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CANADA
DEPARTMENT OF MINES
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MINES BRANCH
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FACTS ABOUT PEAT

BY

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The Dominion Fuel Board has co-operated in facilitating
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FACTS ABOUT PEAT

INTRODUCTION

The serious industrial disorders which occurred in the United States in 1917-18, and again in 1921-22, forcibly directed the attention of Canadians to the possibility of utilizing the large peat resources of the provinces of Ontario and Quebec for fuel purposes. Peat, it is well known, represents the only fuel resource which exists in large quantities in these provinces, and since they are largely or wholly dependent upon the United States for fuels for both domestic and industrial purposes, the desire to render them independent of or less dependent on a foreign source for a fuel supply is only natural.

In 1918 a Peat Committee was appointed jointly by the Federal and Ontario Governments to conduct an investigation, the objective of which was to ascertain the feasibility of manufacturing peat fuel on a commercial scale. Investigations concerning peat resources and processes which have been developed for manufacturing raw peat into a marketable fuel have been conducted by the Mines Branch of the Department of Mines for several years, but interest, prior to the war, as to the possibilities of peat fuel was not keen. High-grade fuels at that time for all purposes could be obtained at reasonable prices. To-day, however, the conditions are changed. Not only is it within the realm of probability that acute fuel shortages will occur at any time, thus depriving the central provinces of a fuel for heating dwellings, upon which human life depends, but imported coal, especially anthracite, which is used almost entirely for domestic purposes, is becoming of lower grade, while the cost per ton is mounting rapidly. Peat fuel, therefore, which can be manufactured from many bogs which are strategically situated with respect to large communities and transportation facilities can now compete with the imported coals for certain purposes, both as to cost per 1,000,000 heat units, and, for certain domestic purposes, as to quality.

General and keen interest in the peat resources of Canada as a possible source of fuel for domestic and other purposes is manifested by the numerous enquiries which are received by the Mines Branch. Inasmuch as the enquiries are generally of a similar nature, it is considered desirable to prepare a bulletin indicating in a brief manner the nature of the peat, the location and estimated fuel contents of bogs so far investigated in Canada, difficulties involved in the production of a marketable fuel from peat, and the underlying principles upon which any successful attempt at manufacturing must be based. It is not the purpose of this bulletin to enter into technical and theoretical phases of the subject. These would require more space than is here available, and would prove of very little value to the average reader.

Through the co-operation of the Dominion Fuel Board, the services of A. J. Forward, B.A., were secured to conduct library and research work and to assist generally in its preparation. As Secretary of the Canadian Peat Society and Editor of its Journal for a period of several years, and also

owing to his active association with the work of the Peat Committee for two years, Mr. Forward's knowledge of the developments in the peat industry both in Canada and other countries has made his services in this connection valuable.

A brief account is given of unsuccessful efforts which have been made at various times and the methods which were experimented with; also the investigation conducted by the Canadian Government as to the manufacture of peat fuel on a small commercial scale. The Air-Dried-Machine-Peat Process, the only process which has so far been employed successfully on a large scale, is described, and the character and value of the fuel manufactured according to this process, as well as certain points arising in connection with its uses, are discussed. Other uses of peat are also briefly dealt with. Detailed information relating to Canadian peat bogs so far investigated are summarized in tabular form. A number of opinions of users of peat fuel are quoted, and a short bibliography is included, indicating the principal sources of information on which the bulletin is based.

It is probable that the peat resources of the provinces of Ontario and Quebec will, in the near future, be considered as a very valuable source of fuel, not only for domestic but for industrial purposes, and those most advantageously situated with respect to thickly populated communities and transportation facilities are bound to be vigorously developed, as soon as the people of the above-mentioned provinces obtain a knowledge of this fuel, its properties, the methods which can be successfully employed for converting it into a fuel and its value in the recovery of by-products. When capitalists no longer look upon the manufacture of peat fuel as a hazard, and peat is manufactured in large quantities, it is likely that by-product recovery plants burning peat, or other plants utilizing peat in some form which will make available a large quantity of by-products valuable to chemical industries and for agricultural purposes will be established. It is hoped that the information contained in this bulletin may serve to correct erroneous ideas which have been entertained by many with regard to peat, its production and utilization as a fuel. Such ideas have in many instances led to disappointment and the loss of large amounts of money, but what is of more moment, the loss of confidence of the people at large in the fuel possibilities of peat. It is further hoped that this bulletin may be helpful in averting further failures and fruitless expenditure of money along lines of effort which cannot possibly lead to success.

(Sgd.) B. F. Haanel

FUELS AND FUEL TESTING DIVISION,
MINES BRANCH,

DEPARTMENT OF MINES,

OTTAWA, August 4, 1923.

NATURE AND ORIGIN OF PEAT

(N.B.—The small figures following paragraph headings indicate the publications correspondingly numbered in the appended bibliography on pages 43-46, to which the reader is referred for further information.)

Peat is a combustible substance formed by the humification or carbonization of plants under certain conditions. It is, like coal, a stratified *mineral*, and intermediate in nature between plant fibre and coal.

The formation of peat in bogs represents the first stage in coal development. So long as surface conditions are unchanged the accumulations of organic matter in bogs may exist indefinitely as peat. But when buried deep and subjected to heat and pressure these deposits undergo alteration, becoming by successive stages lignite, bituminous coal and anthracite.

CONDITIONS UNDER WHICH PEAT IS FORMED 15, 23, 55, 82, 83

Peat-forming plants include principally mosses, such as sphagnum, and sometimes marsh plants, rushes, grasses, algae, and shrubs, tree trunks, roots, leaves, etc. Ordinary decay of these plants in the presence of air does not form peat. Only when decomposition proceeds very slowly in the absence of oxygen, or with the greatest possible exclusion of air, does the process lead to the formation of true peat. Both climatic and physical conditions must be favourable. In countries where surface evaporation is excessive owing to heat or other causes, no extensive peat bogs are formed. Northern Europe, Asia and America have particularly favourable climates and are all rich in peat deposits. Given suitable climatic conditions, the formation of peat bogs requires the existence of basin-like depressions with impermeable subsoil, such as clay, which will retain water on the surface. The presence of water in such basins promotes the rapid growth of plants, such as mosses, algae, marsh plants, etc., which as they die are submerged one layer upon another and are slowly humified. As the process continues for centuries open water spaces are gradually filled up, the surface of the bog constantly rises with new growths, and peat forms underneath.

The formation of peat is going on at the present time, the rate of growth of bogs varying according to their nature and local conditions. Observations on European bogs have shown widely differing rates of growth. On a bog at Warmbrüchen, in Hanover, the depth is stated to have increased nearly three feet in thirty years, while on certain bogs in Switzerland peat formation is estimated to have proceeded at the rate of between one and two feet in a century. As the formation of peat depends upon many factors, the rate of its accumulation varies widely from year to year. Investigations of peat bogs in Canada have not been carried on long enough to afford any data of value as to their rate of growth.

CHEMICAL COMPOSITION OF PEAT 55, 83

The chemical composition of peat varies with the locality of the bog from which it is obtained, and with the plants from which it was formed. Variations in the chemical components of pure peat are, however, comparatively slight, and deviations in composition and behaviour in burn-

ing are mainly due to earthy admixtures, i.e., to the percentage of ash and the composition of the latter.

Pure, ash-free dry peat, according to European authorities, may be assumed to have a chemical composition as follows:—

Carbon.....	57 to 59 per cent
Hydrogen.....	5 to 6 "
Oxygen.....	34 to 38 "

Basing their conclusions on detailed study of the chemical properties of more than 500 samples from different parts of the United States, E. K. Soper and C. C. Osbon say:—

Although the exact atomic relations of the principal elements are not known, and probably are not constant, the formula $C_{62}H_{72}O_{24}$ is typical.

