in B.T.U. per lb	8730	
Fuel ratio, fixed carbon—volatile matter	0·41	0·35

The content of ash is not excessive, and the calorific value about satisfactory.

Rice Lake Peat Bog.

This bog is situated about 7½ miles from Point Dubois, Manitoba, east of the principal meridian. It is traversed at the south end of Rice lake by the City of Winnipeg Construction railway, and covers more or less of:—

Section 25, township 15, range 13,
" 26, " 15, " 13.

This bog has a very small area (See Map No. 161), consisting of a comparatively narrow strip surrounding the lake. The peat is poorly humified, ununiform in quality, and cannot be used for the manufacture of peat fuel.

Analyses of peat (absolutely dry).

	No. 1.	No. 2.
Volatile matter	34·8 per cent	51·1 per cent.
Fixed carbon	9·1 "	17·1 "
Ash	56·1 "	31·8 "
Nitrogen	1·75 "	2·35 "
Phosphorus	0·052 "	0·093 "
Fuel ratio, fixed carbon—volatile matter	0·26 "	0·33 "

The above analyses show the high quantity of ash.

The peat is chiefly formed by sphagnum and wild rice, intermixed with carex and other aquatic plants.

Mud Lake Peat Bog.

This bog is situated about 3 miles from Point Dubois, Manitoba, east of the principal meridian (See Map No. 162), and covers more or less of:—

Section 28, township 15, range 14,
" 33, " 15, " 14.

The total area covered by this bog is, approximately, 139 acres.

This area has an average depth of 9 feet. The volume of peat contained is 2,011,667 cubic yards.

The peat is fairly well humified and uniform in quality, and, with proper treatment, can be used for the manufacture of peat fuel on a small scale; but the finished product will be comparatively light. The surface of the bog is partly grown over with spruce and tamarack.

The peat, after the bog has been thoroughly drained, will probably settle down about 2 feet. Allowing for the decrease in depth through draining, we will have 139 acres with an average depth of, approximately, 7 feet, with a total volume of 1,564,629 cubic yards. Supposing that one cubic yard of such drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry peat substance available is 156,463 tons—of 2,000 pounds—or 208,617 tons of peat fuel, with 25 per cent moisture.

This bog is principally formed by sphagnum moss, and in some parts carex may be found. The bottom layers are intermixed chiefly with carex and other aquatic plants, and occasionally stumps and roots may be found.

Analysis of peat (absolutely dry):

Fixed carbon	23·2	per cent.
Volatile matter	69·1	"
Ash	7·7	"
Nitrogen	1·5	"
Calorific value—in calories per gram	4870	
" —in B.T.U. per lb	8760	
Fuel ratio, fixed carbon—volatile matter	0·34	

The content of ash is not excessive, and the calorific value about satisfactory.

The bog is advantageously situated as regards shipping facilities, being traversed by the City of Winnipeg Construction railway.

Litter Peat Bog.

This bog is situated 2 miles from Point Dubois, Manitoba, east of the principal meridian (See Map No. 163), and covers more or less of:—

Section 33, township 15, range 14.
" 34, " 15, " 14.
" 3, " 15, " 15.

The total area covered by this bog is, approximately, 110 acres. The peat consists of two kinds: peat litter and peat fuel, which are described separately as follows:—

A. PEAT LITTER.

This part of the bog covers more or less of:—

The north part of the southwest quarter section of section 34, township 15, range 14.

The middle of the northwest quarter section of section 34, township 15, range 14.

The south part of the southwest quarter section of section 3, township 15, range 15.

The total area covered by this part of the bog is, approximately, 82 acres. Of this area:—

40 acres have a depth of less than 15 feet, average depth: 10 feet,
42 acres have a depth of more than 15 feet, average depth: 15 feet.

The volume of the peat contained is:—

In an area with a depth of less than 15 feet, 645,333 cubic yards.
" " more than 15 feet, 1,019,462 "

The peat in this part of the bog, especially north of the small pond shown on the map, is not humified, and will produce a very good peat litter.

The upper layers of the part of the bog located in the middle of the northwest quarter section of section 34, township 15, range 14, are comparatively free from humus, and a first class litter may, therefore, be expected.

Allowing for the decrease in depth through drainage, we shall have:—

40 acres, with an average depth of 8 feet, approximately.
42 acres, with an average depth of 13 feet, approximately.

With a total volume of 1,389,739 cubic yards of peat litter.

Calculating[1] that one cubic yard of such bog will furnish about 120 pounds of dry peat substance, the total tonnage of dry peat litter substance available is 83,384 tons—of 2,000 pounds—or 104,230 tons of peat litter, with 20 per cent moisture.

The bog consists of a comparatively deep basin, and the peat contained in this part of the bog is well suited for the production of peat litter.

The peat is principally formed by sphagnum moss, with the exception of the bottom layer, in which typical aquatic plants are found. The surface of the bog is partly wooded with young spruce and tamarack, and around the margin jack-pine is occasionally found. This part of the bog is free from roots and trunks. The bottom of the bog is chiefly a compact, blue clay, but in some cases rock is found.

Analyses of peat litter (absolutely dry).

	I.	II.
Nitrogen	1·35 per cent.	
Phosphorus	0·030 "	0·041 per cent.
Weight of water absorbed by one part by weight of dry peat	$4\frac{3}{4}$	$5\frac{3}{4}$ "

The absorption capacity is about satisfactory.

The south end of this bog is traversed by the City of Winnipeg Construction railway.

B. PEAT FUEL.

This part of the bog covers more or less of:—

The west part of the southwest quarter section of section 34, township 15, range 14; and

The east part of the southeast quarter section of section 33, township 15, range 15.

The total area covered by this part of the bog is, approximately, 28 acres.

[1] This figure is taken from an account of the experiments made at the peat litter bog which belongs to the Swedish Peat Society (called the experimental station at Flahult) and gives the following: 83 kilograms approximately of dry peat litter substance are obtained from 1 cubic metre of raw material, or 1 cubic yard equals 149 lbs. of peat litter, with 20% moisture.—From Supplement of the Swedish Peat Society Journal, No. 3, 1910, page 226, by Hjalmar von Feilizen.

This area has a depth of more than 5 feet, average depth 10 feet.

The volume of the peat contained is:—

In an area with a depth of more than 5 feet, 451,733 cubic yards.

The peat in this part of the bog is well humified and uniform in quality, and by laying out the working field carefully and with proper treatment this part of the bog can be used for the manufacture of peat fuel. In some parts the surface of the bog is grown over with young spruce.

After the bog has been thoroughly drained, the peat will probably settle down about 2 feet. Allowing for the decrease in depth through drainage, we have:—

28 acres with an average depth of approximately 8 feet, with a total volume of 361,387 cubic yards of peat fuel. Supposing that one cubic yard of such drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry peat substance available is 36,139 tons—of 2,000 pounds—or 48,173 tons peat fuel, with 25 per cent moisture.

This part of the bog is principally formed by sphagnum moss. No. stumps or roots were found during our drilling for samples.

Analysis of peat (absolutely dry).

Fixed carbon (by difference)	26·2	per cent.
Volatile matter	66·1	"
Ash	7·7	"
Sulphur	0·2	"
Nitrogen	1·55	"
Calorific value—In calories per gram	5050	
In B.T.U. per lb	9090	
Fuel ratio, fixed carbon—volatile matter.	0·40	

The content of ash is not excessive, and the calorific value is satisfactory.

The whole bog is favourably situated as regards transportation and market, being only 70 miles from Winnipeg.

Taking into consideration the above-mentioned peat litter and peat fuel bog, we find that it contains two kinds of material suitable for manufacturing purposes. If well humified peat fuel is to be found in that part of Manitoba, I would consider that more of the same kind of bogs may exist in the eastern district of the Winnipeg river. However, such investigations would take a very long time, as there is great difficulty in locating the bogs on account of the present sparsely settled condition of the country.

Julius Peat Litter Bog.

This bog is situated about 1 mile west of Shelley, Manitoba, east of the principal meridian, (See Map No. 164) and covers more or less of:—

Sections 34-35, township 11, range 10,
Sections 2-4, township 12, range 10,
Sections 9-11, township 12, range 10,
Sections 15-16, township 12, range 10.

The total area covered by this bog is, approximately, 3,896 acres. Of this area:—

996 acres have a depth of less than 5 feet, average depth 3′-8″,
1,954 acres have a depth of less than 10 feet, average depth 7′-8″,
946 acres have a depth of more than 10 feet, average depth 11′-4″.

The volume of the peat contained is:—
In an area with a depth of less than 5 feet, 5,756,091 cubic yards,
" " 5 to 10 feet, 21,329,339 cubic yards,
" " more than 15 feet, 17,297,084 cubic yards.

The peat located around the small pond shown on the map, and in the part of the bog which is located south of the Canadian Pacific railway —especially the upper layers, is comparatively free from humus, and would produce a fairly good peat litter. Nearer the margin of the bog the peat is more humified, and would give a poor peat litter.

Deducting the 996 acres with a depth of less than 5 feet, and allowing for the decrease in depth through drainage, we have left:—

1,954 acres, with an average depth of approximately 6 feet,
946 " " " 9 feet,

with a total volume of 32,651,756 cubic yards.

Assuming that one cubic yard of such bog will furnish 120 pounds dry peat substance, the total tonnage of dry peat litter substance available is 1,959,105 tons—of 2,000 pounds—or 2,448,881 tons of peat litter, with 20 per cent moisture.

The peat is principally formed by sphagnum moss, with the exception of that near the margin of the bog, where it is heavily intermixed with carex and other aquatic plants.

The surface of the southern part of the bog is heavily wooded with spruce, tamarack, poplars, alders, and other kinds of bushes. North of the Canadian Pacific railway the bog is less wooded, except around the margin. The bog is comparatively free from roots and trunks, and the bottom is chiefly clay; in some places marl, sand, and rock are found.

Analyses of peat litter (absolutely dry).

	III.	IV.
Nitrogen.....	1·0 per cent	
Phosphorus.....	0·028 "	0·057 per cent.
Weight of water absorbed by one part by weight of dry peat...	8	4½

Sample marked IV soaks up water notably faster than the other three samples.

The absorption capacity is about satisfactory.

The middle part of this bog is traversed by the Canadian Pacific railway. It is favourably situated in regard to transportation facilities and market, being only some 60 miles east from Winnipeg.

It is stated that the northern part of the bog is held under lease by the Peat Industries, Limited, Montreal, Que., and that this Company intends to erect, in 1912, an extensive peat litter plant.

Coney Island Peat Bog.

This bog is situated on Coney island, in the Lake-of-the-Woods, about 1 mile west of Kenora, Ontario. The total area covered by this bog is, approximately, 25 acres, with an average depth of 8 feet.

The volume of the peat contained is:—
In an area with a depth of less than 10 feet, 322,667 cubic yards.

The peat is fairly well humified, and uniform in quality, and can be used for the manufacture of peat fuel; but as the bog is comparatively small it is not likely that it could be profitably worked by machinery that would produce a large output.

The surface of the bog is comparatively dry, and the lower layers of the bog have settled compactly. Such bogs require very little drainage.

The peat bog, after it is drained, will probably settle down about one foot. Allowing for the decrease in depth through drainage, we have: 25 acres, with an average depth of approximately 6 feet, with a total volume of 242,000 cubic yards.

Assuming that one cubic yard of such drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry peat substance available is 24,200 tons—of 2,000 pounds—or 32,267 tons of peat fuel, with 25 per cent moisture.

This bog is principally formed by sphagnum moss; in some parts carex and aquatic plants occur, and occasionally stumps and roots may be found. The bottom of the bog is sand and rock.

Crozier Peat Bog.

This bog is situated about 6 miles southwest of Fort Francis, Ontario, in Crozier township, Rainy River district, and covers more or less of:—

Sections 5-8, Crozier township.

The total area covered by this bog is, approximately, 355 acres, and the depth is more than 10 feet—average depth 14 feet. The volume of the peat contained is:—

In an area with a depth of more than 10 feet, 8,062,963 cubic yards.

The peat is fairly free from humus and uniform in quality, and with proper treatment it can be used for the manufacture of a good peat litter.

After the bog is thoroughly drained, the peat will probably settle down about 2 feet. Allowing for the decrease in depth through draining, we have 355 acres, with a total volume of 6,912,223 cubic yards of peat. Assuming that one cubic yard of such drained bog will furnish 120 pounds of dry peat substance, the total tonnage of dry peat substance available is 414,733 tons—of 2,000 pounds—or 518,291 tons of peat litter, with 20 per cent moisture.

This bog is principally formed by sphagnum moss, the bottom layers are intermixed with aquatic plants and remains of carex.

Fort Francis Peat Bog.

This bog is situated about one mile west of Fort Francis, Ontario, in McIrvine and Crozier townships, Rainy River district (See Map No. 165) and covers more or less of:—

Sections 19-20, township McIrvine, Rainy River district,
Sections 29-30, " " "
Sections 24-25, township Crozier, Rainy River district.

The total area covered by this bog is, approximately, 1,700 acres.

Of this area:—

929 acres have a depth of less than 5 feet, average depth 3′-4″,
691 " " 10 " " 7′-0″,
86 " " more than 10 " " 10′-4″.

The volume of the peat contained is:—

In an area with a depth of less than 5 feet, 4,995,959 cubic yards,
" " 5 to 10 feet, 7,803,693 cubic yards,
" " more than 10 feet, 1,433,716 cubic yards.

The peat is fairly well humified and mainly formed by sphagnum moss, intermixed around the margin with aquatic plants and carex.

The middle part of this bog can, with proper treatment, be used for the manufacture of a fairly good peat fuel. In considerable areas around the margin of the bog, the peat is very shallow and heavily grown over with spruce and tamarack, intermixed, in some parts, with young poplar. The middle part is comparatively free from trees.

The peat, after the bog is thoroughly drained, will probably settle down about 2 feet. Deducting the 929 acres which have an average depth of about 3'-4", and allowing for the decrease in depth through drainage, we have left:—

691 acres with an average depth of approximately 5 feet,
86 acres with an average depth of approximately 8 feet,

with a total volume of 6,684,040 cubic yards of peat. Supposing that one cubic yard of such drained bog will furnish 200 pounds of dry peat substance, the total tonnage of dry peat substance available is 668,404 tons—of 2,000 pounds—or 891,205 tons peat fuel, with 25 per cent moisture.

Analysis of peat (absolutely dry).

Fixed carbon	28·9	per cent.
Volatile matter	62·4	"
Ash	8·7	"
Nitrogen	1·65	"
Calorific value—In calories per gram	4950	
In B.T.U. per lb	8910	
Fuel ratio, fixed carbon—volatile matter	0·40	

The content of ash is not excessive, and the calorific value about satisfactory.

In some parts of the bog the peat itself is mixed with small roots. Occasionally stumps and trunks are to be found.

The bog is very advantageously situated in regard to shipping facilities and market, being only 1 mile from Fort Francis and traversed on the south side by the Canadian Northern railway. It is held under lease by the Manitoba Peat Fuel Company, head office in Winnipeg, Manitoba. Some years ago this Company erected a plant and started to manufacture peat briquettes, but a few years later the plant was burned down; part of the machinery was removed, and the rest left buried in the ruins.

At intervals during the investigation of the bogs described above, several reconnaissances were made of the following bogs in different parts of the Province of Manitoba:—

TABLE V.

Peat Bogs Investigated in Manitoba during the year 1911 (See Map No. 153).

The names of the peat bogs.	Locality.		Approximate total area.	Volume of workable peat.			Partial analyses of absolutely dry peat.				Remarks.
	Townships.	Range.		Tons of fuel with contents 25% moisture.	Tons of litter with contents 20% moisture.	Cubic yards.	Fixed carbon.	Volatile matter	Ash	Calorific value.	
Lac du Bonnet..	14.....	10 E.....	249	59,371.....		445,280	25·0	59·4	15·6	.....	Principally formed by sphagnum.
Transmission...	15.....	12 E.....	1,375	936,379.....		7,022,840	24·2	56·8	19·0	.....	Principally formed by sphagnum and carex.
Corduroy.....	15.....	12 E.....	100	43,023.....		322,666	9·1	34·8	56·1	.....	Principally formed by sphagnum and aquatic plants.
Boggy Creek...	15.....	12-13 E.....	661	567,607.....		4,257,049	26·7	65·0	8·3	8730	Principally formed by carex
Rice Lake.....	15.....	13 E.....									
Mud Lake.....	15.....	14 E.....	139	208,617.....		1,564,629	23·2	69·1	7·7	8760	Principally formed by sphagnum.
Litter..... (Peat Litter.)	15.....	14 E.....	82	.....	104,230	1,389,739	.....	.....	.....	.....	Principally formed by sphagnum and carex.
Litter..... (Peat fuel.)	15.....	14 E.....	28	48,173.....		361,387	.....	.....	.....	.....	Principally formed by sphagnum.
Julius.....	11-12.....	10 E.....	3,896	.....	2,448,880	32,651,756	.....	.....	.....	.....	Principally formed by sphagnum.
		Total - - - -	6,530	1,863,170	2,553,110	48,015,346					

PEAT BOGS OF WHICH PRELIMINARY INVESTIGATIONS WERE MADE.

Whitemouth or Transcontinental Marsh.

This bog is situated east of the principal meridian, about 2 miles east of Whitemouth, Manitoba, and covers more or less of townships 4-13, ranges 11-14.

The total area covered by this bog is supposed to be approximately 200,800 acres, running in a north and south direction, between Winnipeg river and Whitemouth lake, and following the Whitemouth river on the east side.

The preliminarily investigated parts of the bog north of the Canadian Pacific railway cover approximately ..... 39,000 acres.
This area covers more or less of townships 11-13, ranges 11-13.
South of the Canadian Pacific railway the preliminarily investigated part covers approximately ..... 13,000 acres.
This area covers more or less of the north part of townships 10 and 11, ranges 12-13.
South of the Transcontinental railway the preliminarily investigated part covers approximately ..... 45,000 acres.
This area covers more or less of townships 9-10, ranges 13-14.

The total area preliminarily investigated covers approximately ..... 97,000 acres.

North of the Canadian Pacific railway the peat is formed of carex, remains of grasses and aquatic plants, slightly mixed with eriophorum and hypnum.