This gives a composition as follows:—

Carbon.....	62 per cent
Hydrogen.....	6 "
Oxygen.....	32 "

and either of these compositions may be considered typical of Canadian peats. The outstanding feature of the chemical composition of peat is the large content of oxygen, namely, 32 to 38 per cent, which contributes very largely to the low heating value of the substance.

PEAT RESOURCES OF CANADA 3-11, 14, 17, 24, 35, 56, 77, 95

The peat resources of Canada have been estimated to cover an area of approximately 37,000 square miles, distributed as follows:—

Province of	Square miles	Average depth in feet
Nova Scotia.....	250	8 to 10
Prince Edward Island.....	10	8 to 10
New Brunswick.....	250	8 to 10
Quebec (in settled parts).....	500	8 to 10
Ontario (in settled parts, 450).....	10,450	5 to 8
Ontario (Moose River Basin, etc., 10,000).....		
Manitoba.....	500	6 to 10'
Alberta, Saskatchewan and Territories.....	25,000	5 to 10
British Columbia and Yukon Territory.....	no data	.....

but of this total area only a small portion is likely at the present time or in the near future to be utilized for fuel purposes.

Surveys of bogs in several provinces of the Dominion have been in progress since 1908; 107 bogs have been investigated and cover an area of 228,367 acres and are estimated to be capable of producing 199,452,000 tons of fuel, containing 25 per cent moisture. These bogs are situated as follows:—

46 bogs in Ontario.....	fuel content	113,513,000 tons
27 " Quebec.....	"	76,176,000 "
8 " Nova Scotia.....	"	6,188,000 "
7 " Manitoba.....	"	1,863,000 "
6 " Prince Edward Island.....	"	1,213,000 "
13 " New Brunswick.....	"	499,000 "

The bogs thus far selected for investigation are located strategically to shipping points or water transportation and within such radius of centres of population as will make them available for development. More detailed information with regard to them will be found in an appendix hereto, pp. 28-33.

Peat bogs suitable for fuel purposes in the vicinity of Toronto

Workable bogs located within convenient shipping distance of Toronto are estimated to be capable of producing 26,500,000 tons of fuel.

Peat bogs suitable for fuel purposes in the vicinity of Montreal

Seven bogs in the Montreal district could furnish that city with 23,500,000 tons.

Peat bogs suitable for fuel purposes in eastern Ontario

Nine bogs in eastern Ontario could supply 47,400,000 tons to Ottawa and neighbouring towns.

The great muskegs of northern Ontario

(Ontario Bureau of Mines, 1904, page 174).

The extent of these peat bogs is enormous, they cover thousands of square miles and in fact clothe practically the entire region of the coastal plain, except on the near borders of the river. No detailed investigations have been made of the thickness of these bogs, but they vary from a few inches to probably 25 or 30 feet.

Since the above was written, investigations have been made of several large bogs in northern Ontario in the vicinity of Cobalt, details of which will be found in the accompanying tables. In addition to the 228,367 acres of peat bogs which have been surveyed and examined in detail, preliminary investigations have been made of a number of bogs in Manitoba, aggregating about 350,000 acres in area, which are found to be, as a rule, poorly humified and unsuitable for fuel. In the absence of coal measures in the central provinces of the Dominion, the peat deposits are a potential source of future fuel supply, and undoubtedly of great importance to this whole territory.

PEAT DEPOSITS SUITABLE FOR FUEL PRODUCTION

The suitability of a bog for fuel production depends upon its—

1. Location: Must be convenient to shipping point and accessible to markets.
2. Extent: The peat contents of the bog must be sufficient to warrant erection of the necessary plant.
3. Depth: Shallow bogs, and those portions of deep bogs of a depth less than 4 to 5 feet, are, generally speaking, unsuitable for commercial production of peat fuel.
4. Character: Peat for fuel purposes must be well humified and have a comparatively low ash content.

Degree of facility of drainage and freedom from stumps and roots are also points which may have a material bearing on the success of operations to produce fuel commercially.

From the reports on investigated peat bogs, a tabulated statement of which will be found in an appendix hereto, the comparative value of the various bogs examined, from the point of view of fuel production, can be readily ascertained.

COMPARISON OF CANADIAN WITH EUROPEAN PEAT 3-11, 55, 86

The heating value of good moisture-free peat ranges from 7,000 to 10,000 B.Th.U. per pound.

The calorific value of dry peat from Canadian bogs varies usually from 8,000 to 9,500 B.Th.U. per pound, and is in that respect about on a par with that from European bogs generally. Irish peat is of exceptionally high calorific value. In some of the bogs examined in the province of Quebec, a heating value of over 10,000 B.Th.U. per pound of dry peat has been found, which compares favourably with Irish peat.

DIFFICULTIES IN THE WAY OF SUCCESSFUL PEAT FUEL MANUFACTURE

The principal obstacles to contend with in successful manufacture of peat fuel are:—

1. Short season of production.

Manufacturing by the only available process, viz: air drying, can be carried on for a period of only about four months yearly.

2. High water content of the raw peat.

Peat when excavated contains 88 per cent to 90 per cent of water.

3. Peat is a low-grade fuel.

Generally speaking two tons of peat fuel are required to produce the same heating value as one ton of anthracite.

4. The large volume of raw material to be handled.

Seven and one-half tons of peat containing 90 per cent water must be excavated and handled to produce one ton of 25 per cent moisture fuel.

REMOVAL OF WATER FROM PEAT BY PRESSURE 23, 31, 55, 57, 58, 60, 71, 72, 87

Numerous attempts have been made to mechanically expel the water from raw peat by pressure, filtration or centrifugal force, all applied in a multitude of ways, but these efforts have invariably ended in failure. The most notable effort in this direction made in Canada was undertaken in 1900-01 by the Trent Valley Peat Fuel Company of Peterboro. At the Kirkfield bog, near Victoria Road station, hydraulic presses built for the purpose, and capable of exerting a pressure of 300 tons, or two tons per square inch, were employed, and fibrous peat was used. The cost was quite out of proportion to the small amount of peat handled, and the low extraction of water, and the efforts were therefore abandoned. Elaborate experiments in this line were carried on for a period of several years at Dusseldorf, Germany. Unlimited capital was available and every idea which appeared feasible received a thorough trial, but the attempt was finally abandoned as impracticable. Methods and machines which have

been successfully used on a large scale for pressing water out of other materials have failed to produce satisfactory results when applied to peat. Owing to the presence of large quantities of colloidal substance, which give to raw peat a pasty or soapy character, after removal of the free water very little more can be forced out even by very powerful hydraulic presses. Though on a laboratory scale, using strong compression for a long time, the percentage of water in peat may be further slightly reduced, it has been found impossible to reduce the water content by pressure lower than 70 to 75 per cent, in operations on a commercial scale. In recent years it has been sought to overcome this difficulty by pre-heating the peat by steam in closed tubes under pressure by what has become known as the Wet-Carbonization Process, with the object of altering the character of the hydro-cellulose or gelatinous matter in the peat, in order that the water contained therein might be extracted by pressure. Several million dollars have been expended on this process, without any commercial production of peat fuel up to the present time.