The middle part of the bog is of a considerable depth. The average depth around the margin is about 7 to 8 feet. Average depth of the middle part of the bog is about 11 to 12 feet.

A large area of the middle part of the bog is comparatively free from trees, nearer the margin it is very heavily wooded with spruce, tamarack, and other soft wood trees.

The peat in the region south of the Canadian Pacific railway is principally formed of carex and aquatic plants. This part of the bog is heavily wooded with spruce, tamarack, alders, and poplars. The surface has been burned over several times, which accounts for the fact that the bog is comparatively shallow. The average depth is about 4 to 5 feet.

In the region south of the Transcontinental railway the peat is formed of carex, remains of grasses and aquatic plants, and intermixed with small roots and undecomposed branches. This part of the bog is comparatively shallow and heavily wooded. The average depth varies from 2 to 5 feet. The bottom of the bog consists principally of a compact, blue clay; in some parts a sand bottom is found.

Under present conditions, the bog described above cannot very well be employed for the manufacture of peat fuel, or even peat litter, for the reason that the peat is not sufficiently humified for the former, and too

much humified for the latter. This condition is caused by the fact that the surface of the bog is flooded during most of the year, and the air has very little opportunity to come in contact with the vegetable substance, which prevents humification of the peat. However, if this enormous area were thoroughly drained, the peat in the middle of the region north of the Canadian Pacific railway would rapidly humify, and could be utilized for the manufacture of a fairly good peat fuel.

Analysis.

Fixed carbon	25·7 per cent.
Volatile matter	58·9 "
Ash	15·4 "
Calorific value—In calories per gram	4510
In B.T.U. per lb	8110
Fuel ratio, fixed carbon—volatile matter	0·44

Such drainage would undoubtedly involve, under present unsettled conditions of the country, a great expenditure of money; but, considering the value of the land that would be recovered for agricultural purposes, land which at present is practically valueless, and taking into account the improvement which would result in the surrounding farming land, consequent upon this drainage, the undertaking would eventually be a paying proposition.

Plum Marsh.

This marsh is situated east of the principal meridian, about 1½ miles southwest of Whitemouth, Manitoba, and covers more or less of townships 10-11, range 11. The total area covered by this marsh is, approximately, 9,000 acres.

The peat is formed of carex, remains of grasses, and aquatic plants, and is of inconsiderable depth, the average varying from 2 to 4 feet.

The surface of this marsh is heavily wooded with spruce, tamarack, alders, and poplars, and a considerable area is flooded during the greater part of the year.

The material in this marsh is not suitable for the manufacture of peat fuel or peat litter, but after this area is properly drained the land will eventually be recovered for agricultural purposes.

Netley Marsh.

This marsh is situated east of the principal meridian, about 1½ miles from Netley, Manitoba, and covers more or less of townships 15-16, ranges 4-6. The total area covered by this marsh is, approximately, 25,000 acres.

The peat is principally formed of carex, grasses, and aquatic plants, and most of it is intermixed with siliceous shells, mollusk excrements, shell fish, and mussels. This marsh is comparatively shallow, the average depth varying from 2 to 5 feet. A considerable portion of this area is flooded for the greater part of the year and the surface is covered with water from 1 to 2 feet deep. When the wind blows from the north, from Lake Winnipeg, the surface is flooded to a depth of from 2 to 4 feet. At present, the northern part of the bog—around the west, middle, and east channels—is used for hunting grounds; the southern part is utilized for growing hay.

Clandeboye Marsh.

This marsh is situated east of the principal meridian, about 4 miles west of Clandeboye, or about 9 miles from Selkirk, Manitoba, and covers more or less of townships 13-16, range 3. The total area covered by this marsh is, approximately, 27,000 acres.

The peat is formed principally of prairie grass, carex and aquatic plants, intermixed with shells. This marsh is very shallow, averaging in depth from 2 to 5 feet, and is not suitable for the manufacture of peat fuel or peat litter; but, by a thorough drainage of this area, valuable land could be recovered and utilized for agricultural purposes.

Big Grass Marsh.

This marsh is situated west of the principal meridian, about 2 miles from Gladstone, Manitoba, and covers more or less of townships 15-18, ranges 10-11. The total area covered by this bog is, approximately, 50,000 acres, varying in depth from 1 to 4 feet. Part of this area is cultivated, around the margin.

The peat is formed principally of carex and aquatic plants; hypnum and sphagnum are found occasionally; and it is heavily intermixed with diatomaceous, siliceous shells, mollusk excrements, and shell fish, which also form the bottom of the marsh, covering it with a layer from one to several feet deep.

Some parts of the marsh are flooded during the greater part of the year.

The Manitoba Government is dredging a trench through the bog in a north-south direction. Such drainage will undoubtedly involve a great expenditure of money, but, considering the valuable agricultural land which would be recovered, which at present is practically valueless, this undertaking would in a short time be a paying proposition.

Analysis.

Fixed carbon	9·9 per cent.
Volatile matter	43·4 "
Ash	46·7 "
Nitrogen	1·95 "
Phosphorus	0·081 "
Fuel ratio, fixed carbon—volatile matter	0·23 "

Douglas Peat Bog.

This bog is situated west of the principal meridian, about 13 miles east of Brandon, or half a mile from Douglas, and covers more or less of townships 9-11, ranges 15-17. The total area covered by this bog is, approximately, 13,000 acres.

The peat is formed principally of carex and the remains of prairie grass. The layer of the peat varies in depth from 1 to 4 feet; it is poorly humified and can not be used as peat fuel or litter. The surface of this bog is comparatively dry and the fields around the margin are used as hay land. By thoroughly draining this area, which could be done comparatively easily, valuable agricultural land would be recovered.

McCreary Marsh.

This marsh is situated west of the principal meridian, about 4 miles east of McCreary, Manitoba, and covers more or less of townships 20-21, ranges 14 and 15. It is more like a large slough and is very shallow, the average depth varying from 1 to 3 feet.

To use this land profitably, it would have to be thoroughly drained. At present some of the area is practically valueless and some of it is used as hay land.

Ochre River, or Turtle Marsh.

This marsh is situated west of the principal meridian, south of Dauphin lake, or about 6 miles northeast of Ochre river, Manitoba, and covers more or less of township 24, ranges 15 and 16. The total area covered by this marsh is, approximately, 9,000 acres.

The peat is formed of Carex, remains of prairie grasses, aquatic plants, intermixed with diatomaceous insects and shell fish, washed in from the lake. This marsh is shallow, and is not suitable for the manufacture of peat fuel or litter; but by a thorough drainage the southern part of this area could be recovered and utilized for agricultural purposes.

Dauphin Marsh.

This marsh is situated west of the principal meridian and west of Dauphin lake, Manitoba, and covers more or less of townships 25-27, ranges 17-18. The total area covered by this marsh is, approximately, 6,000 acres.

The peat formation is similar to that in the Ochre River marsh, being composed of the same vegetation.

The general conclusions drawn from this preliminary investigation of the peat bogs described are, that they are either too shallow, or are composed of material unsuitable for the manufacture of peat fuel or peat litter. By draining thoroughly, however, these enormous areas can be economically recovered, and thus become valuable for use as agricultural land.

TABLE VI.

Preliminarily Investigated Peat Bogs in Manitoba during the year 1911. See Map No. 153.

The names of the bogs.	Locality.		Approximately total area.	Remarks.
	Township.	Range.		
Whitemouth	4–13	11–14E	97,000	Principally formed by carex and aquatic plants.
Plum	10–11	11E	9,000	Principally formed by carex and aquatic plants.
Netley	15–16	4–6E	25,000	Principally formed by carex and aquatic plants.
Clandeboye	13–16	3E	27,000	Principally formed by carex and aquatic plants.
Big Grass marsh	15–18	10–11W	50,000	Principally formed by carex and aquatic plants.
Douglas	9–11	15–17W	13,000	Principally formed by carex and remains of prairie grass.
McCreary	20–21	14–15W	.....	
Ochre River	24	15–16W	9,000	Principally formed by carex and remains of prairie grass.
Dauphin	25–27	17–18W	6,000	Principally formed by carex and remains of prairie grass.
		Total areas =	236,000	

APPENDIX I.

PEAT POWDER.

The Plant for Manufacturing Peat Powder at Bäck.

E. Nyström.

Jernkontorets Peat Engineer.

The works are situated at the Bäck peat bog, near Bäck station, 12 km. south of Ljungby. They are owned by Aktiebolaget Torf, under the management of Lieutenant H. Ekelund, who has planned and worked out the method.

It is evident that a new method of manufacturing with suitable machinery and plans can only become perfected gradually, which is the case here, so that the results of the tests given later should not be considered as final results, since they no doubt will improve with the application of further experience and improvements. At the present time the works have not a sufficient amount of power for the work either on the bog or at the factory; consequently when they are in operation at the same time, it is impossible to run the plant at its full capacity.

Manufacturing of Raw Material.

The bog has an area of 125 hectar and an average depth of 2·5–3 meters after draining. The bottom is composed of a firm sand and is very even. At the border the peat is very well humified, but in various parts of the bog and at considerable depth a poorly decomposed sphagnum peat is found. At the borders stumps are numerous, but further in the bog they occur less frequently.

The digging of the peat during the summer time (end of April to beginning of August) has been done, partly by an Anrep machine, partly by a Svedala digging machine, and partly by a Munktell excavator.

The Anrep machine of the ordinary type, with hand digging and transportation on pallettes, was only used during a part of the season for making the main drain of the bog.

The Svedala machine, constructed by the Abjorn Anderson Mekaniska Verstad A. B. at Svedala, is a clay digging machine with mixer and conveyer for feeding the mixed pulp to the dump cars, which are used for transportation to the drying field. This plant is operated by one electric motor which obtains current from the power station at the factory. The machine is placed on the surface of the bog and requires for its moving a very evenly made track. The digging arm is supplied with buckets digging the peat from the bank from below upwards, and in doing this the different layers of peat become fairly well mixed. The peat is dumped into the mixer placed below and from that on to the conveyer to the cars. If the bog is free from stumps 40m³ of raw peat per hour can without difficulty be excavated, but this is rarely done, as stumps, etc., cause, with this machine, considerable delays in the work. Owing to its heavy weight, 18 to 20 tons, supported on a comparatively small area, breaks and settlings occur, thus causing difficulties in track-laying. Neither can all of the peat be dug out, but a considerable amount has to be left, causing loss and inconvenience if the bottom of the bog is to be used as a drying field. This machine can be considered suited for our bogs only in a few exceptional cases. The plant required eight men for digging and spreading the peat.

The Munktell Excavator is placed at the bottom of the bog, and, like the Svedala machine, is composed of digging machine, miner, and conveyer.[1]

This digging machine has a large capacity, but certain shut downs cannot be avoided, which, with the present arrangements for the transportation of the pulp on the field, should make the average capacity 35–40m³ per hour. The production naturally depends on the condition of the bog. In a shallow bog more frequent moving of the machine is necessary, and the stumps which have to be removed by the digging arm interfere with the excavating, so that a definite figure regarding the capacity of the machine for different conditions cannot be given. At Bäck, however, its average production is 40m³ per hour, but during this year's run certain changes have been found to be advantageous, and when these are made a still greater production can be counted on. This excavator, as combined by Lieutenant Ekelund with the necessary appliances for the pulping and transportation of the raw peat, is, without doubt, the most practicable system which so far has been used.

The pulped peat is conveyed to the dumping cars, running on a portable track near the trench and out into the drying field. At the excavator, a siding and switch are provided for the empty cars which are ready to be loaded. Each car holds about 0·75m³ if filled to the brim, but as they are generally loaded in a heap they give an average capacity of 1m³. Small, light gasoline locomotives take these cars to the drying field, which has a width of 250 metres, where the peat is dumped on both sides of the track, and when the length of one rail has been covered with a sufficient amount of peat, that section of track is moved 5 metres to the side. Thus, when a new line is to be started the new track is ready, with the exception of the curve connecting this spur with the spur at the trench. This, however, is done in a few minutes, after which the work is continued. A field press presses, smooths, and cuts the peat in "strings" about 15 cm. square and with 15 "strings" per "table." The press is run by a 10 H.P. electric motor with cable and winding drum. On each side of the drying field there are cars placed on tracks. On one car the cable wheel is placed, on the other the motor with the winding drum. The peat is cut crossways by hand with a rolling knife. Each excavator with field press is said to require 75 H.P.

[1] Here follows a description of the machine as it appears after changes and combinations with other machinery, but this description should not be published.—Note by H. Ekelund.

The labour required during the summer per shift for digging and spreading of the peat was:—
1 man running the excavator,
1 man and 1 boy in the trench for levelling and oiling,
2 men and 1 boy for loading, track laying, and transporting cars,
1 man for locomotive,
3 men in the drying field, for dumping, pressing, tracking, etc.,
in all 8 men and 2 boys.

The boy in the trench is paid 2 kr. per shift. The others by piece work, 11 öre per car for digging and spreading, except the man running the excavator, who gets 50 öre per day extra.

During the summer the plant was running partly with two 8 hour shifts a day and partly with one 11 hour shift. Assuming the first case with a production of 40 cars of mixed peat per hour, the day's production will amount to 320 cars and the cost of labour will be (when 7 cars ($7m^3$) can be considered equal to one ton of peat 30% water):—

Per shift	37·70 Kr.
Per ton of peat 30% water	0·834 "
Per ton dry substance	1·18 "

The "table" in the drying field = (width of the field press by width of drying field) contains on an average 70 cars of peat corresponding to 10 tons of peat with 30% water.

1·20 kr. for turning and 2·50 kr. for piling the peat is paid per table.

	Ton of peat 30% H_2O,		Per ton dry substance.
For turning	0·12 Kr.	....	0·171 Kr.
For piling	0·25 "	....	0·357 "

When dried the peat is carried in the ordinary peat cars, $2m^3$ capacity, drawn by gasoline locomotives, to the peat sheds. Each car carries about 600 kg. peat with 30% moisture.

per car or per ton 30% moisture.	per ton dry substance.
0·417 kr.	0·595 kr.

to this must be added the cost of two extra men bringing the price up to

per ton 30% moisture.	per ton dry substance.
0·50 kr.	0·714 kr.

The total cost of labour excluding manager, machinists, and foremen is:—

——	Per ton with 30% moisture.	Per ton with 40% moisture.	Per ton with 50% moisture.	Per ton of dry sub.
	Kr.	Kr.	Kr.	Kr.
Digging and spreading	0·824	0·708	0·590	1·180
Turning	0·120	0·103	0·085	0·171
Piling	0·250	0·214	0·178	0·357
Transportation to shed	0·500	0·429	0·357	0·714
	1·694	1·454	1·210	2·422

To this must be added for the total price of production; interest and amortization for the plant, cost of power, oil, gasoline, management, taxes, insurance, etc. These vary considerably according to the capacity of the plant.

THE POWDER FACTORY.

The peat in the storage sheds is loaded into dumping cars, containing on an average about one cubic metre, which are hauled by winch and cable to the floor above the crushing room. Here they are dumped through a hatch into a hopper leading to the coarse crusher. This crusher consists of a pair of toothed rolls and can, according to Mr. Ekelund, handle frozen peat satisfactorily. After passing through the coarse crusher the peat falls directly into a fine crusher. This consists of two rapidly rotating steel discs studded with steel pegs or teeth. The discs revolve in opposite directions and the pegs or teeth are so placed as to travel in between each other without interference. Two such crushers are at the present time installed, but only one is required for supplying the powder furnace. In the fine crusher the peat is fairly well disintegrated after which it passes to a fine screen which separates most of the fibre. The screened material is conveyed into the furnace room by means of a belt conveyer and is then carried to the top of the furnace by means of a bucket elevator [1]

[1]Here follows a description of the furnace, which should not be published.—Note by H. Ekelund.

From the furnace the dried powder passes to a fine screen where about 40–50% of finished powder is obtained, the reject goes to a coarse screen, where the fibre and the insufficiently crushed pieces of peat are separated from each other. The screened material passes through three mills—only two of which can be kept running at the same time on account of insufficient power—and all that goes through the first mill is packed directly into bags, but from the second (and the third) the pulp is again screened on a fine screen and a very fine powder is obtained. The coarser part is re-ground.

The powder is packed in water proof bags and stored in a separate warehouse, from which it is shipped by a narrow gauge railway to the Bäck station.

Results of Test of the Furnace.

In order to determine the capacity of the furnace three different tests were run, from the 12th to the 15th of August, the results of which are given below.

Having no facility for weighing the raw material at the crusher, samples were taken four times per hour from crushed peat entering the furnace. These samples were later made into a general sample from which the average moisture content was determined. Simultaneously samples were taken from the material dried in the furnace, the finished powder and the powder used for firing the furnace.

The finished powder, the unfinished material, and the fibre were weighed separately.

On my arrival at Bäck the furnace was charged with fairly well air-dried peat, and consequently did not require to be kept at so high a temperature. It could, therefore, be fed comparatively fast, but assuming an unfavourable drying season with the peat harvest averaging 50% water, which ought to be the maximum, I suggested that such peat should be used for the test runs. This request was readily acceded to and the experiments were commenced on August 12 with peat taken directly from the field. Notice should, however, be taken of the fact, that the men at the furnace, having been used to running the furnace with comparatively dry peat, were not accustomed to working with wet peat, so that during normal conditions possibly better results could be expected. It is of special importance that the feeding be done uniformly, so that equal amounts of peat pass through the furnace per time unit, and not irregularly as sometimes happened here.

Analyses were made at the testing laboratory.

Test No. 1.

Friday, August 12 from 10 a.m. to 6 p.m.
Time, 8 hours.

Analyses.

——	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Calorific power of combustibles.	Effective heat value.
	%	%	%	%	cal. per kg.	cal. per kg.
Raw peat	53·8	33·0	11·8	1·4	5460	2060
Dried-peat furnace	14·0	.....	.....	.....	.....	.....
Finished powder	13·6	58·2	25·1	3·1	5650	4540
Powder for firing	13·6	.....	.....	.....	5720	4610

Weight of dried peat; finished powder	3,722 kg.	
Unfinished dried peat[1]	1,146 kg.	
Fibre (dried)	116 kg.	
Total	4,984 kg.	
Weight of powder used for firing the furnace		752 kg.
Weight of peat for starting the furnace		135 kg.

The finished product contained 13·6% or 678 kg. moisture, and 4,306 kg. dry substance.

[1]Owing to lack of power only two mills could be run at the same time, so that only part of the peat was ground, and all that passed over the fine screen has to be ground later. This will be remedied, and then the three mills will be sufficient to grind the material from two furnaces.

At the furnace the powder contained 14% or 701 kg. water, and weighed 5,007 kg. The raw material contained 53·8% or 5,014 kg. of water and weighed 9,420 kg.
Thus:—

Weight of water evaporated in the furnace, 4,313 kg.
" " afterwards, 23 kg.

Heat supplied to the furnace:—
By combustion of the powder 752×4,610=3,466,720 cal.
" " peat, 135×3,500= 472,500 cal.

Total..... = 3,939,220 cal.

Thus the furnace has evaporated 1·1 kg. of water per 1,000 calories useful effect of the fuel[1]=66%.
The production of the furnace per 24 hrs., assuming that a sufficient amount of power is available for the millls=
14,604 kg. powder and 348 kg. fibre.
The consumption of powder=15·4% of the finished product.

Test No. 2.

Saturday, Aug. 13, from 6 a.m. to 6 p.m.
Time—12 hours.

Analyses.

——	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Calorific power of combustibles.	Effective heat value.
	%	%	%	%	Cal. per kg.	Cal. per kg.
Raw peat.....	53·7	32·9	11·4	2·0	5470	2070
Dried peat at furnace.....	19·5	.....	.....	.....	.....	.....
Finished powder.....	17·2	56·3	22·1	4·4	5460	4170
Powder for firing.....	8·0	.....	.....	.....	5390	4630

After the run of August 12, the furnace was charged with the raw peat described above, which had been left over from last year and had been frozen in the sheds. The weight of 1 cub. metre of this peat was 436 kg., this peat was used for the run during the whole night and Saturday.
Weight of dried peat:—

Finished powder.....	7,594	kilograms.
Unfinished powder.....	365	"
Fibre (dried).....	72	"
Total.....	8031	"

Weight of powder for firing the furnace=836 kg.
Weight of peat used for starting the furnace=200 kg.
The finished product contained 17·2% or 1,381 kg. water and 6,650 kg. dry substance. At the furnace the dried peat contained 19·5% or 1,610 kg. water and weighed 8,260 kg. The raw peat contained 53·7% or 7,713 kg. water and weighed 14,360 kg.
Thus:—

Weight of water evaporated in the furnace, 6,103 kg.
" " afterwards, 229 kg.

Heat supplied to the furnace:—
By combustion of the powder, 836×4,630 = 3,870,680 cal.
" " peat 200×3,500 = 700,000 "

Total..... = 4,570,680 "

Therefore, 1·33 kg. water was evaporated in the furnace per 1,000 cal.
Useful effect of the fuel = 79·8%.
The production of the furnace per 24 hrs. = 15,918 kg. powder and 144 kg. fibre.
Using, for firing, powder of the same fuel value as the finished powder, consumption was 926 kg. or 11·6% of the finished powder
½ cub. metre of the powder produced (3 bags) weighed 148 kg., spec. gravity 0·296.[2]

[1]When the effect of the current of air is not taken into account and the evaporation heat of the water is assumed to be 600 cal.
[2]This is the weight of lightly packed powder. For shipment the powder is packed hard by shaking.—Note by H. Ekelund.

Test No. 3.

Monday, Aug. 15 from 9 a.m. to 6 p.m.
Time, 9 hrs.

Analyses.

	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Calorific power of combustibles.	Effective heat value.
	%	%	%	%	Cal. per kg.	Cal. per kg.
Raw peat	39·0	40·6	15·4	5·0	5240	2780
Dried peat at furnace	11·4					
Finished powder	11·2	58·1	21·3	9·4	5270	4350
Powder for firing	17·2	56·3	22·1	4·4	5460	4170

The same powder was used as in previous tests.
The weight of 1 cub. metre of raw peat=325 kg.
Weight of dried peat:—

Finished powder	=	7,121 kg.
Unfinished powder	=	943 "
Fibre (dried)	=	253 "
		8,317 "

Weight of powder for firing = 782 kg.
Weight of peat for starting the furnace = 150 kg.
The finished material contained 11·2% or 931 kg. water and 7,386 kg. of dry substance.
At the furnace the dried peat powder contained 11·4% or 950 kg. water and weighed 8,336 kg.
The raw peat contained 39% or 4,722 kg. water and weighed 12,108 kg.

Thus:—

Weight of water evaporated in the furnace	3,772 kg.
Weight of water evaporated afterwards	19 "

Heat supplied to furnace:—

By combustion of powder, 782 × 4170	=	3,260,940 cal.
Peat, 150 × 3500	=	525,000 "
Total	=	3,785,940 cal.

Therefore 1 kg. of water has been evaporated in the furnace per 1,000 cal. Useful effect of the fuel = 60%.

The production of the furnace per 24 hours = 21,504 kg. powder and 674 kg. fibre.

Using powder or firing of same fuel value as the produced powder, the powder consumption = 750 kg., or 9·3% of the produced powder.

½ cub. metre finished powder weighed 171 kg., spec. grav. 0·342.[1]

According to test No. 1 using raw peat of 54% water, the production is 14·6 tons per 24 hours, and the powder consumption for the furnace 15% of the production.

The furnace, however, was fed rather irregularly, causing a comparatively small production and high fuel consumption.

According to test No. 2, with the same peat as before, the production was about 16 tons per 24 hours and the powder consumption 11·5% of the produced powder. The content of water in the finished product was, however, too high, due to rapid feeding of the furnace.

According to the test No. 3, using raw peat of 39% moisture, the production was about 16 tons per 24 hours, and the powder consumption 11·5% of the produced powder. The content of water in the finished product was, however, too high due to rapid feeding of the furnace.

According to the test No. 3, using raw peat of 39% moisture, the production is 21·5 tons per 24 hours, and the powder consumption for the furnace is 9·3% of the produced powder, the latter containing 11% water.

During normal conditions and with uniform feeding the production of the furnace naturally depends on the moisture in the peat and in the finished product. The physical condition of the peat should also be taken into account, because the amount of fibre in the peat exerts a proportional resistance to evaporation. The useful effect of the fuel in the furnace depends on the moisture allowable in the finished powder, so that the less water this contains the less will be the useful effect.

[1] This is the weight of lightly packed powder. For shipment the powder is packed hard by shaking.—Note by H. Ekelund.

All the three experiments have proved that the dried peat leaving the furnace contains more water than the finished product. When leaving the furnace the peat powder is hot and more or less evaporation subsequently takes place according to the moisture contents of the material. It would undoubtedly be advantageous to allow the dried powder to pass through a long conveyer before it is put through the mills.

Judging from the results obtained from the test runs, 15 tons of powder with 12–13% moisture were obtained per 24 hours, using peat 50% water, and 21 tons from peat of 40% water. Consumption of powder for the furnace was 12% in the first case and 9% of the production in the latter.

The furnace was run with two 12 hour shifts. Each shift of 7 men and 2 boys, as follows:—

1 man and 1 boy loading peat in the sheds.
1 man feeding the coarse crusher.
1 man in the crushing room.
1 man at the furnace.
2 men in the milling room.
1 man engine driver,
1 boy carrying and crushing the peat for the generator.

These are paid 3 kr. per day per man and 2 kr. per boy, or 50 kr. per 24 hours in all. With a production of 15 tons per 24 hours, the price of labour per ton is 3·33 kr., with 21 tons production the price is 2·38 kr. per ton.

Two furnaces can be run with the same staff, by replacing boys with men. The wages per 24 hours will then become 54 kr., or for a 30 tons production 1·80 kr. per ton, and for a 42 tons production, 1·29 kr. per ton. To this should be added interest and amortization of the plant, power, oil, bags, management, taxes, insurance, etc.

COST.

COST OF A PLANT CONSISTING OF ONE EXCAVATOR AND TWO FURNACES, PRODUCING ABOUT 9,500 TONS SALEABLE POWDER.

Manufacturing of Raw Material.

Data for the Calculation.

The plant shall be amortized in 20 years; hence, the bog must contain enough material for this period.

The excavator produces 40 cubic metres per hour, with cost as already mentioned.

The average depth of the bog after draining is 2·5 metres, and the specific gravity of the peat is such that 7 cubic metres=1 ton of peat with 30% moisture. The bog is worked 120 days, night and day. One hectare of such a bog contains 25,000 cubic metres of peat mud, corresponding to 3,500 tons of peat with 30% moisture. Thus the smallest area of the bog should be 100 hectares, and should be situated at a convenient distance from railway or other transportation facilities, and where labour is available during the summer.

During unfavourable summers the peat dug in the month of August might not become sufficiently dried, but in such event it may be left on the bog during the winter until the following spring, when, after a short time, it can be transferred to the sheds.

The yearly production of the excavators=115,000 cubic metres.

COST OF PLANT AT THE BOG.

The bog, drained and surveyed	45,000 kr.
One digging machine, complete	25,000 "
Tracks on the bog, spreading machine, cars, gasoline locomotives, etc	25,000 "
4 sheds with a capacity of 7,500 cub. metres each[1]	40,000 "
Power station, 75 H P. capacity	15,000 "
Total =	150,000 "
Interest 4%, Amortization 5% of the bog[2]	4,050 "
" 4% " 5% " sheds[2]	3,600 "
" 4% " 7% " machinery	7,150 "
Foreman's pay 5 months	1,000 "
Fuel for motors, 75 H.P., requiring 3 kg. peat 30% water per H.P. hour, 3×75×24×120=648 tons at 3 kr[3]	1,944 "
Gasoline for 3 locomotives, 5,400 litres at 11 öre	594 "
2 engine drivers, 4 kr. per day=8 kr. per 24 hours	960 "
Oil and supplies	500 "
Taxes	500 "
Insurance	5,500 "
Miscellaneous	1,202 "
Total - - - - - -	22,000 kr.

Yearly production $\frac{115000}{7}$ =16,400 tons with 30% water.

[1] The sheds at Bäck cost 25,000 kr.

[2] Interest is here calculated to be the same during the whole period, though it decreases gradually through the amortization.

[3] The guaranteed fuel consumption of motor is 0·60 kg. soft coal per effective H.P. year, corresponding to 1·2 kg. peat (30% water); hence the figure above is too high.—(Note by H. Ekelund.)

TOTAL COST PER TON.

	Water.			Dry substance.
	30%	40%	50%	
Total cost	1·70 kr.	1·45 kr.	1·20 kr.	2·40 kr.
Other cost	1·34 "	1·15 "	0·95 "	1·91 "
Total (round numbers)	3·00 kr.	2·60 kr.	2·15 kr.	4·30 kr.

THE POWDER MANUFACTURING.

Data for the Calculations.

Two furnaces charged with peat with 50% water, producing, per 24 hours, 30 tons of powder. Fuel for the furnaces 12% of the production.

Two furnaces charged with peat with 40% water, producing 42 tons of powder per 24 hours, with a fuel consumption of 9% of the production.

The finished product contains 12% water.

Five per cent of the weight of the dry substance is fibre obtained by screening, of which 3% is obtained in the crushing room and 2% in the milling room.

The amount of peat required to keep the furnaces in operation 280 days per year is as follows:—

Peat 30% water ..... 2,500 tons.
" 40% " ..... sufficient for 120 days run.
" 50% " ..... " " 100 " "

Power is supplied from a 175 H.P. suction gas generator power plant, requiring 1·3 kg. peat (30% water) per H.P. hour.

Cost of Plant.

Factory building	25,000 kr.
2 furnaces, complete	18,000 "
Conveyers, power transmission lines, cables	6,000 "
3 crushers (one at 1,895 kr., 2 at 2,780 kr.)	7,455 "
3 mills at 2,100 krs.	6,300 "
Transmission line to crushing and milling room	3,000 "
Belting	3,500 "
Screens, complete	3,000 "
Power station, suction gas plant, 175 H.P. kr.	50,000* "
Repair shop	2,000 "
Miscellaneous	945 "
	126,000 "
Office and living houses	14,000† "
Stock house	5,000† "
Total	145,000 "
Interest 4%, amortization 5% on buildings 44,000 kr.	3,960 "
" 4% " 7% on machinery 100,000 kr.	11,000 "
Management of the whole plant	5,000 "
Taxes for the factory	500 "
Insurance	500 "
Oil and miscellaneous	1,040 "
Total	22,000 "

Peat with 40 per cent water required.

During 180 days, 180 × 42 tons of powder are produced, of which 0·09 × 7,560 = 680 tons, are required for firing, thus leaving 6,880 tons of saleable peat powder containing 12% of water. 680 tons of peat powder contain 598 tons of dry substance. Adding 5% for fibre, 630 tons dry substance is required, corresponding to 63,000 cub. metres peat mud, or 1,050 tons with 40% of water. From this, 31 tons of fibre suitable for bedding, and 21 tons of dried fibre are obtained. 6,880 tons of

* According to specifications received for the complete power plant of H.P. supplying the bog and the factory with power, the price is 45,000 kr. 15,000 kr. of this is charged to the bog, and 30,000 kr. to the factory.—H. Ekelund.

† The price of the living house is 6,000 kr., but interest and amortization of this is obtained by rents. The price of the stock house is 3,000 kr., included in factory building account 25,000 kr.; hence the item 19,000 kr. should be omitted.—H. Ekelund.

powder contain 6,055 tons of dry substance; adding 5% for fibre, 6,373 tons of dry substance is required, corresponding to 63,730 cub. metres of bog, or 10,620 tons of peat with 40% of water.

From this is obtained 318 tons of fibre suitable for bedding and 212 tons of dried fibre.

Peat with 50 per cent water required.

During 100 days, $30 \times 100 = 3,000$ tons of peat powder are produced of which $0{\cdot}12 \times 3,000 = 360$ tons are required for firing, thus leaving 2,640 tons saleable peat powder containing 12% of water.

360 tons of peat powder contain 317 tons of dry substance; adding 5% for fibre, 333 tons of dry substance will be required corresponding to 3,330 cub. metres of bog or 666 tons of peat with 50% water.

From this is obtained 20 tons of fibre suitable for bedding and 13 tons of dried fibre.

2,640 tons of powder contain 2,323 tons of dry substance; adding 5% for fibre, 2,445 tons of dry substance is required corresponding to 24,450 cub. metres of bog or 4,890 tons of peat with 50% water. From this is obtained 147 tons of fibre suitable for bedding and 98 tons of dried fibre.

Number of employes for the powder factory.

8 men, 3 kr. per day each,
1 engine driver, 4 kr. per 12 hrs.,
1 foreman, 4 kr. per 12 hrs.,
Wages per 24 hrs. = 64 kronor.

Price of production of 6,880 tons of powder.
(From peat 40% of water.)

	Kr.
Wages 64×180	11,520
10,620 tons of peat 40% water for saleable powder at 2·60 kr	27,612
1,050 tons of peat 40% water for powder for firing furnace	2,730
$180 \times 800 = 144$ tons of peat 30% water for starting furnaces at 3 kr	442
$1{\cdot}3 \times 175 \times 24 \times 180 = 983$ tons of peat 30% water for suction gas plant at 3 kr	2,949
Interest, amortization, etc. $\frac{180}{280} \times 22,000$	14,143

Per ton	kr.	8·63
Wear of bags	"	0·40
Miscellaneous	"	0·07
Total kr		9·10

Price of production of 2,640 tons of powder.
(From peat 50% of water.)

	Kr.
Wages 64×100	6,400
4,890 tons of peat 50% water for saleable peat powder at 2·15 kr	10,513
666 tons of peat 50% water peat powder for firing furnaces, at 2·15	1,432
$100 \times 800 = 80$ tons of peat 30% water for starting the furnaces at 3 kr	240
$1{\cdot}3 \times 175 \times 24 \times 100 = 546$ tons of peat 30% water for the suction gas plant at 3 kr	1,638
Interest, amortization, etc, $\frac{100}{280} \times 22,000 =$	7,860
Total kr	28,083

Per ton	10·63 kr.
Wear of bags	0·40 "
Miscellaneous	0·07 "
Total kr	11·10 per ton.

Average cost per ton $= \frac{87479}{95} + 0{\cdot}47 = 9{\cdot}65$ kr.

As saleable by-product is obtained—
329 tons of fibre 40% water suitable for bedding,
167 " " 50% " "
The former is sold at 12 kr. and the latter at 8 kr. per ton.

Average cost of peat powder per ton will be $\frac{81955}{9520} + 0{\cdot}47 = 9{\cdot}00$ kr.[1]

[1] Mr. Nystrom in his letter of October 26, 1911, communicates that 344 tons of dried fibre has been omitted in his calculation which should be corrected. This fibre is sold for bedding at 15 kr. per ton (we hope to get an altogether different price, when the fibre is to be used for other special purposes) and the income accounted should be credited with $344 \times 15 = 5160$ kr. or per ton of powder $\frac{5160}{9520} = 54$ öre. This will lower the average price of product to 8·46 kr. per ton. It should also be borne in mind that Mr. Nystrom has based his calculation on a production of peat powder with 12 per cent moisture; but experience has proved that the most economical and best results are obtained using powder with 15 per cent moisture, and this will—as Mr. Nystrom remarks at the end of this report—lower the price considerably.—(Note by H. Ekelund.)

Peat Necessary for one Year's Production.

				Peat. Cub. Metres.
The power plant for the bog	(120 days.)	648 tons peat	30% water	4,536
" " "	(180 days)	983 "	"	6,881
Peat for starting the furnaces	(280 days)	224 "	"	1,568
The power plant for the bog	(100 days)	546 "	"	3,822
Powder for firing the furnace	(180 days)	1,050 "	"	6,300
" " "	(100 days)	666 "	"	3,330
The saleable peat requires				26,437

During 180 days, 10,620 tons of peat 40% water = 63,730 cub. metres.
During 100 days, 4,890 tons of peat 50% water = 24,450 peat.

Total..... = 88,180

Peat required..... = 114,617 cub. metres.
Peat excavated about..... = 115,000 "

Fuel consumption $\frac{26437}{114617}$ = 23% of the peat mud excavated.

In the above calculation most figures are supplied by Lieut. H. Ekelund.[1] The cost of the power station and sheds I have put at my own estimation, otherwise the cost of production depends largely on local conditions, so that a detailed estimate of cost could not be given.