EVAPORATION BY ARTIFICIAL DRYING 28, 44, 55, 58, 60

The artificial drying of peat is not a process which simply involves the evaporation of so many pounds of water. Peat has peculiar physical properties that make the solution of the problem difficult. An important one is its poor conductivity of heat. When wet peat is subjected to a comparatively high temperature as in a drying oven, the surface may become charred before even a small percentage of its moisture has been evaporated. Pieces of peat dried in this manner have been found on inspection to be completely charred on the outside while the moisture content on the inside was in the vicinity of 75 per cent. While a thermal efficiency of 70 per cent in evaporation of water is quite possible, it can not be realized in practice in the drying of a substance with such poor conductivity as peat. Investigation of a plant in operation at Orentano, Italy, showed an efficiency of 52 per cent. Data referring to the drying of other materials are therefore often very misleading when applied to the drying of peat. Raw peat when excavated from the bog usually contains from 87 to 90 per cent water. Even assuming a thermal efficiency of 70 per cent in the dryer, where peat has a moisture content as high as 86 per cent, in order to obtain 100 pounds of dry substance, an equal amount of dry peat or its equivalent must be burned to produce the heat required for evaporation of the water contained, leaving a net product of zero. The same thing holds good for production of peat of varying degrees of moisture content. To obtain 100 pounds of 25 per cent moisture peat, consumption of the same amount of 25 per cent moisture peat or its equivalent is necessary. Therefore any process involving removal of the water from raw peat by evaporation alone is absolutely impracticable. Assuming again that by the costly operation of pressing out the water by hydraulic presses, the moisture content of the peat supplied to the dryers can be lowered to 70 per cent, to produce 100 pounds of dried peat product, 41 pounds of such product or its equivalent must still be used to operate the dryers. The costliness of the operations and the small net production of fuel obtained must necessarily render a process of this nature unprofitable.

EUROPEAN EXPERIENCE IN ARTIFICIAL DRYING 55, 69

In Europe, where air-dried peat fuel has long been produced in millions of tons annually, many processes have been advanced by inventors, involving the substitution of mechanical pressure and artificial drying for what may be called the natural process of air-drying. The failure of all these attempts has been recorded in a recent and authoritative work on the subject by A. Hausding, published in Germany and translated for the British Fuel Research Board.¹ The conclusions arrived at by Hausding after a general survey of the European industry are important, and should be carefully noted by every one interested in peat development.

Every artificial drying plant has, up to the present, no matter how promising it seemed to be, always proved too expensive, both as regards plant costs and running expenses.

Whoever values his money should never attempt the artificial drying of raw peat.

The heat or other energy corresponding to it required to evaporate the amount of water is so great, that from the commercial standpoint complete failure must be inevitable, even when the technical contrivances are assumed to be as perfect as possible.²

AIR-DRYING THE ONLY SUCCESSFUL METHOD 21, 44, 55, 58, 69

The only economic process in existence at the present time for production of peat fuel is that which utilizes the sun's heat for the removal of moisture from the raw peat. The peat fuel production in European countries, which amounts in Russia to about 7,000,000 tons annually, and in Ireland to between 6,000,000 and 8,000,000 tons annually, is practically all manufactured under this method.

Hausding, already quoted above, states:—

During the past twenty-five years not a single one of the many discoveries or inventions in the domain of peat winning has attained any considerable importance or any success worth noting, except the peat dredgers (excavators), the automatic sod spreaders, or peat pulp distributors, and the cut peat machine. Millions have already been invested in experiments on so-called new solutions of the peat problem and have been lost.

For winning peat by machinery on a large scale the only machines that have proved successful are the mixing, kneading and forming machines, with or without dredgers and sod spreaders for manufacturing machine peat. Real experts confine themselves, therefore, to the improvement of this method.³

IMPROVEMENT OF QUALITY OF THE FUEL 15, 55

Large quantities of hand-cut turf are manufactured in Europe. These form a fuel of too low a grade to be satisfactory, especially in Canada where the people are accustomed to the use of such a high-grade fuel as anthracite. Efforts to produce an improved quality of fuel from peat have been made in various ways. Pulping or maceration of the raw peat before air-drying materially increases the density, burning qualities, and toughness of the fuel blocks. This process producing what is known as "machine peat" is the only one which has proved successful.

¹ A Handbook on the Winning and the Utilization of Peat, by A. Hausding. Translated from the Third German Edition, by Hugh Ryan, D.Sc., Professor of Chemistry in University College, Dublin. Printed and published by His Majesty's Stationery Office, London, 1921.

² Hausding, pp. 72, 268.

³ Hausding, pp. xviii, 318.

BRIQUETTING OF PEAT WITHOUT CARBONIZING 22, 23

All efforts to produce peat briquettes commercially have failed, primarily through inability to reduce the water content of the raw peat economically to the 10 to 15 per cent necessary for successful briquetting; also owing to the fact that the briquettes produced were hygroscopic, readily absorbing moisture and disintegrating on exposure to moist air, while the use of binding materials to overcome this latter difficulty adds too greatly to the cost of manufacture. Any advantage gained by briquetting is more than offset by the additional cost. Briquettes with 15 per cent moisture content have only 15 per cent higher fuel value than air-dried peat with 25 per cent moisture from the same raw material, while production of equal fuel values is at least 50 per cent cheaper for air-dried peat than for briquettes.

CARBONIZATION OF PEAT 15, 31, 40, 42, 55, 87, 92

The devising of a process which would economically remove the water content of the peat by pressure, carbonize the dewatered substance, and briquette the carbonized residue has been frequently attempted, under the belief that such a process would enable the manufacture of peat fuel to be conducted throughout the year regardless of weather conditions.

In order to comprehend just what such a process implies it is necessary to analyse the various stages through which the raw peat fuel must be carried before it appears as a finished briquette:—

1. The raw peat substance containing 90 per cent moisture must be excavated and transported to some central plant.
2. The water content must be expelled as far as possible by pressing, in either a filter or hydraulic press.
3. The remaining moisture content must be reduced by artificial drying to at least 10 per cent, in order to permit,
4. Carbonizing to be conducted efficiently.
5. The carbonized residue must be mixed with the proper kind and proportion of binder, and
6. This mixture briquetted in briquetting presses.

To produce, therefore, one ton of briquettes with a heating value of say 12,000 heat units per pound, a fuel substance containing 88 to 90 per cent of water and 10 to 12 per cent combustible matter and ash, must be carried through six costly operations. Not only would the labour charge be high, but the capacity of the plant would have to be excessive in order to produce a comparatively small quantity of finished briquettes. The initial capital investment would be exorbitant, consequently excessively high overhead charges would result. The impracticability of removing the water from the peat by pressure or evaporation through artificial drying has already been dealt with. An economic factor of great importance is the excessive amount of raw material as compared with the resulting product, which must in such a process be excavated from the bog, transported and handled in a central plant.

Assuming as possible the reduction of moisture content of the raw peat by pressure to 70 per cent, and assuming also a dryer efficiency of

70 per cent (neither of which would be obtainable in large scale continuous operation) in order to deliver 2,000 pounds of dry substance for carbonization the equivalent of 830 pounds of absolutely dry peat would have to be supplied to the dryers. When this dry substance is carbonized at a low temperature one ton of absolutely dry peat which required 830 pounds for drying, making 2,830 pounds of absolutely dry peat, would yield between 900 and 1,000 pounds of carbonized residue, so that in order to yield approximately one ton of carbonized residue, approximately three tons of absolutely dry peat will be required. This does not take into consideration the heat equivalent of the energy required in operating presses, pumps, dryers or other portions of the plant, nor does it take into account heat losses which will occur in carrying out such manufacturing operations, but merely refers to the quantity of dry fuel which must be furnished to the dryers and to the carbonizers.

It will be seen therefore, that for every ton of carbonized material delivered to the briquetting presses, 30 tons of raw peat containing 90 per cent moisture must be excavated at the bog, transported to the manufacturing plant and put through the various apparatus for pressing and drying in order to render it suitable for carbonizing.

Briquetting the carbonized residue is in itself a costly process, and may materially affect the economic result, especially in view of the necessity for the use of binding materials.

The development of coal briquetting plants in the United States and other parts of the world has been accompanied by many dismal failures, and there are to-day only a few plants in the United States which can be said to be manufacturing briquettes from coal at a profit, and it is questionable if there are any in Canada. If it has proven difficult to briquette a high-grade substance like coal which requires no preliminary heat treatment such as drying and carbonizing, it would appear to be a forlorn undertaking to devise a process to economically convert a low-grade fuel substance like peat into a high-grade fuel where so many costly operations are involved.

BY-PRODUCTS FROM CARBONIZATION OF PEAT 20, 44, 55, 58, 81, 92

During the process of carbonizing, a certain quantity of by-products is produced, namely, gas, tar oils, ammonia, and alcohol, the latter if the carbonizing is carried out in such a manner as to make the recovery of alcohol possible. If the main object in carbonizing peat is to produce a fuel, the temperature at which carbonizing is conducted would of necessity be so low that the minimum quantity of gas is produced, and this quantity of gas would in no sense be sufficient to supply the heat required for drying, nor is it likely that the tar-oils obtained could be used as a binder for the formation of briquettes. If these oils could be used a tar-distilling plant would have to be installed.

Without going further with this analysis it can be seen that in such an effort to produce a marketable fuel which must sell at a price not higher than that at which the standard fuels are sold, a very large quantity of heat is absorbed. Even if the cost of drying the raw peat were left out of consideration and it were assumed that dry peat was available

for beginning manufacturing, it is improbable that carbonizing dry peat could be profitably carried out. The chances for profit in such a process depend very largely on the profitable disposal of the by-products obtained, and these can only be readily disposed of when there are chemical industries in existence which are capable of absorbing large quantities of the by-products. The chances for carrying out a commercial carbonizing process would be far greater in countries like England, France, Germany or Belgium, which are highly industrialized and have large numbers of chemical industries which depend for their existence on the by-products obtained from coal distillation; but even in such countries attempts to carbonize peat have not proved economic.

CARBONIZATION OF AIR-DRIED-MACHINE PEAT

To determine the value of air-dried-machine peat fuel as a source of charcoal, a carload of this fuel dried to 25 per cent moisture was shipped¹ to the carbonizing plant of the Standard Chemical Company, and put through their wood charcoal retorts. A peat charcoal of excellent quality was obtained, the amount being 750 pounds per ton of 25 per cent moisture peat. If this amount were sold at the rate of \$16 per ton, it would yield \$6; the tar oils amounting to 140 pounds would return, at one cent per pound, \$1.40. One gallon of alcohol was obtained, and this would return fifty cents; the ammonium sulphate recovered amounted to 30 cents, making a total of \$8.20 as the gross receipts. Against this must be charged the cost of raw material, operating, labour and overhead charges. With peat properly prepared for carbonizing at a figure in the vicinity of \$3.50 per ton a profit of \$1.20 might be realized, but inasmuch as the yield of alcohol from wood per ton is 4 gallons, and in addition acetate of lime to the value of \$1 is recovered—but no ammonium sulphate—the net profits from carbonizing wood would be in excess of the profits it is possible to realize from the carbonization of peat. When wood becomes too scarce for the production of chemicals and wood charcoal, and air-dried-machine peat fuel can be supplied in sufficient quantities to meet the demand of such an industry, then peat may be looked upon as a source of fuel by carbonization.

The peat charcoal obtained was not only of excellent quality, but was also in the form of large pieces, so that briquetting was unnecessary. When, however, a raw peat is carbonized without first being treated according to the air-dried-machine peat process, the carbonized residue must be briquetted. The quantity of by-products obtained would be the same for either method of carbonizing. It is manifest, therefore, that if this latter process cannot be carried out commercially at a profit sufficient to attract capital, there is not the slightest chance for the success of a process which involves many costly operations and requires the briquetting of the carbonized residue.

UNSUCCESSFUL EFFORTS TO PRODUCE PEAT FUEL IN CANADA ^{22, 23, 24, 33, 34, 39, 54, 60, 82}

In 1864 a plant for the manufacture of peat fuel was established at Bulstrode, Que., by James Hodges, an English engineer, and two or three others followed in the next few years. Owing to the poor quality and

¹ By the Joint Peat Committee in co-operation with the Mines Branch.

friability of the fuel produced, and the low prices of coal with which it had to compete, as well as to defective methods of operation, the attempts failed.

About 1890, and for several years thereafter, there was a marked revival of interest in peat fuel, and numerous enterprises were started, mostly with a view to the manufacture of briquettes. These efforts were based on wrong principles, and all ended in failure and loss of the money invested. No exact information is available as to the expenditures made, but including the many undertakings not recorded, the amounts lost in misdirected efforts to produce peat fuel in Canada probably run into the millions of dollars. The following is a partial list of unsuccessful companies which were promoted and carried on operations mainly between 1897 and 1910:—

Company	Head office	Bog	Date	Capital
				\$
Brockville Peat & Power Co.....	Brockville.....	Brookville.....		99,000
Canada Fertilizer Co.....	Montreal.....	Farnham.....	1909	
Canadian Peat Fuel Co.....	Toronto.....	Welland.....		
Canadian Peat Co., Ltd.....	Alfred.....	Alfred.....	1910	250,000
Central Peat Co., Ltd.....	Toronto.....		1900	50,000
Compagnie de Chauffage a la Tourbe.		St. Hubert.....	1875	
Condensed Peat Fuel Co., Ltd.....	Peterboro.....		1904	40,000
Cornwall Peat Co.....	Cornwall.....	Newington.....		
Dominion Peat Products Ltd.....	Brantford.....	Newington.....	1902	100,000
Ellise Peat Co.....	Stratford.....	Brunner.....		
Grand Valley Peat Products Ltd.....	Toronto.....	Luther.....	1904	100,000
Huntingdon Peat Co.....		Port Lewis.....	1875	
Huron District Peat Co.....			1899	
Ideal Gas Co., Incorp.....	Montreal.....			
Imperial Peat Co.....	Guelph.....		1903	1,000,000
International Peat Co., Ltd.....	Toronto.....		1903	250,000
International Peat Engineering Co.....	Montreal.....	Farnham.....	1910	
Lanark County Peat Fuel Co.....	Perth.....	Perth.....	1900	30,000
Manitoba Peat Co.....	Fort Francis.....	Fort Francis.....		
Montreal and Ottawa Peat Co.....	Ottawa.....	Alfred.....	1904	75,000
Newtonville Peat Manufacturing Co.....		Port Hope.....		
Ontario Peat Fuel Co., Ltd.....	Toronto.....	Welland.....		1,000,000
Ottawa Peat Co., Ltd.....	Ottawa.....	Mer Bleu.....		200,000
Peat Development Syndicate Ltd.....	Toronto.....		1901	40,000
Peat, Gas and Coal Co.....	Portland.....	St. Bonaventure d'Upton.....		1,000,000
Peat Industries Ltd.....	Toronto.....	Welland.....	1901	500,000
Peat Industries Ltd.....	Montreal.....	Farnham.....	1911	
Peat Machinery Supply Co.....	Toronto.....			
Peterboro Peat Co., Ltd.....	Peterboro.....		1902	150,000
Prince Edward Peat Fuel Co.....	Picton.....			20,000
Quebec Combustible Co., Ltd.....	Fraserville.....	Cacouna.....		
Quebec Peat Co.....	Quebec.....			100,000
Sahlstrom Peat Syndicate.....	Ottawa.....	Brookville.....		
Simcoe Peat Fuel Co.....	Barrie.....			20,000
Southern Ontario Peat Co., Ltd.....	Brantford.....		1900	100,000
Stratford Peat Co., Ltd.....	Stratford.....	Brunner.....	1902	40,000
The Argentine Peat Syndicate Ltd.....	Guelph.....		1901	60,000
The Peat Board Co., Ltd.....	Toronto.....	Cannington.....	1904	250,000
Toronto Peat Fuel Co.....	Toronto.....	Picton.....	1903	40,000
Trent Valley Peat Fuel Co.....	Peterboro.....			500,000
Western Peat Fuel Co.....	Chatham.....		1900	100,000

ACTIVITIES OF CANADIAN GOVERNMENT 3-13, 16, 43-50, 51, 52, 63-68, 82

In the year 1908 the Director of the Mines Branch of the Department of Mines undertook to have the status of the peat industry in Europe thoroughly investigated, in order to determine whether an economic process for manufacturing peat fuel could be found in those countries and one which could be successfully employed in this country. At the same time he began the systematic investigation of the peat resources of Canada, paying special attention to those peat bogs which were favourably situated with respect to transportation facilities as well as inhabited districts.