This calculation, however, is made under rather unfavourable circumstances and a new plant erected with the experience obtained from the first plant should be more profitable. With some changes made in the excavator its capacity ought to be considerably increased, thus lowering the price of labour and other costs per ton of peat.

In most cases, the peat contains a considerably less amount of water than I have used in my calculations. Further it may be assumed that the effect of the furnaces would be increased by the lengthening of the drying conveyers, and reducing the number of workmen by installing certain labour saving machinery.

As soon as possible test firing will be made to compare the peat powder with coal, and as soon as results are obtained, a report will be issued.

It seems reasonable that very little is gained by drying the powder to less than 15% water, and if so, the production of the furnaces will be increased and the fuel consumption will be decreased considerably, thus contributing to a lower price per ton of peat powder.

Stockholm, September 17, 1910.

[1] Note by H. Ekelund.—All figures given to Mr. Nystrom have been verified by me.

APPENDIX II.

A REPORT ON THE MANUFACTURE OF PEAT AND PEAT POWDER AT THE BÄCK PEAT BOG, USING THE EKELUND SYSTEM.

Captain Ernst Wallgren.

(Chief Engineer, Swedish Government Peat Investigation.)

During the last four years, as far as I have had the opportunity, I have made a study of the new system for manufacturing peat powder invented by Lieut. H. Ekelund. I have also during the last two seasons visited the plant and conducted trial runs in order to ascertain the exact cost of production of the peat and the peat powder.

Based on a complete analysis of the general samples taken during the test runs, together with other data obtained at the plant (interest and amortization), I have made my calculations in the following report herewith submitted.

With the introduction of new machinery, constructed and combined by Lieut. H. Ekelund, especially adapted to the local conditions at the Bäck peat bog, I consider that most important improvements have been made in the method of peat manufacturing as compared with previous methods. The plant at Bäck produces both air-dried peat averaging 40% water and the finished product—peat powder—averaging 15% water, at a very low cost, requiring as it does, a small amount of labour for the large production.

The peat powder is a splendid fuel for boilers, etc., and its cost of production is exceedingly low. With the conditions prevailing at the Bäck peat bog, the manufacturing of 10,000 tons of powder per year from two furnaces, the cost of production certainly does not exceed kr. 8·50 per ton of peat powder, this made from raw material costing at the very most kr. 3·00 per ton. With the application of the experience obtained from the year's run and with certain changes made in the facilities for the transportation of the peat on the field, etc., and with an increased capacity of the plant, using 4 to 6 furnaces, the price of the finished product will undoubtedly become lower than 8 kr.

The significance of this for our peat industry as well as for our balance of trade and our independence of foreign fuel is evident. The nation owes to Lieut. Ekelund its appreciation.

We do not now face a problem which has been proved to be only theoretically correct, since the Ekelund system as applied to the Bäck bog, has shown practical results. The fuel obtained has proved cheaper than soft coal when burned under a boiler. This also applies to bogs where local conditions would cause an increase of a couple of kronors in the price of manufacturing.

Skara, Nov. 12, 1910.

Calculation of Cost of Production of 10,000 Tons of Peat Powder, at the Bäck Peat Bog.

DATA FOR CALCULATION.—According to my own investigation, which agrees with information given by the management, the Munktell excavator with peat and spreading machines handles on an average of 35–40 cub. metres of peat mud per hour, which correspond to 5–6 tons[1] of peat with 40% moisture or 130 tons per day of two ten hour shifts.

[2]The price 8·50 kr. includes all expenses: labour, foreman, management, insurance, taxes, wear of bags, fuel, interest on capital, expended, and working capital with 5%, amortization and maintenance 7%, of the capital.

In the north part of the bog, where the obsolete Svedala machine has been operating, the peat is lighter and stumps are numerous.

The production from this part with a Munktell machine will be smaller, which I shall put as low as 115 tons per day as a safe estimate.

Two Munktell's excavators, under conditions similar to those of the Bäck peat bog, should, during 75 working days, dig out about 18,400 tons of peat, 40% water, which amount is necessary for the production of 10,000 tons of peat powder. Generally for manufacturing raw peat containing an average of 40% water, the excavators will be able to operate at least one month longer than the three months mentioned, and perhaps the larger part of the harvest of peat from the three first months may contain less than 40% water.

With only one machine working in the best part of the bog, only 13,000 tons of raw peat could be obtained during 100 days, thus being considerably short of the 18,000 tons required. Therefore two excavators should be available on the bog.

[1] Metric ton = 2,204 lbs. = 1,000 kilogram.
[2] 1 kronor = 100 öre = 27 cents.

Raw Peat Required.

According to the test made at the peat factory (Sept. 5 and 8) the amount of peat required, calculated for a production of 10,000 tons of saleable peat powder and of 800 tons of peat powder for firing the furnaces, will be as follows:—

	40% Water.	15% Water.	Dry substance.
Material required for saleable powder	14,170 tons	10,000 tons	8,500 tons
Material for fibre	600 "	420 "	360 "
Loss by combustion in the furnaces	660 "	470 "	400 "
Total	15,430 tons	10,890 tons	9,260 tons

	40% Water.	15% Water.	Dry substance.
Material required for powder for firing furnace	1,130 tons	800 tons	680 tons
Material for fibre	50 "	35 "	30 "
Loss by combustion in the furnace	50 "	35 "	30 "
Total	1,230 tons	870 tons	740 tons

Thus 390 tons of the dry substance is fibre, which can be sold for peat litter, and, calculating on an average 25% water, 500 tons of peat litter is obtained.

Raw Peat Required for the Suction Gas Plant.

Peat required per effective H.P. is calculated at 1·3 kg. for peat of 30% water; 1·5 for peat of 40% water.

Raw Peat Required for Working the Bog.

With a power of 150 H.P. for 75 days of 20 hours at 1·5 kg. per H.P. =

$$\frac{150 \times 20 \times 75 \times 1{\cdot}5}{1000} = 340 \text{ tons of peat with 40\% water.}$$

Raw Peat Required for the Powder Works.

At the test runs, controlled by me, the average production was 20·5 tons per 24 hours, less 1·5 tons required for firing. Excluding powder for fuel, two furnaces produce 38 tons of powder per 24 hours, or 10,000 tons during 263 days (24 hours). Instead of one furnace using 80 H.P., figure on 150 H.P. for two, thus (150 H.P. for 24 hours and 263 days at 1·5 kg. per H.P.) would require 1,400 tons of peat of 40% water.

During the test made at the peat powder plant Sept. 5–8, the suction gas plant consumed 8·4 tons of peat containing 30% moisture to produce 67·1 tons of peat powder, which makes 1,200 tons of peat for 10,000 tons peat powder, or 1,400 tons with 40% moisture.

Summary of Peat Required.

For the operation of the plant at the bog	340 tons.
For the operation of the powder plant	1,400 "
For fuel for the furnace	1,230 "
For saleable peat powder	15,430 "
Total amount of peat of 40% water	18,400 "

Cost of labour by piece-work.—According to data obtained at the Bäck peat bog, 67 öre is paid per ton of peat of 40% moisture excavated by the Munktell machine and spread out on the field; for turning, 13 öre was paid; piling, 25 öre, and transportation into sheds, 40–50 öre per ton of peat—giving a total cost for labour and transportation of 1·55 kr. per ton of peat of 40% moisture.

The total time for the engine drivers at the powder plant is divided over 300 working days, as follows:—

During 37 days only the raw peat plant is running.
" 38 " both the raw peat plant and powder plant are running.
" 225 " only the powder plant is running.
Total 300 " per year, each day with two shifts.

The raw peat is manufactured during 75 days and the peat powder during 263 days, giving a total of 600 shifts per year.

TABLE VII.

Data from the test runs at Aktiebolaget Torfs Peat Powder Factory at Bäck (Ekelund's System) made September 5-8, 1910.

Raw peat with its water content.

Shift No.	Operating hours.	Number of operating hours.	Amount of peat per shift.	Weight per cub. yard.	Combustibles.	Ash.	Water.	Effective Calorific Value. Cal.	Effective Calorific Value. B.T.U.	Total Effective Calorific Value. Cal.	Total Effective Calorific Value. B.T.U.
			Lbs.	Lbs.	%	%	%				
1	9.15 a.m.—1.30 p.m.; 2·00 a.m.—6.00 p.m.	8¾	19,472	629	59·5	1·7	38·8	2,911	5,240	25,718,585	46,293,633
2	6·00 p.m.—9.35 p.m.; 9.50 p.m.—6.00 a.m.	11¾	31,475	662	57·5	1·5	41·0	2,658	4,784	37,958,898	68,326,016
3	6·00 a.m.—6·00 p.m.	12	33,408	686	56·5	2·0	41·5	2,658	4,761	47,292,600	85,126,680
4	6·00 p.m.—6·00 a.m.	12	37,389	640	55·9	2·1	42·0	2,648	4,766	44,920,672	80,857,210
5	6·00 a.m.—6·00 p.m.	12	35,897	606	59·4	2·2	38·4	2,885	5,193	46,987,995	84,578,391
6	6·00 a.m.—6·00 a.m.	12	34,858	583	57·9	1·9	40·2	2,779	5,002	43,952,664	79,114,795
7	6·00 a.m.—6·00 p.m.	10	30,528	696	58·5	2·6	38·9	2,790	5,022	38,644,290	69,559,722
	Total or Average	78	229,027	*644*	**57·7**	**2·0**	**40·3**	**2,747**	**4,945**	285,475,804	513,856,447

Dry substance of the raw peat.

Shift No.	Dry substance.	Weight (calculated).	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.	Calorific Value. Cal. per kg.	Calorific Value. B.T.U.	Effective Calorific Value. Cal. per kg.	Effective Calorific Value. B.T.U.	Total Effective Calorific Value. Cal. per kg.	Total Effective Calorific Value. B.T.U.	Hydrogen in the organic substance.
	%	Lbs.	%	%	%	%	%							%
1	61·2	11,917	53·08	6·03	37·04	·07	2·78	5,438	9,788	5,139	9,250	27,786,573	50,015,831	6·2
2	59·0	18,571	58·96	6·24	34·19	·07	2·54	5,220	9,396	4,885	8,793	41,161,010	74,089,818	6·4
3	58·5	23,051	56·60	6·08	32·84	·06	3·42	5,242	9,436	4,950	8,910	51,777,000	93,198,600	6·3
			56·2	6·1	33·7	·07	(2·91)							6·3
4	58·0	21,683	......	......	......	......	3·66	5,299	9,538	5,003	9,005	49,224,517	88,604,131	Calculated 5·7
5	61·6	22,113	......	......	......	......	3·60	5,352	9,634	5,056	9,101	50,726,848	91,308,326	
6	59·8	20,845	......	......	......	......	3·11	5,349	9,628	5,051	9,092	47,772,358	85,990,244	
7	61·1	18,652	......	......	......	......	4·28	5,242	9,436	4,947	8,905	41,866,461	75,359,630	
Total or Average	**59·7**	136,855	......	......	......	......	**3·15**	*5,306*	*9,551*	**4,998**	**8,906**	310,314,767	558,566,580	

The dried product and its water content.

Shift No.	Finely Ground Finished Powder. Weight.	Finely Ground Finished Powder. Number of bags of 4½ bushels.	Finely Ground Finished Powder. Average weight per bag.	Powder, which has not passed through the Finishing Mill. Weight.	Powder, which has not passed through the Finishing Mill. Number of bags.	Total dried powder finely ground and other.	Fibre. Weight.	Fibre. Number of bags.	Total dried material.	Finely Ground Powder. Combustible substance.	Finely Ground Powder. Ash.	Finely Ground Powder. Water.	Effective Calorific Value. Cal. per kg.	Effective Calorific Value. B.T.U.	Total Effective Calorific Value. Cal. per kg.	Total Effective Calorific Value. B.T.U.
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.		Lbs.	%	%	%				
1	11,635	80	145	432	4	10,067	655	7	12,721	84·6	5·1	10·3	4,567	8,221	26,360,724	47,449,303
2	18,424	139	132	1,635	16	20,056	847	9	20,903	81·8	3·1	15·1	4,257	7,663	40,432,986	72,779,375
3	23,894	171	139	1,706	15	25,600	979	11	26,578	78·8	4·2	17·0	4,044	7,279	48,766,596	87,779,887
4	22,452	166	134	1,446	14	23,898	1,109	13	25,007	79·0	4·0	17·0	4,171	7,508	47,324,166	85,183,499
5	22,189	160	139	1,849	16	24,037	791	8	24,828	81·7	3·5	14·8	4,270	7,686	48,101,550	86,582,790
6	20,939	153	136	1,442	13	22,380	1,175	12	23,573	80·9	3·9	15·2	4,179	7,522	44,623,362	80,322,052
7	18,847	136	139	1,057	9	19,867	694	7	20,561	79·9	6·9	13·2	4,245	7,641	39,601,605	71,282,889
Total or Average	138,339	1,004	139*	9,547	87	146,885	6,280	67	154,163	**80·7**	**4·3**	**15·0**	**4·220**	**7,596**	295,210,989	531,379,781

*Or 29 lbs. per bushel loose measure.

Dry substance of the dried material.

Shift No.	Finely Ground Powder. Dry substance.	Finely Ground Powder. Weight.	Dry substance of the coarse powder.	Dry substance of the dried powder.	Dry substance of fibre.	Dry substance of the total amount of dried material.	Loss of peat substance of the powder, by combustible and treatment.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.	Calorific Value. Cal. per kg.	Calorific Value. B.T.U.	Effective Calorific Value. Cal. per kg.	Effective Calorific Value. B.T.U.	Total Effective Calorific Value of the Dried Material. Cal. per kg.	Total Effective Calorific Value of the Dried Material. B.T.U.	Hydrogen in the organic substance.
	%	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	%	%	%	%	%							%
1	89·7	10,436	388	10,824	586	11,410	507	55·18	5·19	32·82	1·42	5·68	5,450	9,828	5,159	9,286	26,708,143	48,074,654	5·5
2	84·9	15,640	1,389	17,028	745	17,773	798	56·75	5·59	32·85	1·16	3·65	5,400	9,720	5,098	9,176	41,110,272	73,998,490	5·8
3	83·0	19,832	1,415	21,247	813	22,060	991	58·29	6·46	29·05	1·14	5·06	5,340	9,612	4,995	8,991	49,994,955	89,990,920	5·8
								56·74	5·75	31·57	1·14	(4·80)							6·0
4	83·0	18,635	1,201	19,836	919	20,755	430					4·82	5,440	9,792	5,148	9,226	48,478,716	87,261,689	Calculated 5·7
5	85·2	18,904	1,576	20,408	674	21,154	958					4·11	5,410	9,738	5,115	9,207	49,093,770	88,368,786	
6	84·8	17,755	1,206	18,961	996	19,957	888					4·60	5,330	9,594	5,036	9,065	45,600,980	82,081,764	
7	86·8	16,327	917	17,244	602	17,846	807					7·96	5,310	9,55	4,927	9,018	40,703,619	73,266,514	
Total or Average	**85·0**	117,529	8,092	125,620	5,335	130,955	5,142†					**5·05**	*5,382*	*9,689*	**5,078**	**9,140**	301,699,455	543,042,814	

†Of this 2,092 lbs. by treatment in the furnace.

Powder for firing the furnace.

Shift No.	Lbs.	Number of bags.	Per cent of dried powder.	Per cent of dried material.	Its Dry Substance. Lbs.	Its Dry Substance. Per cent of dry substance of raw peat.	Total Effective Calorific Value. Cal. per kg.	Total Effective Calorific Value. B.T.U.	Water. In the raw peat.	Water. In the dried material.	Water. Evaporated in the furnace.	Final Product. Peat Powder Produced. Per hour.	Final Product. Peat Powder Produced. Per 24 hours.
									Lbs.	Lbs.	Lbs.	Lbs.	Tons (2,000 lbs.)
1	1,331	11	11·0	10·5	1,195	10·0	2,758,468	4,965,242	7,555	1,311	6,244	1,463	17·5
2	1,582	14	7·9	7·5	1,342	7·2	3,056,526	5,501,745	12,904	3,161	9,744	1,706	20·5
3	1,803	15	7·0	6·8	1,497	6·5	3,307,992	5,954,386	16,354	4,518	11,835	2,133	25·6
4	1,600	14	6·7	6·4	1,327	6·1	3,028,146	5,450,663	15,704	4,252	11,452	1,992	23·9
5	1,634	14	6·8	6·6	1,399	6·3	3,159,800	5,687,640	5,850	3,674	10,110	2,003	24·0
6	1,591	14	7·1	6·7	1,349	6·5	3,017,258	5,431,928	14,013	3,577	10,436	1,862	22·3
7	1,325	11	6·7	6·4	1,150	6·2	2,551,245	4,592,241	11,875	2,726	9,162	1,986	23·8
Total or Average	10,863	93	**7·3**	**7·0**	9,219	6·75	20,879,415	37,120,947	92,189	23,200	68,983*	**1,895**	**22·7**

*Or 6·35 lbs. of water per lb. of peat powder used.

The figures in bold type are calculated on the total production. The averages in *Italics* are the corresponding totals divided by the number of working shifts.

Skara, Sweden, Nov. 12, 1910.

Ernst Wallgren,
Chief Engineer, Swedish Government Peat Investigation.

Lars Jönsson,
Assistant Engineer.

THE PEAT PLANT.

Price of the Plant.—

The bog drained and surveyed		45,000 kr.
2 complete digging and peat machines		50,000 "
Means of transportation		25,000 "
Sheds		25,000 "
Part of powder plant		20,000 "
Total		165,000 "

Cost of Production (liberal estimate).—

Interest 5% on 165,000 kr. and on 15,000 kr. working capital		9,000 "
Amortization and maintenance, 7% on 165,000		11,550 "
Administration and manager's salary	2,000 kr.	
Insurance	1,000 "	
Taxes	500 "	
		3,500 "
Foreman (150 days at 4 kr.)	600 "	
Engine driver (112 days at 4 kr.)	450 "	
		1,050 "
Cost of labour and transportation of 18,400 tons of peat at 1·55 kr.		28,000 "
Fuel for the suction gas plant (340 tons at 3 kr.)	1,020 kr.	
Gasoline for 2 locomotives (2,500 litres at 11 öre)	280 "	
Oil	500 "	
		1,800 "
		54,900 "

Or, at the most, 3 kr. per ton of peat 40% moisture, corresponding to 5 kr. per ton of dry substance.