As a result of the investigation conducted in Europe, a small commercial plant of 30 tons daily capacity was imported from Sweden and erected on a portion of the Alfred bog, which had previously been prepared for its reception, and for two years was operated, during the working season, to demonstrate to those who might be interested, how peat fuel could be manufactured economically. At the conclusion of these two seasons' work, the Swedish engineer, who was brought over for the purpose of operating the plant, showed that peat fuel, with that plant, could be manufactured on a small scale at a cost which would permit it to be sold on the market as a domestic fuel in competition with coal.

The Mines Branch further conducted an exhaustive investigation concerning the utilization of this fuel for the production of power when burned in a gas producer, especially designed for peat; and again in 1914, the Mines Branch published a report entitled "Peat, Lignite and Coal," which treated of the value of these fuels for the production of gas and power when burned in a by-product recovery producer gas plant. From that year to 1918 no experimental work was conducted, but departmental interest was never wholly lost, since efforts were made to keep abreast of the improvements which were reported from time to time in the peat-using countries of the world.

In order to introduce economies for the manufacture of this fuel, and to allow a reduction in its selling price, the Mines Branch recommended that in the design of any future machine there should be incorporated all possible labour-saving devices. For example, it was recommended that the excavation of the peat be performed mechanically.

A company was formed for the purpose of putting into effect this recommendation, and a plant of the Anrep type was not only designed and constructed, embodying many new mechanical labour-saving devices, but was actually given a very successful try out, in the course of which a quantity of fuel was manufactured. But in 1914, when manufacturing operations were contemplated on a commercial scale, war was declared, and the promoters withdrew their financial assistance.

In the early spring of 1918, the Dominion Government and the Government of the province of Ontario jointly appointed a committee to conduct an investigation concerning the utilization of the peat resources of Ontario for fuel purposes. This committee, after carefully considering all processes which had been devised for manufacturing peat fuel, decided that the air-dried-machine-peat process was the only one that could in

any sense be termed economic, and, therefore, recommended to the Governments that machinery be constructed for the purpose of carrying out this process in the most economic manner possible.

MANUFACTURE OF MACHINE PEAT FUEL BY THE AIR-DRYING METHOD

LENGTH OF SEASON OF MANUFACTURE 19, 21, 55

In the manufacture of air-dried peat fuel excavation must be discontinued in time to permit the fuel to dry below 50 per cent moisture before severe frost sets in. Peat which is frozen while it contains more than this percentage of moisture will disintegrate and become useless as a domestic fuel.

It has been found by experience at Alfred, Ontario, that the average season during which operations can be carried on in that locality covers about 100 working days, or from the beginning of May until the end of August.

The length of season of fuel production in Canada compares favourably with that of those countries in Europe where the greatest production takes place, and while the action of frost is not so great a factor in limiting operations in Ireland, the superior climatic conditions for drying in Canada to some extent offset this.

STEPS IN THE PROCESS

The operations necessary for production of air-dried-machine peat fuel are:—

- (a) Excavation of the raw peat.
- (b) Pulping or maceration.
- (c) Conveying the peat pulp to the drying field.
- (d) Spreading and cutting into blocks.
- (e) Turning the partially dried blocks of fuel.
- (f) Harvesting.

EXCAVATION OF RAW PEAT

The upper layers of a peat bog are as a rule less humified than the deeper strata, which yield a fuel more dense and of better quality. In excavating the raw peat therefore, it is desirable to mix all the layers from top to bottom in order to obtain fuel of as great uniformity of quality as possible. The type of excavator found most suitable consists of a series of buckets on an endless chain, which are drawn on a sloping surface from bottom to top of the cut. In the Anrep excavator employed at Alfred, Ontario, an excavating element of this description moves automatically back and forth, supported on a framework which is advanced from four to six inches in the line of excavation at the end of each traverse. Thus, the operation of excavation is continuous and automatic.

MACERATION 15, 44, 55, 82

Maceration is the name given to the operation of mixing and pulping. It is quite probable that a chemical change is effected during maceration, since the colour of the mass undergoes a change, but by far the most

important effect produced is the homogeneous distribution of the binding substance throughout the peat. Pulping also serves to break or cut the fibres and roots which are generally found in all peat bogs, but to a greater amount in some than in others. This operation results in a notable increase in density of the fuel produced; and other physical qualities depend largely upon the degree of maceration obtained. It may be said, therefore, that it is one of the most important steps in the process of fuel production from peat. Hitherto the apparatus chiefly used for this purpose has depended upon the action of rotating knives intermeshed with stationary knives. At Alfred, Ontario, a machine of the Swing Hammer-mill type, similar to those in use for shredding pulpwood and other materials, has been employed with marked success, and has resulted in production of fuel of excellent quality.

CONVEYING PEAT PULP TO DRYING FIELD

The most generally employed method for transporting the pulped peat to the drying field has been by means of small dump cars running on light portable tracks and moved by cables. This plan involved considerable manual labour in moving tracks, and loss of time through derailling of cars and otherwise. At Alfred, Ontario, there has been developed and put into successful operation a portable belt conveyer for this purpose.

The conveyer consists of ten spans of latticed box girder bolted together, the whole being supported on eleven caterpillar elements. The conveyer belt is carried on rollers, on the top of the girder, and is 850 feet in length between centres. The peat is automatically delivered to the macerator, and from the macerator to the belt conveyer, and from this to the spreader, so that all operations from that of excavation to spreading and cutting the peat on the drying field are performed continuously.

When a row of peat the length of the belt has been laid on the drying field the belt conveyer travels sideways on the caterpillar elements a distance of about 13 feet in preparation for the laying of the next row. It was anticipated that there might be trouble in moving the conveyer over the uneven surface of the bog, but during the working season hundreds of moves were made and no trouble of any kind was experienced, the whole bridgework being scarcely an inch out of line at the end of the season.

SPREADING THE PEAT PULP AND CUTTING INTO BLOCKS

From the belt conveyer the peat pulp is automatically delivered to a spreader, which is also actuated by power and lays the peat on the field in strips twelve feet in width and five or six inches thick. The thickness of the peat laid is uniform but may be varied, and spreading made thicker or thinner as may be required. Devices are attached to the spreader which cut the pulp into blocks about 4 inches wide by 10 inches long. The blocks may, however, be made of any size required by adjustment of the cutters. No pressure whatever is applied to the peat blocks which are formed by the above cutting process, and depend for their firmness and

solidity on the natural process of shrinkage during drying. When a row is completed the spreader is moved ahead with the belt conveyer and the direction of spreading reversed.

THE DRYING FIELD

The moss and small shrubs usually present on a peat bog, when pressed down by the spreading apparatus, form a suitable surface for depositing the peat pulp to dry and serve to preserve it from contact with the wet peat below. Where these have been destroyed by fire leaving bare spots, seeding with suitable grasses will tend to improve the surface. The peat pulp as excavated, therefore, can be laid to dry on the area adjacent to the excavation. The area required for an output of 10,000 tons annually will be approximately 50 acres. A row of peat 770 feet long and 12 feet wide will produce 16 tons of 25 per cent moisture fuel. Allowing an average period of 40 days for drying, sufficient area must be provided to lay 250 rows.