THE PEAT POWDER FACTORY.

Cost of the Plant.—

Building, etc.		25,000 kr.
2 furnaces, complete		50,000 "
Part of the power plant		30,000 "
Total		105,000 "

Cost of Production (liberal estimate).—

Interest 5% on 105,000 (cost of the plant), 5% on 10,000 (working capital)		5,750 "
Amortization and maintenance, 7% on 105,000		7,350 "
Administration and manager's salary	2,000 kr.	
Taxes	500 "	
Insurance	1,000 "	
		3,500 "
Foreman (263 days at 4 kr.)	1,050 kr.	
Engine drivers (485 days at 4 kr.)	1,950 "	
		3,000 "
Labour (14 men in two shifts 263 days), 3,682 days at 3 kr		11,050 "
Wear of bags, oil, etc., 50 öre per ton of saleable powder		5,000 "
Peat: 1,400 tons for the powder plant, 1,230 tons for peat powder for furnaces, and 15,430 tons for saleable powder—18,060 tons (40% water at 3 kr)		54,180 "
Miscellaneous		170 "
Total		90,000 "
From this should be deducted the price of 500 tons of fibre separated by screening and sold for bedding at an average price of 10 kr. per ton		5,000 "
Total cost of production		85,000 kr.

Or, at the most, 8·50 kr. per ton of powder with 15% of water, or 10 kr. per ton of dry substance of the saleable peat powder.

Possible Reduction in Manufacturing Cost.

By changing the peat machine so that woody matters can be removed without loss of time, and by using electric power for the transportation of the peat pulp on the field, a considerable gain in production may be expected.

In favourable years the peat should be drier than 40% water and most likely the production when using two digging machines would be more than 18,400 tons per season, which ought to reduce the cost of production to considerably less than 5 kr. per ton of dry substance, as mentioned, or 3 kr. per ton of raw material with 40% water.

By application of these suggestions, with some minor changes to the furnace, together with the experience now obtained in running the plant, the cost of production of peat powder should be considerably less than 10 kr. per ton of dry substance of the peat powder, and hence less than 8 kr. per ton of peat powder with 15% water.

This applies to a still greater extent to a larger plant with 4–6 furnaces.

SKARA, SWEDEN, Nov. 12, 1910.

APPENDIX III.

NOTE ON THE OPERATION OF THE MUNKTELL-EKELUND EXCAVATOR ON THE BÄCK PEAT BOG.

A. Anrep, Jr.

The bottom of the Bäck peat bog is placed by nature higher than the railway track. It is smooth and hard, with an even slope, and is composed of sand and gravel; consequently it can be cheaply and easily drained. The peat is very uniformly decomposed and has an average depth of 3 metres (about 10 feet) after draining. This bog is considered to be an exceptional Swedish peat bog.

On the bottom of this bog is placed a Munktell-Ekelund excavator combined with an Anrep macerator, which are driven by an electric motor.

As the surface of the bog bottom is hard, smooth, and easily drained, the heavy excavator showed satisfactory results, and worked like all other known sand and clay excavators placed on hard and solid ground.

The Ekelund excavator excavates a trench 25 feet wide, digs around stumps, roots, and trunks and gets rid of same. However, when the stumps are pulled and when the rails have to be moved for the excavator, the operation must be stopped. The scoops dig out each layer without intermixing the different layers of the peat bog, which is a most important point with bogs in which the different layers differ in quality.

It is only adapted for peat transported and spread by gasoline or other engines. Such a process gives unsatisfactory results because the peat layers which are left on the drying field by such a system give a very ununiform and rough product, which is apt to crumble by handling and consequently increase the cost of the dry fuel.

Inasmuch as the excavator is placed on the bottom of the working trench, it is impossible to dam it up during the winter months; hence the walls of the trench are exposed to the frost, which is very injurious to the peat; except in a very few instances where it is of such a formation that it is able to withstand freezing.

Therefore, in general, such a scheme of working would not be favourable in countries like Canada, Russia and northern Sweden, where climatic conditions have to be taken into serious consideration.

If the bottom of the bog is formed by nature of blue clay, bleaching ground, or mud, and is quite level and firm, it would still give an insufficient bearing to the very heavy Ekelund excavator.

APPENDIX IV.

DISCUSSION ON PEAT POWDER AT STOCKHOLM.

The following information is abstracted from a report of the Technological Meeting held in Stockholm on November 19, 1911.

Captain Wallgren, who led the discussion on "The prospects for generating steam in general by using Ekelund's peat powder," described under what circumstances Ekelund's peat powder was manufactured at the Bäck peat bog, and said: "It should be observed that the conditions for manufacturing peat on the Bäck bog are especially favourable." The cost of manufacturing one ton of peat powder containing 40% moisture was about 8 kronor, 50 öre (1 krona=27c.), which he considered very low. He was convinced, however, that the cost in general of manufacturing peat powder on the ordinary Swedish peat bogs would exceed the above cost by 2 kronor per ton. He considered that even if this were the case, judging from the results obtained at the tests performed by the Steam Boiler Society, it would still be able to compete in fuel value with coal. These tests gave the following result, that 1 kilogram of coal was equal in fuel value to 1·4 kilograms of peat powder (1 kilogram = 2·2 lbs.), which results Captain Wallgren thought were too much in favour of the latter, because the fuel value of the coal could not be perfectly utilized during the above-mentioned test. However, if the tests of fuel value were undertaken with suitable arrangements for both kinds of fuel, the peat powder, according to Captain Wallgren's statement, would still be able to compete with coal.

Captain Wallgren stated that Dr. de Laval's wet-carbonizing method would, in the future, be able to compete with peat powder. At present, the method is only in an experimental stage and it will probably be a considerable time before any definite or practical results are obtained, although late information is very hopeful. He believes that the wet carbonized process will in the future solve the peat question, but in the meantime that peat powder will come into use.

At the same meeting Engineer Spets stated that the results obtained in testing the fuel value of peat powder, manufactured by the Salström process, showed that the cost of producing one ton of steam was 2 kronor and 40 öre, when the cost with coal was only 2 kronor.

Engineer Larson stated that the peat powder contained a larger percentage of ash than peat in a raw state. The reason for this he explained to be, that a certain quantity of peat burns up during drying, and taking this into consideration it will be found that the peat in a powder form has lost a certain percentage of its calorific value in the natural state.

He also stated that the cost of manufacture is considerably higher than that given by controllers, and that peat powder, under the most favourable circumstances, would not compete with coal.

Captain Wallgren proposed that this section of the Technological meeting should organize a committee and make a thorough test of both fuels. This proposal was defeated by a large majority.[1]

Mr. Alf. Larson, in a letter addressed to the late Mr. Anrep, dated November 20, stated that according to the figures given by Captain Wallgren, the price of 1 ton of peat powder is as follows:—

	kronor.	öre.
Cost of manufacturing peat powder on the Bäck peat bog	8	50
Cost of peat powder manufactured on an ordinary bog would exceed the above amount by	2	00
Freight and delivery to the purchaser from the factory	2	00
Profit per ton	1	50
Total cost per ton of peat powder	14	00

According to Captain Wallgren's statement, 1 ton of coal is equal in calorific value to 1·4 tons of peat powder.

Cost of peat powder compared with coal:—

Cost of 1·4 tons of peat powder.....19 kronor 60 öre
" 1 ton of coal at the harbour, from.....14 to 15 kronor.
" 1 ton of coal inland, varying from.....16 to 17 kronor.

Mr. A. Hendune, Moscow, Russia, in a letter of November 16, 1911, to the late Mr. Anrep, states: "I was lately in Dumfries, Scotland, and have seen the factory in operation for five days. I am convinced that the carbonization of peat was not performed in a practical and commercial manner, and that they have not succeeded in extracting the water economically by pressure."

The wet carbonizing process was taken up in 1902 by Dr. Ekenberg and Alf. Larson. At that time they received a bonus of 20,000 kronor from the Swedish government, which was spent without obtaining any economic results. In 1910 Dr. de Laval took up the experiments again. That year he received 19,000 kronor as a bonus from the Government, and a considerable sum from the Iron and Steel Society. In 1911 he received from the Government another bonus of 10,000 kronor.

His report to the Government officers is considered to be very favourable and promising. However, the process is still considered in Sweden to be in the experimental stage.

[1] This shows that Swedish technical men are not perfectly sure, at present, of the success of the new method of utilization of peat powder.

APPENDIX V.

TRANSLATION OF ARTICLES APPEARING IN SWEDISH NEWSPAPER: "STOCKHOLM AFTONBLADET."

March 9, 1912.

Ragnar Törnberg, who is manager of the middle and north Swedish Steamboiler Society, Branch Office, Göteborg, has been appointed engineer by Peat Company Torf.

Engineer Törnberg is convinced that it will be possible to produce peat powder which will be well suited as fuel for all kinds of purposes.

Taking into consideration the effective fuel value of the peat powder, it will cost less at the factory than coal at any Swedish harbour. Mr. Törnberg considers also the technical question solved, as the previous tests gave the best results, and it has shown that the powder is a splendid fuel for generating steam. It does not form soot nor slag, and gives an even flame, and it also requires less labour to run such a plant.

Lieutenant Ekelund has promised that before long he will deliver some remarkable news which, without doubt, will attract great attention.

March 12, 1912.

Hj. v. Porat, mechanical engineer, has demonstrated how to run a locomotive in the most practical way with peat powder.

The trial took place between Stocksund and Rimbo, returning on the Roslagen's railway, —a distance of 10 Swedish miles. (1 Swedish mile = 7 English miles.)

As the patents of his inventions are not yet issued, no detailed description can be obtained.

As peat powder is more bulky than coal, it was stored in a large receptacle which was placed on the tender of the locomotive. The floor of the receptacle sloped downwards to the engine, so that the powder ran down a specially constructed apparatus, which transported it mechanically to the fire box. On the way to the fire box the powder passed through a drum, where it was mixed with pre-heated air, which is necessary for combustion.

A small fire was started with coal or oil for the purpose of igniting the powder. As soon as the ignition has taken place the fire can be quenched.

The supply of powder can be regulated to suit the consumption of steam or the amount of heat required.

During the stops at the stations, as much powder is supplied as will keep the fire up.

Engineer Porat thinks that a low fire can be kept up for an hour without re-ignition or consuming large amounts of fuel.

He thinks, also, that steam can be raised more quickly with powder than with coal.

APPENDIX

The following tables give information regarding the amount of peat manufactured in Sweden and Denmark, which were the only two countries for which this information could be obtained.

It is hoped that next year statistics may be obtained relating to the amount of peat manufactured in Russia, Germany, Holland, and Norway.

TABLE VIII.

Table of Peat Manufactured in Sweden during 1909.

This table is taken from the report submitted to the Swedish Government in 1909, by Captain Wallgren, Government Peat Engineer.

County.	Peat Litter.				Average price per bale of				Peat Fuel.		Average price per ton.			
	Amount manufactured.								Amount manufactured.					
	No. of bales manufactured.		Loose peat.											
	No. of places in each county.	Bales.	No. of places in each county.	Cub. metres	Total m'f'g cost		Price at nearest railway station.		No. of places in each county.	Tons.	Cost of m'f'g per ton.		Price at nearest railway station.	
					Kr.	öre	Kr.	öre			Kr.	öre	Kr.	öre
Stockholm	3	18,504	6	20,190	1	02	1	16	2	35	5	60	11	
Upsala	2	49,347	4	48,525		66		78	3	3,669	7	36		
Sodermanland	2	24,909	3	40,939		93	1	03	1	200	5			
Ostergotland	3	24,200	4	6,020		88		93	3	5,150	6	40	10	
Jonkoping	8	127,480	9	130,370		85		89	.....	.....	.....	.....	.....	.....
Kronoberg	8	156,731	9	169,100		94		93	9	11,399	7	82	10	27
Kalmar	3	47,673	3	36,160		87		95	1	700	.....	.....	9	
Gottland	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,848	.....	.....	.....	.....
Blekinge	2	22,222	2	19,688		84		95	.....	.....	.....	.....	.....	.....
Kristianstad	10	238,232	8	264,433		99		98	6	12,685	11	20	10	33
Malmohus	1	32,226	1	29,000	1		1	17	3	5,691	9	31	10	
Hallands	2	39,487	4	65,015		91	1	09	4	776	8	17	11	
Goteborgso Bohus	1	800	1	2,000	1		1	35	.....	.....	.....	.....	.....	.....
Skaraborg	10	189,882	8	136,230		81		91	9	5,949	8	07	10	86
Varmland	9	65,800	7	83,327		89	1	01	3	3,370	6	50	10	
Orebro	14	322,684	14	186,608		79		87	4	3,495	7		11	
Vastmanland	5	98,808	6	75,800		87		91	3	3,396	8	06	8	
Kopparberg	4	25,495	5	19,100		86	1	03	1	50	.....	.....	.....	.....
Gafleborg	5	82,135	6	122,120		87	1	10	.....	.....	.....	.....	.....	.....
Jamtland	3	10,600	1	2,000	1	06	1	42	.....	.....	.....	.....	.....	.....
Vasternorrland	1	.....	1	2,000		70	.....	.....	.....	.....	.....	.....	.....	.....
Vasterbotten	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Norrbotten	1	4,000	1	3,800	1	25	1	70	2	322	10	05	.....	.....
Total	104	1,655,635	109	1,467,525		91	1	06	57	64,925	7	82	98	7
Average per factory		15,920	.....	13,463		88		98	.....	1,139	8	18	101	9

The amount of peat fuel manufactured is comparatively small, but as the last three seasons have been exceptionally wet, several large peat fuel plants have closed down for a time. These expect to resume work in 1910.

1 kronor=27 cents.

TABLE IX.

Total Amount of Machine Peat Manufactured in Denmark during 1910.