MOISTURE IN PEAT FUEL

For Domestic Purposes.—Peat fuel is ordinarily dried to between 25 and 30 per cent moisture content. A slightly higher percentage of moisture is rather an advantage than otherwise, since the drier peat burns too quickly, and with the ordinary stoves in use in Canada it is difficult to control the combustion. Peat fuel containing 30 per cent moisture, or slightly more, is also tougher, and stands handling better than the drier fuel.

For Generation of Steam. The moisture content should not exceed 30 per cent, preferably 25 per cent to obtain the best results.

For Use in Gas Producers. The best results are obtained with peat having a water content of 25 per cent or less.

TURNING

As the peat shrinks in drying cracks open up along the lines of the cuts made in it. When drying has proceeded to a point where the top surface of the blocks is sufficiently firm, the blocks are turned to expose the underside to the air. This operation is performed by manual labour, an ordinary hand rake being the only implement required.

HARVESTING

Depending on the season and drying conditions, the drying of the fuel is usually completed in two to three weeks after turning, when it is ready for shipment and use. The harvesting apparatus employed at Alfred consists of a conveyer trough, into which the peat is pitched by men with coke forks. The trough mounted on caterpillars moves under its own power, one end being elevated to load the peat into small cars in which it is transported to the storage piles or direct to cars for shipment. Small losses occur in harvesting through fines remaining on the ground. Additional fines are removed from the product by screening before loading into cars for shipment. The amount of fines is greatly increased where the fuel is allowed to remain on the drying field until it becomes over dry.

DETERIORATION IN SHIPMENTS

Air-dried peat fuel when well made with proper moisture content will suffer very little deterioration through breaking up by handling in shipment. The small amount of fines produced is not a disadvantage, since even the dust from peat fuel can be readily burned.

EFFECT OF EXPOSURE TO RAIN

The protective skin formed on peat fuel during the drying process serves to shed moisture, and it is therefore not injured by exposure to rain to a greater extent than such a fuel as wood under similar conditions.

STORAGE SPACE REQUIRED

The theoretical heating value of standard air-dried peat fuel is approximately one-half that of anthracite coal. Two tons of peat must therefore be stored in place of one ton of anthracite. In practice, however, certain favouring conditions, such as more complete combustion, lower ash, and economies in utilization, tend to make the comparison more favourable to peat in this respect, than the above would indicate. The volume of the peat fuel, owing to its low specific gravity, is, on the other hand, much greater than that of coal. The volumes of 1 ton (2,000 pounds) of peat fuel as manufactured by the Peat Committee in 1922, of Pennsylvania anthracite, and of Pennsylvania soft coal, are 63, 37 and 40 cubic feet respectively. The storage space required for peat fuel will, therefore, be between three and four times that needed for anthracite coal to produce equivalent heat values.

FIRE RISK OF STORING PEAT

Peat fuel when stored in piles is not liable to spontaneous combustion. It may be stored under conditions similar to those for storage of other fuels, with no greater risk than from wood for example. Naturally, it would not be wise to drop burning matches or cigarette ends in dry peat dust.

USE OF PEAT FUEL IN FURNACES

Owing to its free burning character peat fuel is not adapted to replace coal in furnaces during severe winter weather. But as an auxiliary fuel it is an excellent material with which to kindle a coal fire. When the fire has become low, if a small amount of peat is thrown on top of it, and the draughts opened without shaking, the coal fire will be very soon brought up to more intense combustion, and in this way quick results and economy of fuel are obtained. During the fall and spring months, when only a moderate amount of heat is required, coal can be saved, and at the same time economy in cost of heating effected by the use of peat fuel.

PEAT FUEL FOR GRATES

Peat, as manufactured at Alfred, is an ideal fuel for open grates and in many ways preferable to cannel coal. It is clean to handle, and does not explode like cannel coal, nor throw cinders, ashes or pieces of fuel out of the grate. It burns quietly with a very cheerful yellow flame, and then subsides into a red glow which lasts for a long time.

PEAT FUEL FOR COOKING

For cook stoves, and especially for baking where an intense steady heat is required for a comparatively short time, peat fuel is unexcelled. It is more easily ignited than coal, requires much less draught, except just as the fire is being started, and a much less quantity should be used to make a fire, though it must be renewed more frequently.

CLINKERS AND ASH

Peat does not clinker and burns to a very light clean ash. No unburned carbon is left and in this respect peat is more economical than coal. The amount of ash present in peat fuel will depend on the percentage of ash in the raw peat from which it was manufactured. The ash content of the Ontario bogs so far examined varies between 4 and 26 per cent, but a large number of the bogs have an average ash content in the vicinity of 6 to 7 per cent. The ash content of bogs in the province of Quebec is exceedingly low, varying between 2 and 8 per cent, and the average of all the bogs is considerably below 8 per cent. The ash content of peat is non-fusible under ordinary conditions, thus high temperatures can be maintained without the production of troublesome clinkers.

When covered with ashes a peat fire can easily be kept alive over night, and by merely opening the dampers and adding a small quantity of fresh fuel, a surprisingly active fire is quickly rekindled.

ECONOMIES FROM USE OF PEAT FUEL

Owing to the complete combustion obtained all the heat from the peat is made available, and the ash which is left contains no unburned carbon, therefore there is no waste. In this way it has an advantage over coal, in burning which, under ordinary conditions, large amounts of unburned carbon are often thrown out with the ashes and clinkers. Under some conditions higher efficiency can be obtained with less fuel consumption than where coal is used, as in cooking, where high temperatures are usually required for short periods only. It has been stated by a great many people who have tried it that one ton of peat fuel for kitchen purposes, for the cooking range, goes further than one ton of anthracite coal.

PEAT DUST

Coal slack cannot easily be burned even in small quantities in the ordinary furnace. On the contrary, any small particles or dust from peat can be used to advantage. If a coal fire is so low as to have only a bright spot in it, which would hardly ignite wood, a little of this dust thrown on it will commence burning and make a hot fire in a very short time, and in this way coal can be saved.

COMPARATIVE HEATING VALUE OF PEAT AND ANTHRACITE COAL

Standard peat fuel, as manufactured at Alfred, has a gross heating value of about 6,630 B.Th.U. per pound, while the average anthracite, now coming into Canada, has a gross heating value of about 12,500 B.Th.U. per pound. Standard peat fuel has a moisture content of 30 per cent.

Theoretically, therefore, it takes about two pounds of peat to give the same heating value as one pound of anthracite. This is based on a comparison of the theoretical heating values of the two fuels. In practice, however, a comparatively large portion of coal passes through the grates unburned, and is entirely lost, while in the case of peat complete combustion results. In mild weather, owing to the difficulty in controlling a coal fire, a great deal of heat is wasted or the fires go out. With the peat fuel this is not the case. This is a distinct advantage which peat fuel has over anthracite coal.

According to actual experience four pounds of peat will, in mild weather, furnish as much useful heat as three pounds of coal when burned in the ordinary furnace and surface heaters. For open fireplaces and domestic ranges the comparison is even better.

UTILIZATION OF PEAT FOR POWER PRODUCTION ^{15, 16, 40, 43, 44, 47, 55, 56, 59, 90, 92}

Peat has been and is to-day being successfully utilized in Europe for the production of power:—

1. By burning it in specially designed boilers for the generation of steam.
2. By burning it in by-product recovery producers of the Mond type.
3. In gas producers without by-product recovery.
4. For burning in locomotives.

EXPERIENCE WITH PEAT FUEL

Of the 3,000 tons of peat fuel manufactured by the Mines Branch at Alfred in 1910 and 1911, 1,200 tons were distributed, at a nominal price, among the householders of Ottawa and the villages and small towns in the vicinity of the plant. A large number of opinions of users, mostly very favourable, were collected by the Canadian Peat Society and published in their journal.