Names of peat plants.	No	D=steam. EM=electric motor PM=gasoline. The figures indicate H.P. used	Number of labourers.	Number of engineers and drivers.	Number of horses.	The drying field. F=hard ground. M=boggy ground.	Working time. Working hours per day.	Working time. From date to date.	Working time. Wasted days.	Working time. Total working days.	The Manufactured Product. Daily capacity, thousand. Average.	Daily capacity, thousand. Maximum	Yearly. per 1,000.	Yearly. Tons.	Tons during 1909.
		A.–Machine Peat													
Holmegaard glass works I	1	D 8	29	4	2	M	10	27–4 – 3–8		82	63	72	5,000	2,500	4,739
Holmegaard glass works II	2	D 10						27–4 – 30–7	2	77	62	72	5,000	2,500	
(1) "Sogaard," Roskilde	3														
													10,000	5,000	4,739
		B. Machine Peat Manufactured with Additional Water. 1.—*Stationary Plants.*													
Baks, N., peat plant, Sparkaer	1	D 5	3	3	2	F	10	8–5 – 3–8		about 68	25	42	1,700	850	1,000
Bjerregaards peat plant, Vinderup	2	D 6	10	4	4	F	10½	18–4 – 30–7	3	85	55	70	3,900	1,755	2,000
Bjornkaer peat plant, Vinderup	3	D 8	10	4	4	F	10½	20–4 – ?	4	about 73	55	74	4,000	1,600	2,100
Brunmhag peat plant, Ebeltoft	4	D 8	10	3	3	F and M	11	23–5 – 8–8		about 56	35	41	1,970	985	983
Braendstrup peat plant, Rodkaersbro	5	D 7	7	3	2	F	10	6–5 – ?		60	33	46	2,000	900	900
Engesvang, large plant, Moselund	6	D 40 D 20	18	5	4	F	11	11–4 – 30–7	3	about 80	150	170	11,000	4,950	3,565
Engesvang, small plant, Moselund	7	D 10	9	3	3	F	11	23–4 – 21–7	2	72	65	85	4,500	2,250	
Finderup peat plant, Viborg	8	PM 4	4	2	2	F									
Gammelgaards peat plant, Mejrup, Holstebro	9	D 6	6	3	2	M	10	15–4 – ?		50	40	45	2,000	1,000	
Gandrupgaard peat plant, Doense	10	PM 12	7	7	6	F	11	1–5 – 31–7		60	65	80	4,000	2,000	875
Gatten peat plant, Hornum	11	D 5	5	4	3	F	11	14–5 – 30–7		66	31	41	about 2,000	1,000	925
Grauballegaard peat plant, Silkeborg	12	D 8	9	4	3	F	11	30–4 – 30–7	11	66	40		2,500	1,125	1,650
(2) Horby peat plant, Hobro	13	PM 10	8	1	1	F	10	10–5 – 13–8		70	32	42	2,250	1,125	
Kalbygaard peat plant, Laasby	14	D 7	10	2	3	M and F	10½	11–5 – 2–8		52	50	62	2,500	1,250	1,500
Karup peat plant, Karup	15	D 6	6	5	3	F		26–4 – 28–7		72	35	42	2,500	1,500	1,920
Klosterlund peat plant, Moselund	16	D 12	9	3	3	F	11			75	60	80	4,500	2,250	2,250
Kaergaard peat plant, Sparkaer	17		11	4	4	F	10	7–5 – 26–7	5	63	65	83	4,250	1,590	2,270
Lundergaards bog, Aabybro	18	D 12	13	6	5	F	11	25–4 – 1–8	4	78	70	80	5,000	1,875	1,500
Mosbjerg peat plant, Tolne	19	D 8	11	3	2	F	11	29–5 – 15–8		about 55	40	52	2,000	800	1,200
Mosegaards plant, Sparkaer	20	D 10	7	2	2	M	10	16–6 – 8–7		20	33		626	203	625
Moselund A, Moselund	21	D 8	3	4	4	F	11	14–4 – 30–7		28	48	56	4,000	2,000	2,250
Moselund B, "	22	D 35	8	1	1	M	11	25–4 – 16–7		50	55	64	2,400	960	1,250
Moselund C, "	23		12	3	2	F	11	11–4 – 26–7		80	80	102	5,600	2,520	2,500
Nagbolgaard peat plant, Lunderskov	24	D 8	9	4	3	F	10½	15–5 – 23–7		about 52	66	82	3,000	1,125	2,020
Onsild peat plant. Onsild	25	D 5	6	3	2	F	10	29–4 – 30–7	6	71	37	48	2,450	1,100	977
Ronbjerg peat plant, Peat litter plant, Vinderup	26	D 12	11	3	3	F	10½	14–4 – 5–8		about 85	60	75	5,000	2,500	2,400
Ronbjerg peat plant, Peat litter plant, Vinderup	27	D 12	9	3	3	F	10½	20–4 – 4–8		90	50	75	4,500	2,250	2,100
Ronbjerg peat plant, Ronbjerg	28	D 12	16	4	5	F		14–4 – 4–8		95	80		7,500	3,750	4,000
Stauso peat plant, Ronbjerg	29	D 8	7	3	3–4	F	10	11–4 – 31–7		about 82	30	45	2,300	920	1,500
Sparkaer peat plant, Sparkaer	30	D	11	4	3	F and M	10	2–5 – 3–8	10	78	70	88	5,300	1,855	2,520
Staarupgaard peat plant, Hojslev	31	D and EM 8	11	4	4	F and M	10	1–5 – ?		55	57	72	3,100	1,550	1,500
Stokholm peat plant, Doense	32	PM 10	6	3	3	F		23–5 – 14–7	9	32	45	53	1,500	525	700
Sorensen, Kbm. peat plant, Ronbjerg	33	PM 8	4	2	1	F and M	9	3–5 – 17–7	15	43	20	27	1,000	400	750
Tandrup peat plant, Bedsted	34	D 6	9	2	1	M	11			about 55	60	68	3,300	1,650	1,500
Tougaards peat plant, Sparkaer	35	D 12	9	4	3	F	10½	6–5 – 29–7		72	60	74	4,250	1,700	2,072
Tustrup peat plant, Randers	36	D 6	8	3	2	F	10	15–5 – 15–7	13	39	35	52	1,200	720	
Tvaer bog, the northern peat plant, Vinderup	37	D 12	10	3	3	F	10½	16–4 – 5–8	4	88	51	75	4,750	1,900	1,930
(3) Tvaer peat bog, central peat plant, Vinderup	38	D 10	10	4	4	F	10½	16–4 – 4–8	4	87	47	70	4,300	1,720	1,950
Vestergaards peat plant, Sparkaer	39	D 8	4	3	2	F	10	2–5 – 27–7	3	70	about 38	45	2,500	1,250	640
Videbaek peat plant, Videbaek	40	D 4	6	3	2	F	11	3–5 – ?	15	about 32	about 38	45	1,200	600	550
Okaer peat plant, Sparkaer	41	D 20	5	3	2	F	10½	1–5 – 29–7	about 6	about 70	about 40	49	2,681	1,340	2,715
Ostergaards peat plant, Sparkaer	42		5	2	2	F	10½	24–4 – 17–6	about 5	about 46	33		1,500	490	2,077
													136,527	61,833	63,164
		2.—a, *Floating Plants.*—													
Aa peat bog, Vedde (4 plants)	1	D 24	18	8	10	M	11	1–5 – 30–7	3	73	133	170	8,910	3,564	4,639
Birknaer peat plant, Ostbirk	2	PM 6	5	2	1–2	F	10	17–5 – 16–8			about 33	35	800	400	250
(4) Brokso peat plant, Herlufmagle	3														
(5) Bedsted peat plant, Bedsted	4	EM 6	5	1	1	M	10	25–4 – 24–6	2	about 49	about 20	30	900	450	500
(6) Hassing peat plant, Hordum	5														
Holmegaards glass-works, Olstrup	6														
Erik Jorgensen's peat plant, Ejby	7	PM 2	3			M	10	17–5 – 6–8		56	12	15	672	268	
Kvodsted peat plant, Logstrup	8	PM 2	3	1	1	M	10	1–6 – 3–8		about 35	16	24	550	200	400
Mosegaard peat plant, Struer	9	D 6	5	2	2	M	11	7–5 – 28–7		about 70	30	45	2,100	1,050	982
Rosenholm peat plant, Hornslet	10	PM 8	6	3	4	F	10	2–5 – 16–7	4	61	50	65	2,830	1,132	1,483
(7) Solvang peat plant, Thorsager	11	PM 4	4	2	1	M	10	28–5 – 4–8		about 53	20	28	1,000	500	
Tangsgaard peat plant, Humlum	12	D 5	5	2	2	M	11	9–5 – 30–7		about 56	35	42	1,900	950	950
Tranekaer peat plant, Tranekaer	13	D 4	8	2	2–3	M	10	10–5 – 16–7		58	35	52	2,000	1,600	2,225
													21,662	10,114	11,429
		b.—*Peat Plants Driven by Motor or Horse-power.*—													
Bogildgaard's bog, Kellerup	1	H	2 men 7 boys		1	F	10	1–6 – 20–8		15–20	9	13	150	52	52
Lyng bog, Kibaek	2	H	7	1	1	M	10						40		
(8) Th. Jensen, Linderupgaards Mark, Sindal	3	PM 8	4	3	2	M	11	10–5 – 24–6		about 30	50	69	1,300	650	
L. Nielsen's peat plant, Pindstrup, (3 plants)	4	H	11		3	M	10	6–5 – 25–6	none	43	40		1,700	850	800
Pindstrup peat plant, Pindstrup	5	H 10 PM 1	36	1	11	M	10	1–5 – 1–8		about 65	120	150	7,000	2,800	2,206
(9) Spjarupgaard peat plant, Egtved	6														
(10) Stubbergaards peat plant, Sevel, Vinderup	7	D 4	6	3	2	F	10	5–5 – 7–6		about 20	about 20	26	380	266	
Sondergaard, H., peat plant, Ronbjerg	8	PM 4	3	1	1	F and M	10	15–5 – 26–7		about 35	20	25	600	300	750
(11) Vikso peat plant, Vikso	9														
		509	521	175	167								11,170	4,913	3,808
											Total:		179,359	81,865	83,140

The total peat manufactured during 1910—about 180,000,000 peat bricks, or about 82,000 tons.

" " " " 1909— " 193,000,000 " " " 89,000 "

(1) Was not working in 1910.
(2) (7) and (10) are new plants.
(3) "The Central Peat Plant," earlier called Tvaer peat bog, southern plant.
(4) Information is lacking.
(5) First year in operation.
(6) Peat plant ceased running.
(8) Works as contractor on several bogs.
(9) The amount manufactured is of no importance.
(11) Information was not given this year.

This table was given by J. Rasmussen, peat engineer, to the Danish Peat Society Journal, "Hedeselskabets Tidskrift," February 10, 1911.

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HON. ROBERT ROGERS, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
EUGENE HAANEL, PH.D., DIRECTOR.

REPORTS AND MAPS OF ECONOMIC INTEREST

PUBLISHED BY THE

MINES BRANCH

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3. Investigation of the different electro-thermic processes for the smelting of iron ores, and the making of steel, in operation in Europe. Report of Special Commission—by Dr. Haanel, 1904. (Out of print).

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45. Production of Coal, Coke, and Peat in Canada during the calendar years 1907 and 1908. Bulletin on—by John McLeish.

46. Production of Natural Gas and Petroleum in Canada during the calendar years 1907 and 1908. Bulletin on—by John McLeish.

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    Vol. I—Coal Washing and Coking Tests.
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117. General Summary of the Mineral Production in Canada during the calendar year 1910. Bulletin on—by John McLeish.

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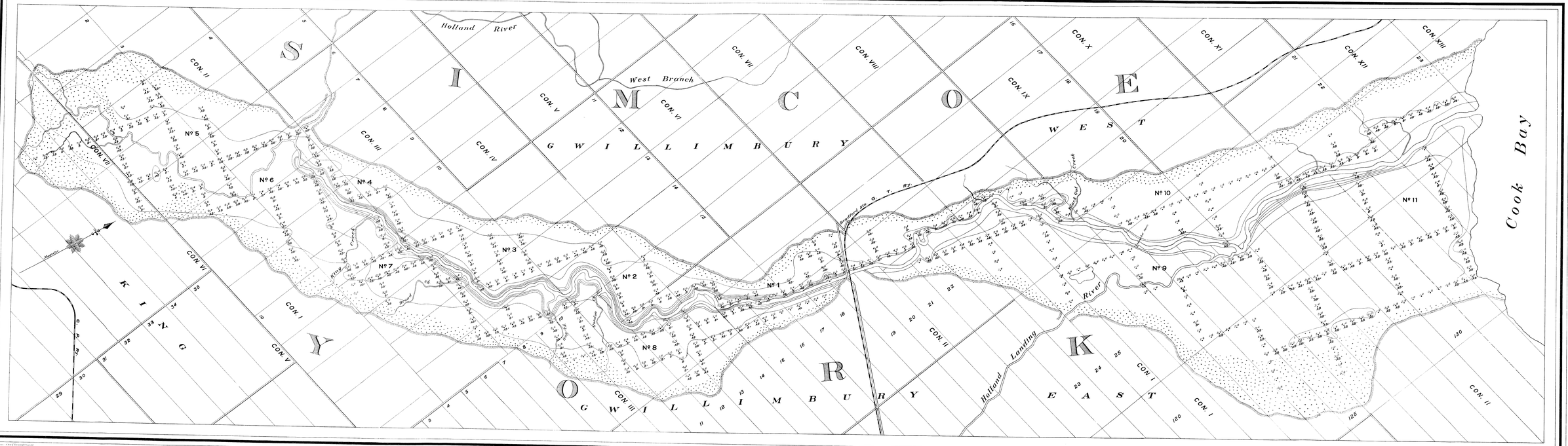

THE HOLLAND PEAT BOG
ONTARIO

Scale of Feet

LEGEND
Margin of Bog
Heavily wooded areas
Nº 1 roll *Location where samples were taken for analysis*

Surveyed by
A. Anrep 1910

Map Nº 113

To accompany Bulletin No. 4,
"Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151

Canada

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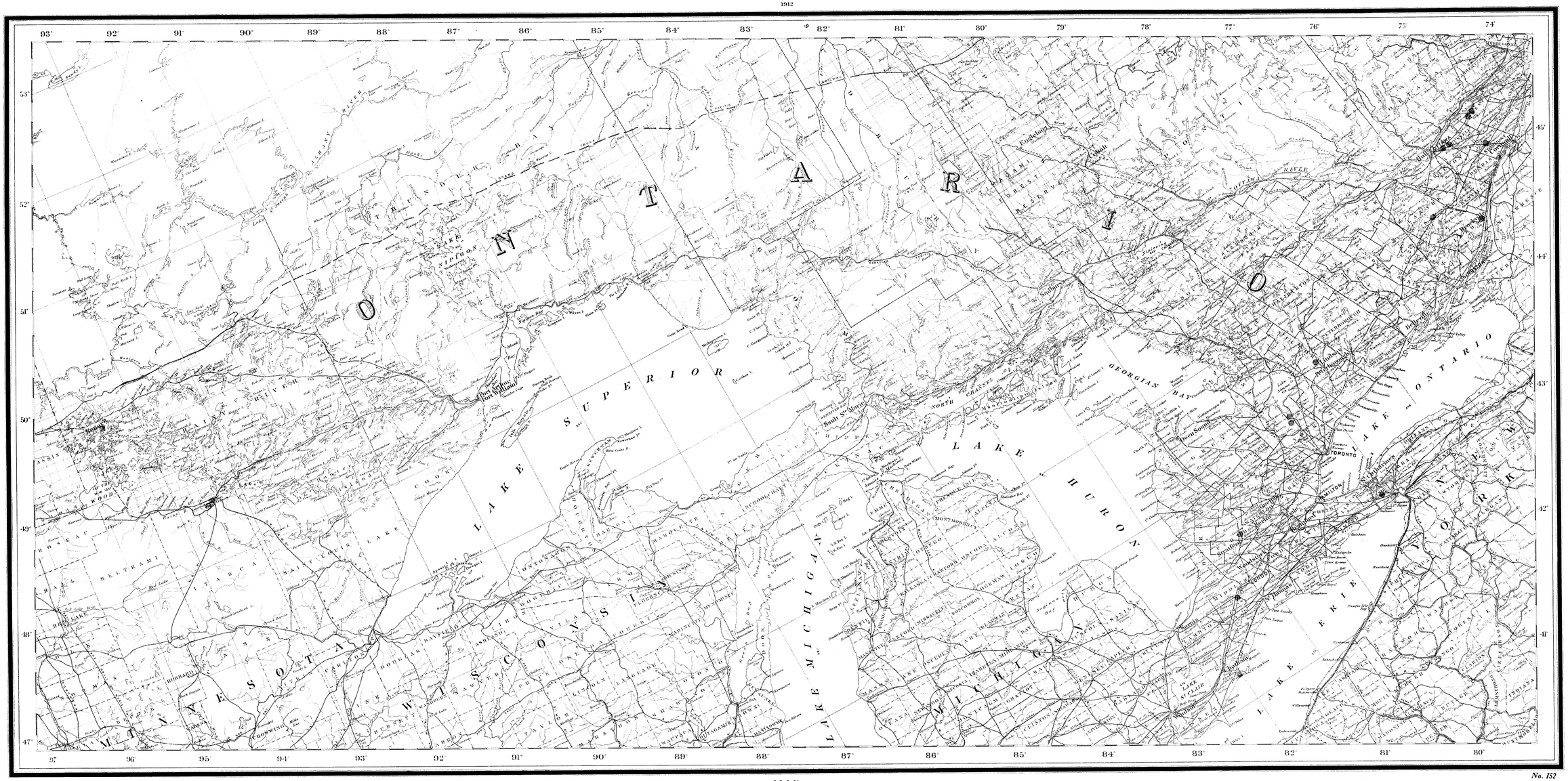

No. 152

To accompany report No. 151
"Investigation of Peat Bogs and Peat Industry of Canada," 1910-1911, by A. Anrep, Peat Expert.

Base map, Chief Geographer, Dept. of the Interior
H. E. Baine, Chief Draughtsman

● *Peat fuel bogs.*

○ *Peat litter bogs.*

MAP
SHOWING THE LOCATION OF
PEAT BOGS INVESTIGATED
IN
ONTARIO.

Scale 35 Miles to 1 Inch

45 0 25 50 75 100 125 150

Canada

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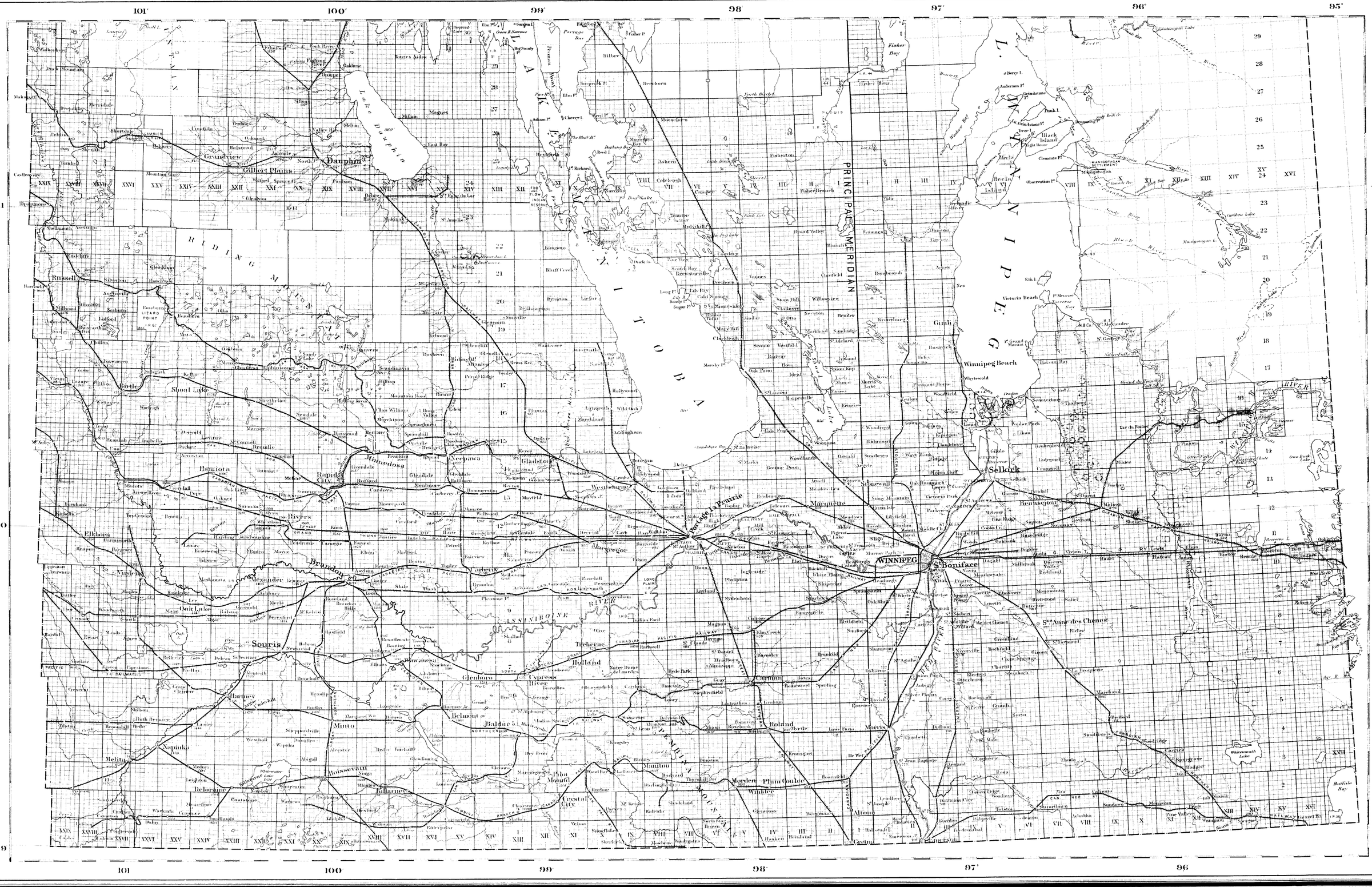

Base map, Chief Geographer, Dept. of the Interior
H. E. Baine, Chief Draughtsman.

- *Peat fuel bogs.*
- *Peat litter bogs.*
- *Not workable bogs.*

MAP

SHOWING THE LOCATION OF

PEAT BOGS INVESTIGATED

IN

MANITOBA.