In the course of the investigations made by the Peat Committee, a considerable quantity of peat fuel was produced through operation of the several plants incidental to their development, and over 8,000 tons was sold for domestic consumption.

During the earlier stages of manufacture, the fuel produced lacked uniformity of quality, and some shipments of inferior fuel were made. In 1922, however, largely owing to improvement in the maceration of the raw peat, not only was peat fuel of high quality turned out, but a fairly uniform standard was maintained throughout the season. Several hundred replies to a questionnaire sent out to dealers and consumers indicated general satisfaction with the fuel and a ready demand for much larger quantities.

DISTRIBUTION OF FUEL IN 1922

Shipments of over 2,200 tons were made to various points in Ontario, including: Ottawa, Toronto, Peterboro, Belleville, Arnprior, Renfrew, Cornwall, Iroquois, Prescott, Brockville, Kingston, Finch, Spencerville, Richmond, Morewood, Winchester, Hawkesbury, St. Eugene, Sarsfield, Cumberland, and New Liskeard. Over 600 tons were sold in Montreal and vicinity, and several hundred tons were sold locally, and drawn direct from the plant by the purchasers.

THE REASON FOR APPOINTMENT OF PEAT COMMITTEE

The Peat Committee was not appointed, as is believed by some, for the purpose of manufacturing peat fuel on a commercial scale to relieve the fuel shortage which existed at the time of its formation, but was appointed with definite instructions to conduct investigations that should determine whether peat fuel can or cannot be manufactured on a commercial basis, and under conditions existing in Canada, at the present time, with the employment of existing peat machinery. The Committee's work was, therefore, of an entirely investigatory nature, and the production of fuel was merely incidental to the carrying on of the necessary investigations.

SCOPE OF THE INVESTIGATION

Two types of peat machines were chosen for experimentation as offering the greatest promise of obtaining satisfactory results.

The first year's operation of these plants disclosed good features and weaknesses in both, and it became apparent that it was possible that the weak points in the operation of both might be avoided, and the advantageous features of each combined in a single plant. Such a combination plant was therefore designed and erected, and in 1922 was operated with such measure of success as to warrant the conclusion that a practical working type had been developed capable of successful commercial operation. The actual production obtained fell short of being commercial owing largely to defective power supply, and other restrictive conditions affecting the operations.

In addition to this commercial scale plant, a small machine based on the same general plan of design and operation was developed to supply the need for operating on small and shallow bogs, or for operations on a small scale to meet local fuel demands in the immediate vicinity of a bog. Extensive and careful investigations were made as to the effect on the various operations, of weather, frost, and meteorological conditions generally, as to length of season, character and physical properties of the raw material and best conditions for handling same, degree of maceration most favourable to quality of fuel, best disposal of peat on the drying field to obtain the maximum results from the natural forces of sun and wind relied upon for removal of water, rate of drying and effect of turning and cubing, and generally, as to all conditions affecting the output and quality of fuel.

Independent investigation was also carried on in the laboratories of the Fuel Testing Station, Mines Branch, Department of Mines, acting in collaboration with the Peat Committee, which had for its objective the determination of the value of pulping and grinding the raw peat, the chemical effect, if any, on the raw peat substance, the relation existing between this mechanical treatment and the rate of drying and physical properties of the finished fuel.

Experiments were also made in the briquetting of peat alone in various conditions and in admixture with coal. With a view to ascertaining the possible results of carbonization of air-dried peat fuel on a commercial scale, a carload of the finished fuel was also put through the retorts of the Standard Chemical Company, at Longford, Ont.

RESULT OF THE INVESTIGATION 68

In its interim report presented to the Federal Government and the Government of the province of Ontario, December 5, 1922, the committee stated that:

While the machine has not actually been constructed to the design which the committee esteems would be reasonably free from defects, the problems involved have, in their opinion, been thoroughly investigated, and drawings for a complete standard equipment with power plant, pulverizing unit, conveyer and spreading system are now under way; and

While the committee has completed research work requisite to the development of a successful peat manufacturing plant, and is able to place at the disposal of those interested, construction data and operating statistics, it is of the opinion that the establishment of a peat industry is of such importance to Canada and especially the province of Ontario, that the Governments should undertake the construction and operation of a perfected plant until its possibilities are fully demonstrated.

COST OF PRODUCTION OF PEAT FUEL 67, 68

Based on the performance of the experimental combination plant and the estimated cost of an entirely new and remodelled plant, complete with an efficient power unit and larger macerator, the production and other costs of the finished peat per ton are estimated to be:—

	10 hour day	20 hour day
Production costs.....	\$2 00	\$2 00
Overhead costs.....	2 48	1 50

A total cost of finished peat fuel, on board cars at siding of plant of \$4.48 for a ten hour day, for a season of 100 days, or \$3.50 for a twenty hour day during the same season. The total production of saleable fuel in the first case would be 10,000 short tons, and in the second case 20,000 short tons. Overhead costs, however, increase rapidly as the production decreases, consequently, the committee recommends that plants of this type be operated for twenty hours per day. The figures for production costs include an ample allowance for cost of raw fuel, paid for on a royalty basis, and for clearing and draining the bog.

MACHINES USED IN THE MANUFACTURE OF PEAT FUEL

A number of machines for excavating and macerating the raw peat and for spreading it on the drying ground, either in the shape of sods or as pulp, have been developed in Europe. These machines, generally speaking, have insufficient capacity of production and require the employment of too much hand labour to warrant their importation into and use in Canada. The machines which have been developed at Alfred under the direction of the Peat Committee are considered to be the most efficient and best adapted to conditions existing on Canadian peat bogs yet produced. While undoubtedly susceptible of further improvement, a degree of working efficiency and economy of operation has been reached which would warrant their employment in commercial exploitation of peat bogs.

These machines are:—

- (1) Mechanical excavator.
- (2) Macerator.
- (3) Belt conveyer.
- (4) Spreader.
- (5) Harvester.

In addition to these machines, which constitute the plant necessary for large scale manufacture of peat fuel, a smaller combined plant has been developed for use on the smaller bogs and where manufacture is to be carried on to supply local demands.

ESTIMATED COST OF PLANT 67, 68

For an output of 10,000 tons during a season of one hundred 10 hour days, or of 20,000 where operations are carried on for twenty hours per day, the following table shows the cost of plant, interest charges on investment, depreciation and administration on which the overhead charges are based:—

Capital cost		Interest per cent	Depreciation	Administration
Power plant.....	\$25,000	7	10%—\$2,500	10% on \$100,000 for 20 hours daily operation, or 10% on \$50,000 for 10 hours daily operation.
Peat plant.....	35,000		20%—7,000	
Harvesting equipment.....	25,000		14%—3,500	
Buildings, equipment and miscellaneous.....	5,000		10%—500	
Total... ..	\$90,000	\$6,300	\$13,500	\$10,000 or \$5,000.

OTHER USES OF PEAT

Apart from their value as a source of fuel, peat bogs are capable of furnishing raw material for the development of various industries. The following are a few of the more important uses of peat.

Sulphate of Ammonia 16, 44, 55, 58, 79, 82

By extraction of the nitrogen content of peat in suitable retorts large amounts of this valuable fertilizer could be manufactured. The peat of the average Canadian bog has a nitrogen content which makes it especially valuable for burning in a producer of the by-product recovery type, which permits of the recovery of 70 per cent of the nitrogen in the fuel.

The fuel content of Canadian bogs investigated is estimated at 199,452,000 tons of 25 per cent moisture fuel. This reduced to the dry state is equivalent to 149,509,000 tons, and if the average nitrogen content is 1.75 per cent the total quantity of free nitrogen available will be approximately 2,600,000 tons. From this quantity of nitrogen 8,500,000 tons of ammonium sulphate could be produced, assuming a recovery efficiency of 70 per cent, which would represent a total value of approximately \$340,000,000, depending on the market price.