Scale, 1:7,920,000 or 12½ Miles to 1 Inch

10 0 10 20 30 40 50 Miles

No. 153.

To accompany report No. 151
"Investigation of Peat Bogs and Peat Industry of Canada," 1910-1911, by A. Anrep, Jr. Peat Expert.

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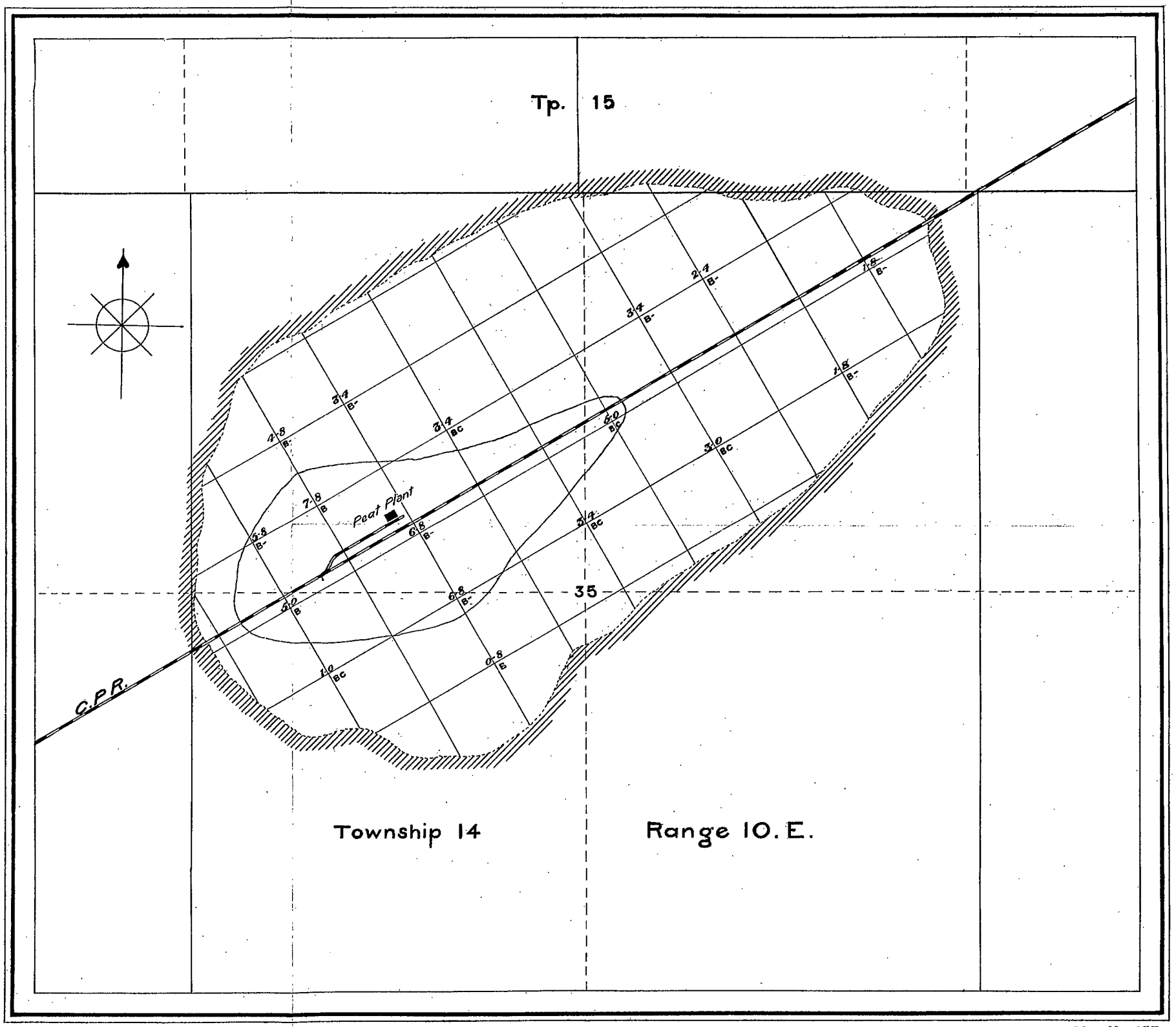

H. E. Baine, Chief Draughtsman

LAC DU BONNET PEAT BOG

MANITOBA

Scale of Feet

500 0 500 1000 1500

Map No. 157,

To accompany Bulletin No. 8,
"Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

Surveyed by
A. Anrep—1911

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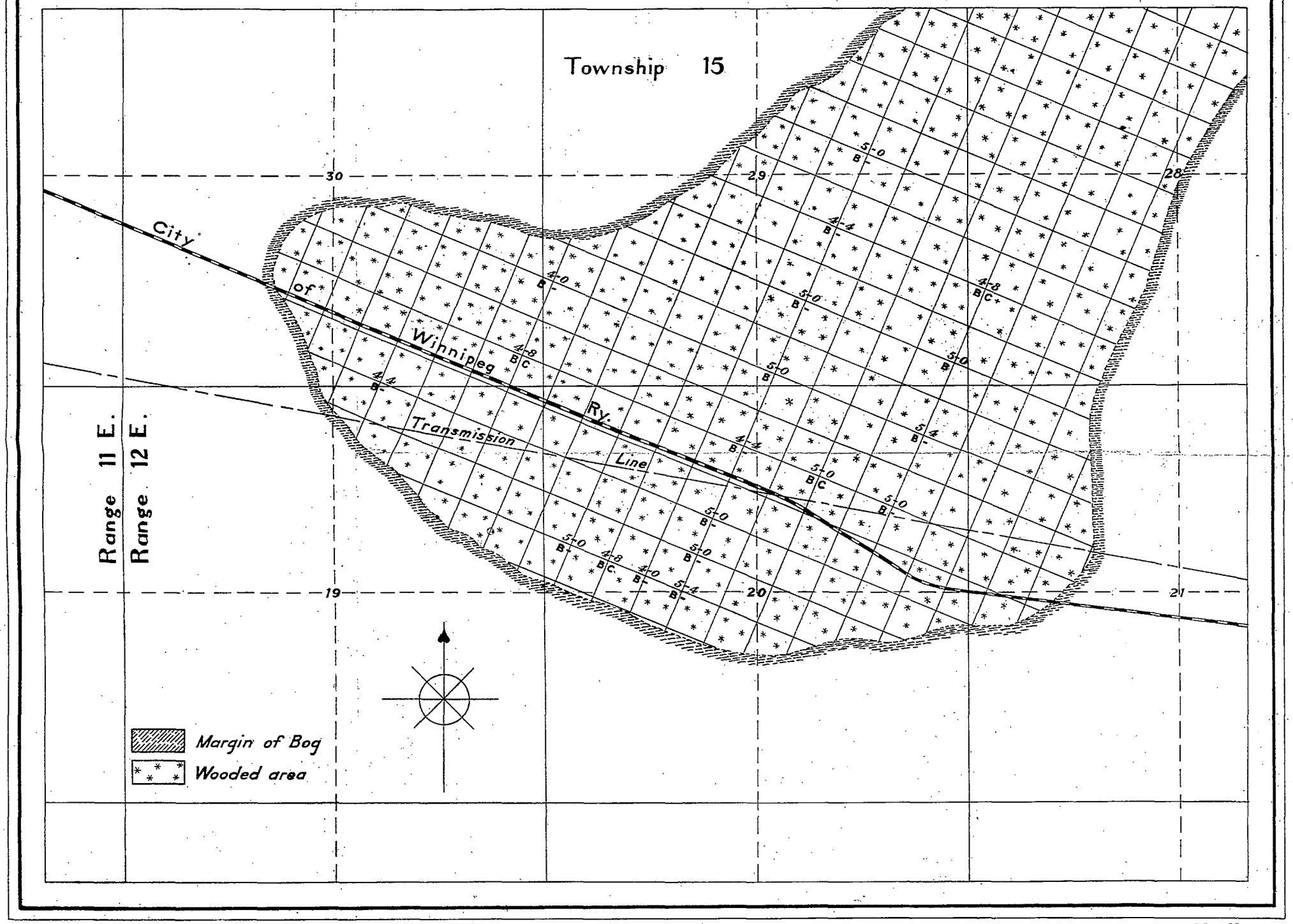

H. E. Baine, Chief Draughtsman

Map No. 158,

TRANSMISSION BOG

MANITOBA

Scale of Feet

1000 0 1000 2000 3000 4000

To accompany Bulletin No. 8,
"Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

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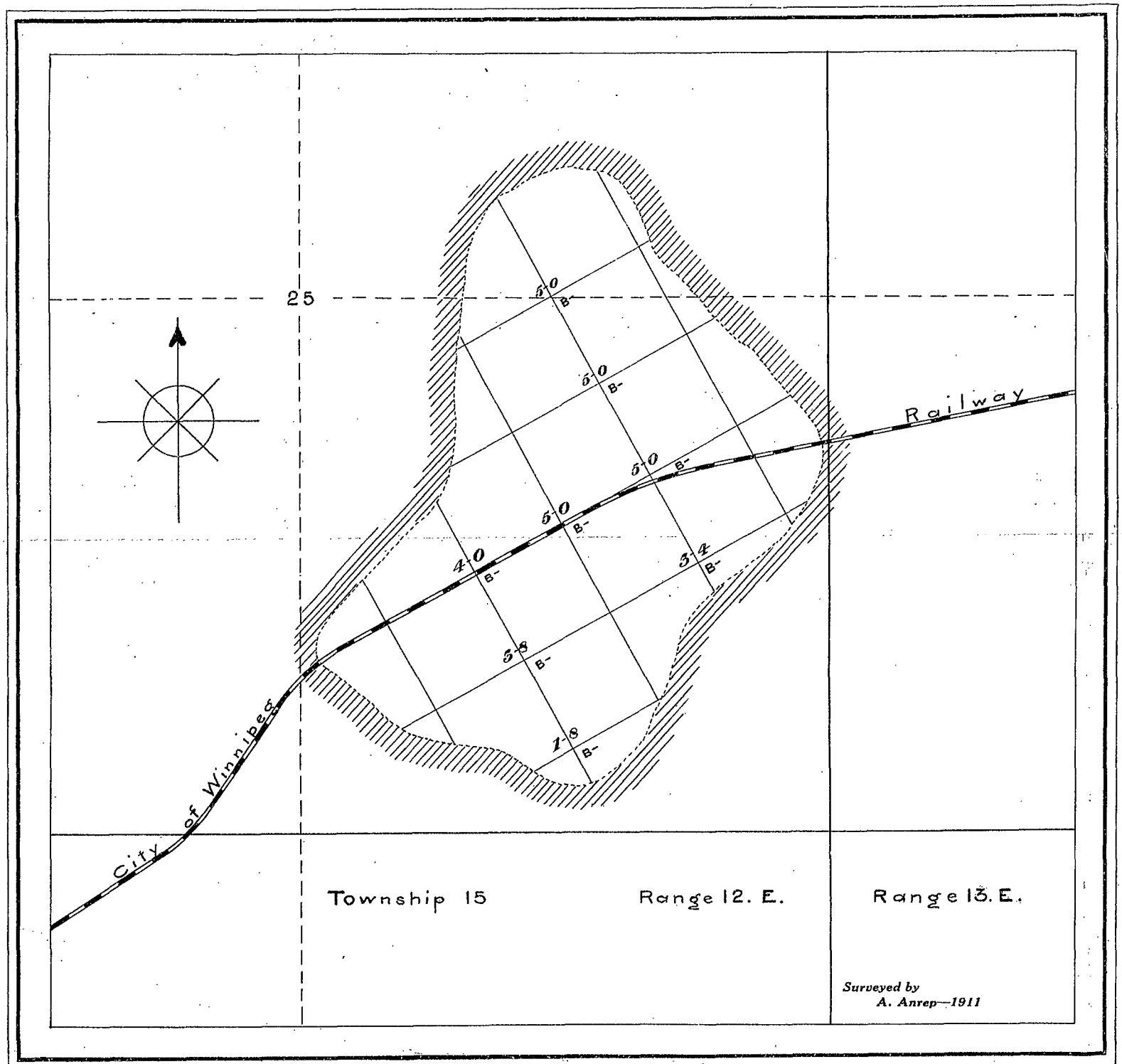

H. E. Baine, Chief Draughtsman

CORDUROY BOG

MANITOBA

Scale of Feet

500 0 500 1000 1500

Map No. 159,

To accompany Bulletin No. 8,
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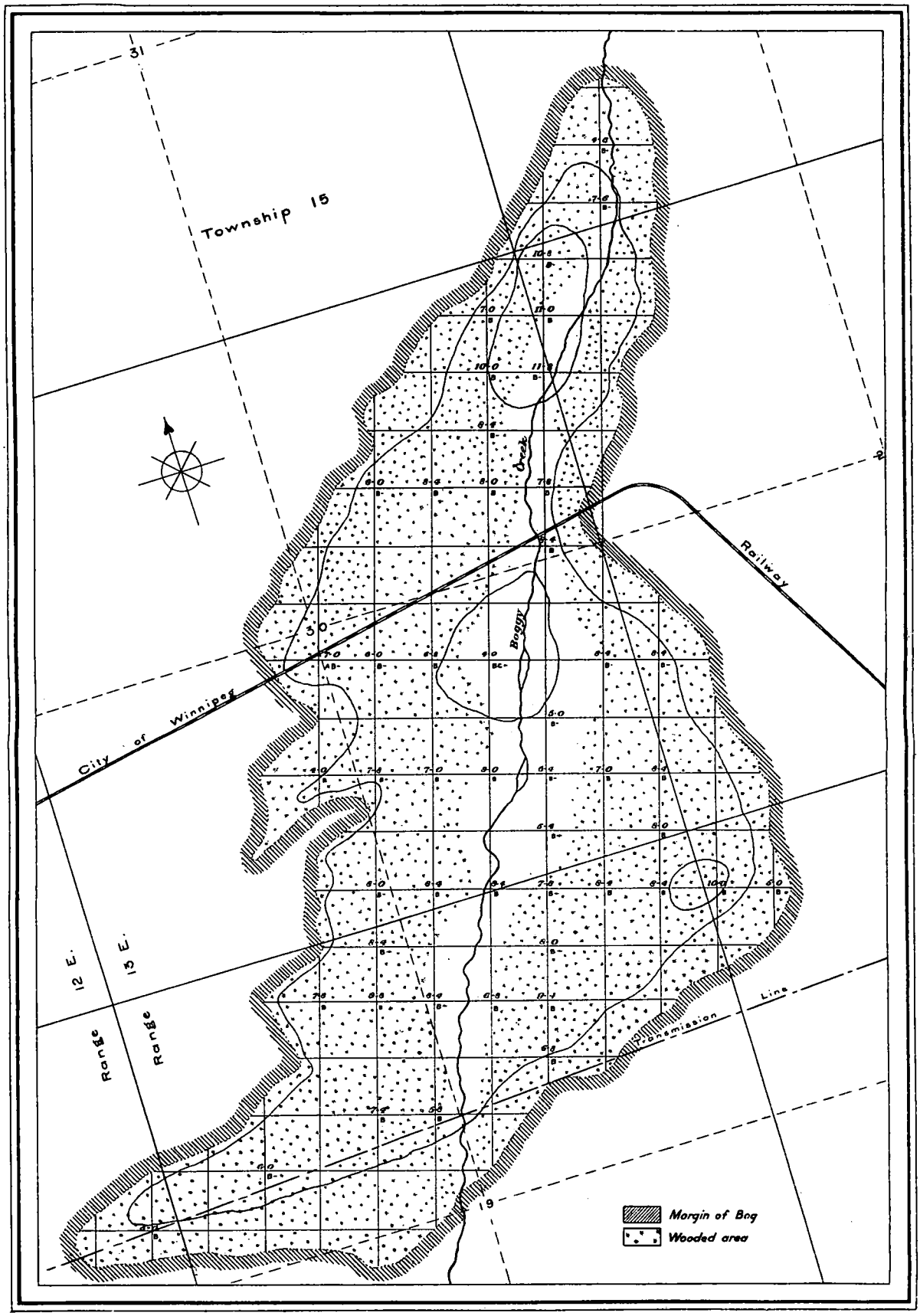

BOGGY CREEK PEAT BOG

MANITOBA

Scale of Feet

500 0 500 1000 1500 2000 2500 3000

Map No. 160,

To accompany Bulletin No. 8, "Investigation of Peat Bogs and Peat Report No. 151. Industry of Canada."

8

1911

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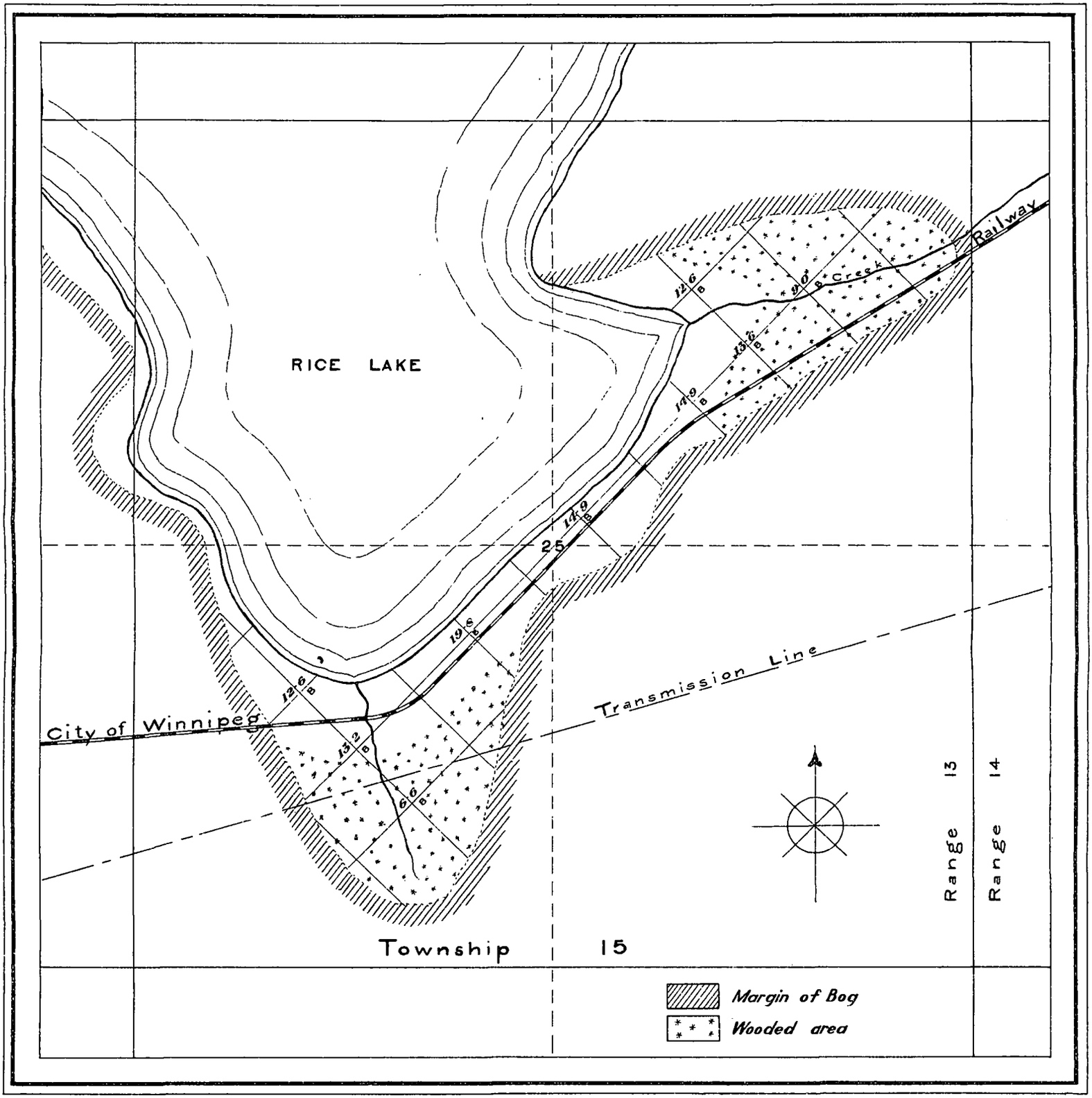

H. E. Baine, Chief Draughtsman

RICE LAKE PEAT BOG
MANITOBA

Scale of Feet
500 0 500 1000 1500

Map No. 161,

To accompany Bulletin No. 8,
"Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

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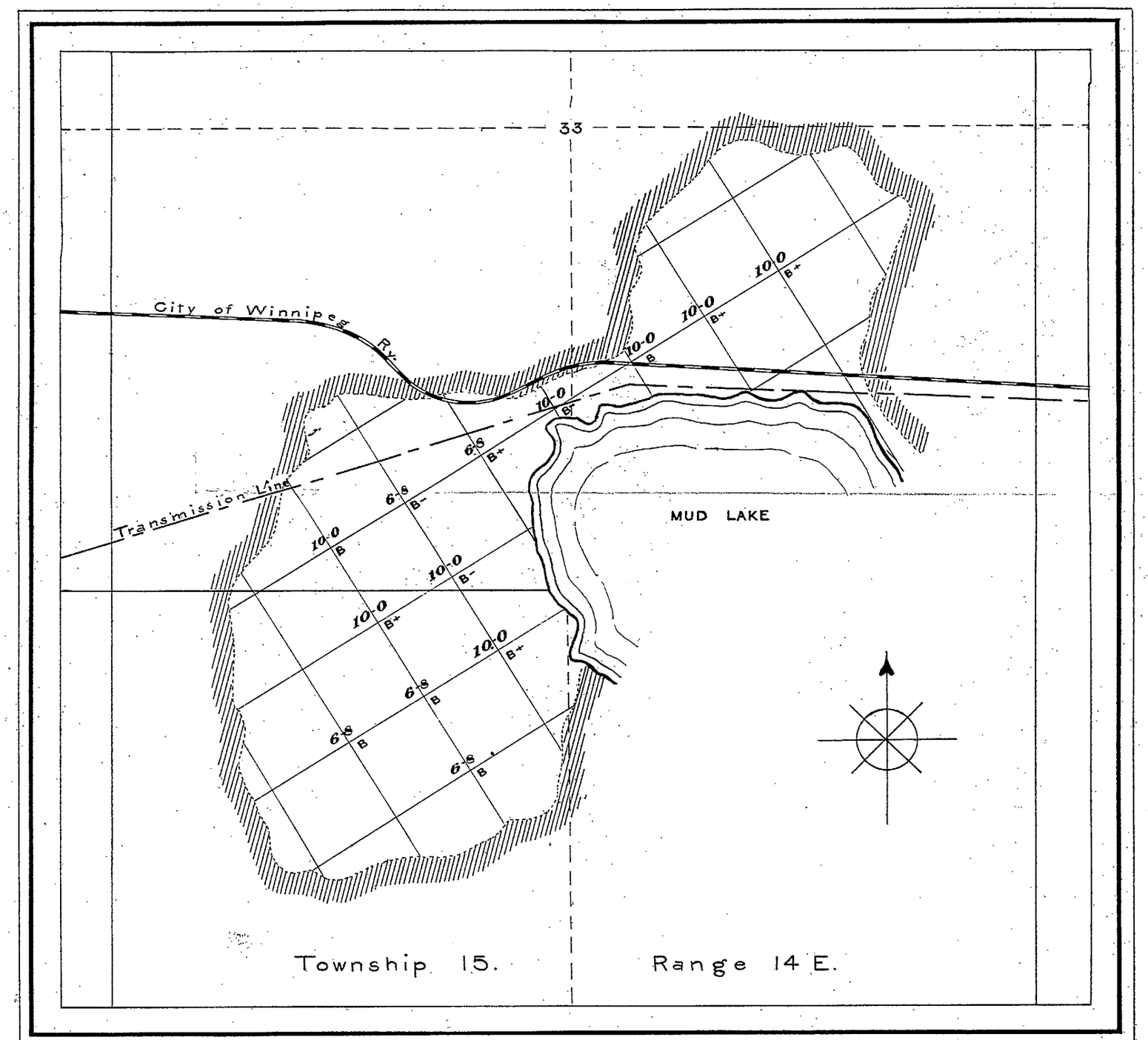

H. E. Baine, Chief Draughtsman

MUD LAKE PEAT BOG

MANITOBA

Scale of Feet

500 0 500 1000 1500

Map No. 162,

To accompany Bulletin No. 8, "Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

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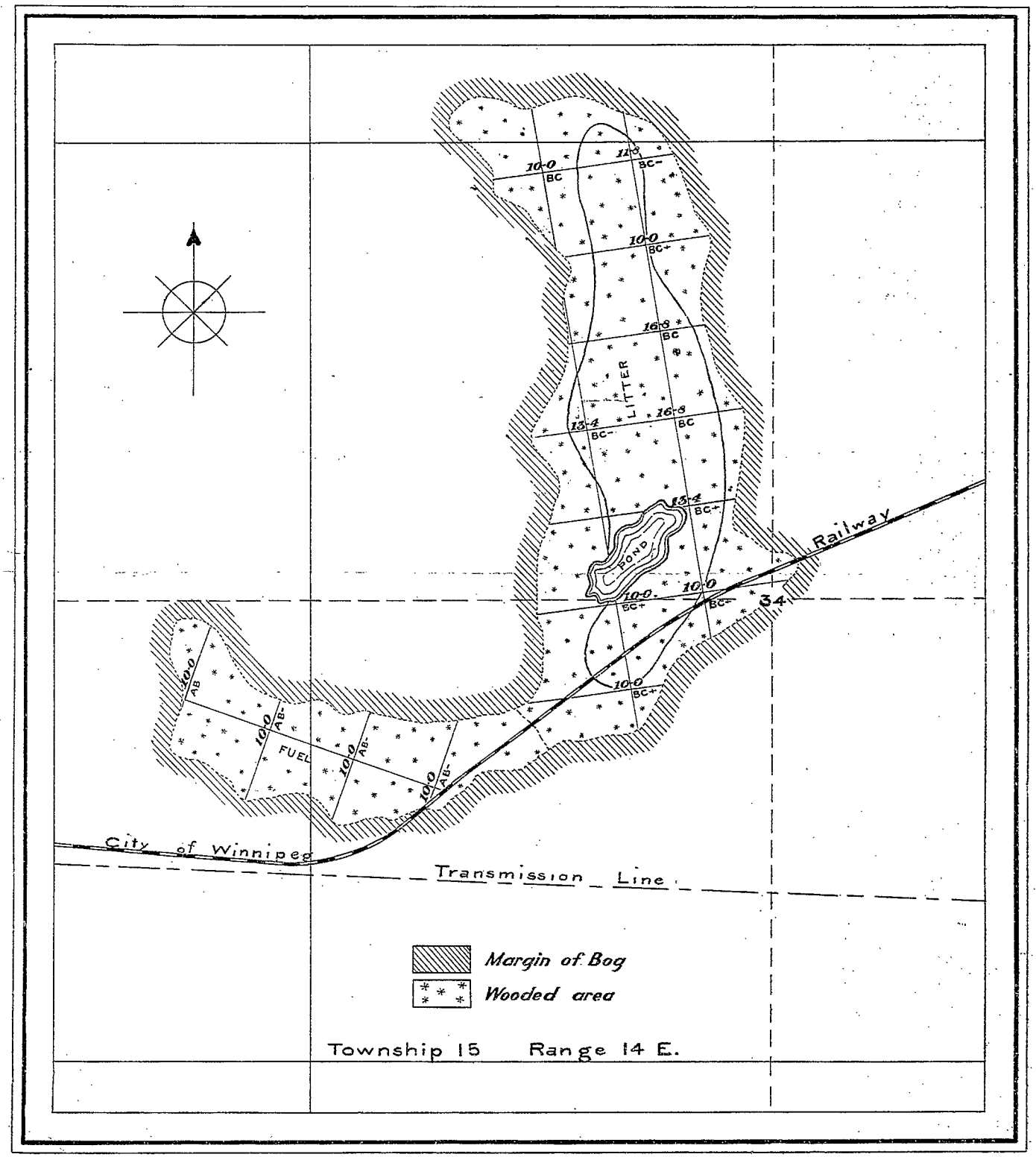

H. E. Baine, Chief Draughtsman

LITTER BOG
MANITOBA

Scale of Feet
500 0 500 1000 1500

Map No. 163.

To accompany Bulletin No. 8,
"Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

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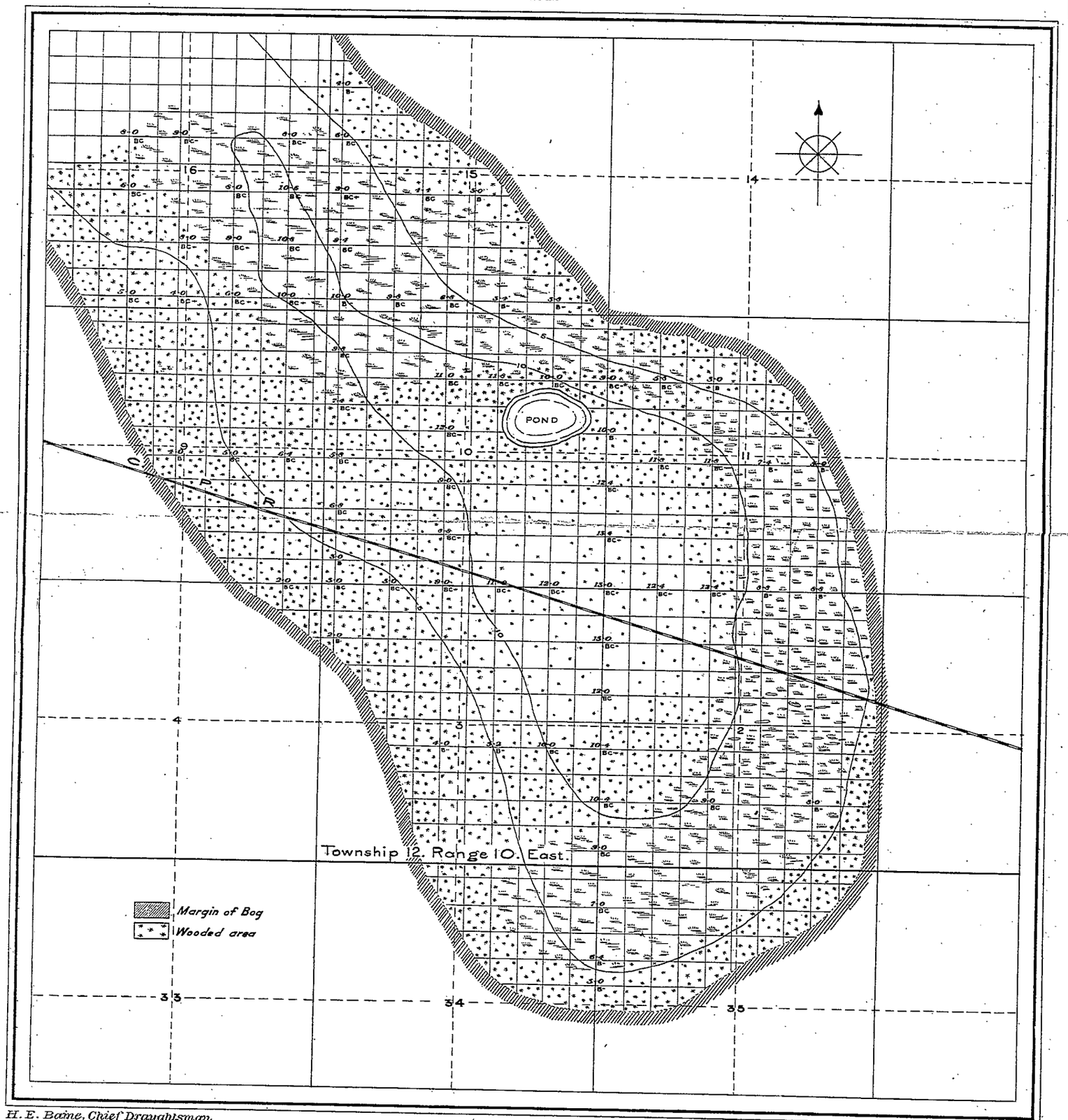

H. E. Baine, Chief Draughtsman

JULIUS PEAT BOG

MANITOBA

Scale of Feet

1808 0 1000 2000 3000 4000

Map No. 164,

To accompany Bulletin No. 8
"Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

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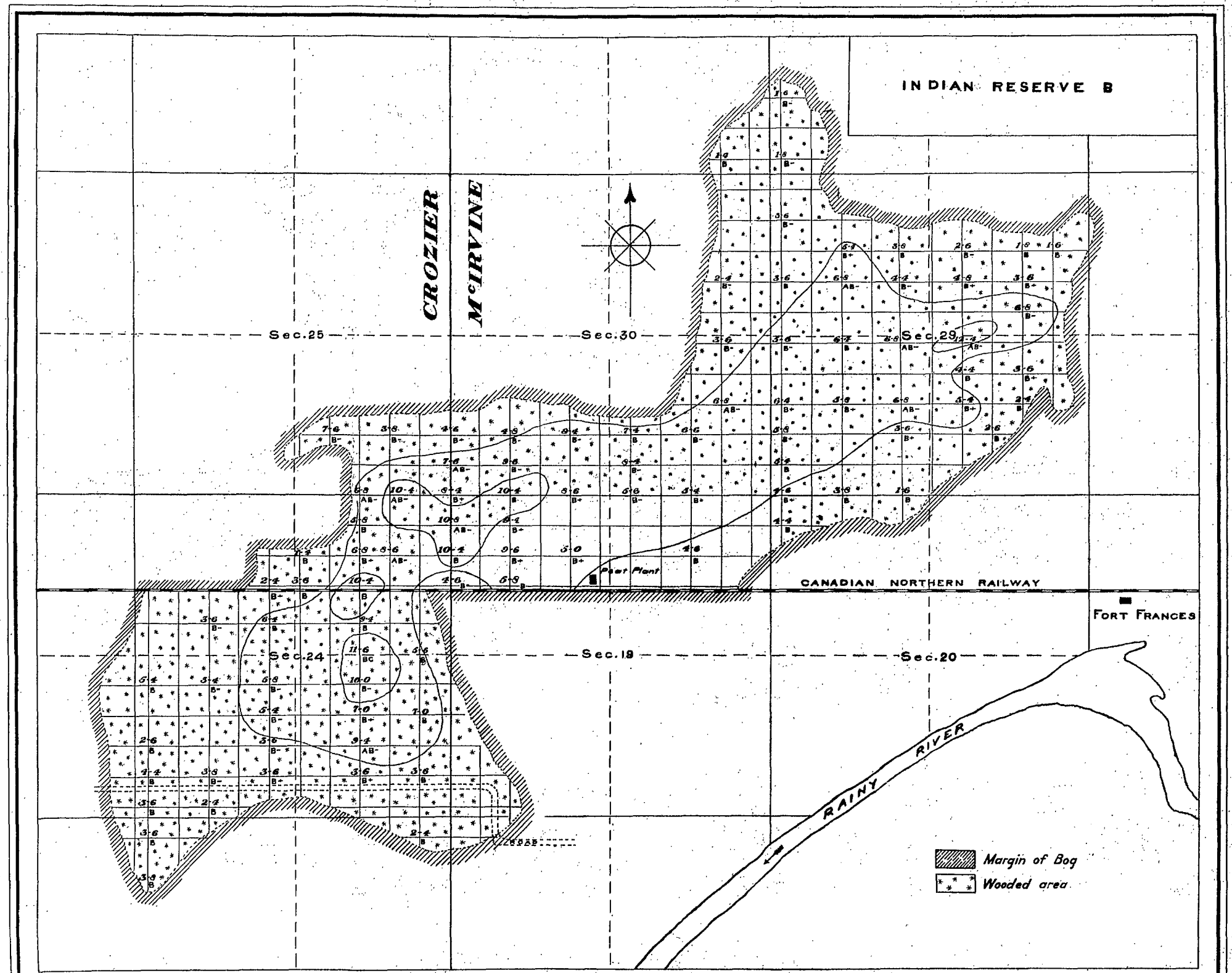

H. E. Baine, Chief Draughtsman

FORT FRANCIS PEAT BOG

ONTARIO

Scale of Feet

1000 0 1000 2000 3000 4000

Map No. 165,

To accompany Bulletin No. 8, "Investigation of Peat Bogs and Peat Industry of Canada." Report No. 151.

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