Peat Litter 28, 38, 55, 58, 62, 76, 94

Owing to the high absorptive quality of peat, an excellent stable litter can be produced from peat moss. Peat litter will absorb 8 to 10 times its own weight of moisture as against $2\frac{1}{2}$ to 3 times for ordinary straw litter. Large quantities of peat litter are manufactured in Europe.

Peat Mull 55, 82

Peat dust is an excellent packing and preservative material for fresh fruits, vegetables, etc.

Fertilizer 2, 18, 55, 70, 76, 76, 81

Peat mixed with sewage and burned in a rotating furnace has been used to produce a valuable fertilizer. Mixtures of fish offal, tankage and other substances have also been very successfully used as fertilizers. Peat is also used to a considerable extent in the United States as a basic material or carrier in the manufacture of chemical fertilizers.

Cattle Food 55

Peat has been used with molasses for feeding cattle, hogs, poultry, etc. The valuable food qualities of molasses are made available, and the corrective properties of the peat prevent the evil effects resulting from the use of molasses by itself.

Textiles 55

In Germany textile materials are manufactured, into the composition of which peat fibres largely enter.

Cardboard 55

Peat fibre has also been used for the production of paper, cardboard, etc.

Surgical Bandages

During the war sphagnum moss bandages were extensively used in the military hospitals to replace absorbent cotton, and proved to be of special value owing to their antiseptic qualities.

Peat Bogs Investigated in Canada

ONTARIO

These tables have been compiled from the published reports of investigations conducted in 1908-1909 by Erik Nystrom and A. Anrep, and in subsequent years by Mr. Anrep, supplemented by further data based on later surveys made by Mr. Anrep furnished by the Geological Survey Branch of the Department of Mines. A list of published reports of investigations will be found in the bibliography hereto appended.

Peat Bogs	Approx. area	Less than 5 feet deep	5 to 10 feet deep	10 to 15 feet deep	Over 15 feet deep	Approx. contents	Estimated workable volume	Estimated fuel production with 25 per cent moisture	Estimated litter production with 25 per cent moisture	County or district
	acres	acres	acres	acres	acres	cub. yds.	cub. yds.	tons	tons	
aMer Bleu.....	5,000	1,564	2,237	856	347	56,050,700	38,440,000	5,126,000	.....	Russell.
aAlfred.....	6,800	1,386	3,084	1,316	1,014	100,182,450	70,270,000	9,369,000	.....	Prescott.
aWelland.....	4,900	1,435	2,877	588	.....	50,975,000	30,796,000	4,106,000	.....	Welland.
aNewington.....	3,800	887	1,191	748	974	62,913,800	46,566,000	6,209,000	.....	Stormont.
aPerth.....	3,800	638	958	2,098	106	55,523,000	38,445,000	5,126,000	.....	Lanark.
aVictoria Road.....	67	36	15	12	4	638,700	400,000	54,000	.....	Victoria.
bBrunner.....	2,290	1,260	1,030	.....	.....	15,687,500	8,790,000	1,172,000	.....	Perth.
bKomoka.....	900	605	295	.....	.....	4,786,700	1,900,000	254,000	.....	Middlesex.
bBrockville.....	1,400	356	475	490	79	18,601,500	12,705,000	1,694,000	.....	Leeds.
bRondeau.....	1,570	958	316	207	89	13,985,000	7,856,000	1,047,000	.....	Kent.
cHolland.....	14,640	9,084	4,025	1,025	506	123,592,000	61,640,000	8,219,000	.....	Simcoe and York.
cConey Island.....	25	.....	25	.....	.....	322,600	240,000	32,000	.....	.....
cCrozier.....	355	.....	355	.....	.....	8,063,000	6,910,000	.....	518,000	Rainy River
cFort Frances.....	1,700	923	691	86	.....	14,293,000	6,680,000	891,000	.....	Rainy River.
eRichmond.....	5,500	3,340	2,160	.....	.....	62,777,000	20,908,000	2,783,000	.....	Carleton.
eLuther.....	4,900	1,000	1,650	1,700	550	73,143,000	55,820,000	7,443,000	.....	Dufferin.
eAmaranth.....	500	275	225	.....	.....	4,310,000	1,978,000	264,000	.....	Dufferin.
eDurham.....	40	.....	.....	.....	.....	.....	.....	.....	.....	Grey.
eGargill.....	6,600	.....	.....	.....	.....	.....	.....	.....	.....	Bruce.
eWestover.....	1,400	1,045	355	.....	.....	8,411,000	2,290,000	306,000	.....	Wentworth.
eMarsh Hill.....	5,100	1,018	1,446	1,267	1,369	91,214,000	72,156,000	9,280,000	.....	Ontario.
eSunderland.....	580	240	340	.....	.....	4,999,000	2,740,000	366,000	.....	Ontario.
eManilla.....	745	380	355	10	.....	6,611,000	2,990,000	399,000	.....	Victoria.
eStoco.....	1,285	361	666	230	28	.....	10,086,000	1,345,000	.....	Hastings.
eClairview.....	280	280	.....	.....	.....	451,700	.....	.....	.....	Lennox and Addington.
eTweed.....	50	.....	50	.....	.....	.....	.....	.....	.....	Hastings.

<i>e</i> Buller.....	100		100							Hastings.
<i>f</i> Moose Creek.....	12,000						94,612,000	12,615,000		Stormont, Prescott and Russell.
<i>f</i> Westmeath.....	2,745						20,080,000	2,677,000		Renfrew.
<i>f</i> Meath.....	1,695						13,492,000	1,799,000		Renfrew.
<i>k</i> Thedford.....	3,550		3- 6 ft.				11,697,000	1,560,000		Lambton.
<i>k</i> Nellie Lake.....	3,090		4-11 ft.				24,916,000	3,322,000		Nipissing.
<i>k</i> Drinkwater.....	250		3-12 ft.				2,000,000	267,000		Nipissing.
<i>k</i> Cochrane.....	890		5-14 ft.				10,621,000	1,416,000		Timiskaming.
<i>k</i> Brower.....	2,220		5- 8 ft.				11,584,000	1,544,000		Timiskaming.
<i>k</i> St. John.....	2,050		4- 8 ft.				10,043,000	1,339,000		Timiskaming.
<i>k</i> Maybrooke.....	1,280		4-10 ft.				11,650,000	1,553,000		Nipissing.
<i>l</i> Beverly.....	1,730		3- 5 ft.				2,033,000	271,000		Wentworth.
<i>l</i> Halton.....	480		3 ft.				1,548,000	207,000		Halton.
<i>l</i> Aberfoyle.....	300		4- 6 ft.				1,048,000	137,000		Wellington.
<i>l</i> Pelee Point.....	6,010		2-15 ft.				36,302,000	4,840,000		Essex.
<i>l</i> Harrowsmith.....	380		4-20 ft.				3,497,000	464,000		Frontenac.
<i>m</i> Arthur.....	1,475	543	932			13,146,000	7,518,000	1,003,000		Fort William and Rainy River.
<i>m</i> William.....	1,790	927	863			14,225,000	6,962,000	928,000		Fort William and Rainy River.
<i>m</i> Twin Cities.....	995	897	98			5,126,000	791,000	105,000		Fort William and Rainy River.
<i>m</i> Verona.....	6,830	1,426	2,121	1,881	1,40210	6,451,000	79,768,000	10,636,000		Addington and Fron- tenac.
	124,087							113,513,000	518,000	

QUEBEC

<i>d</i> Large Tea Field.....	5,270	1,960	2,130	1,180		56,335,000	36,179,000	4,824,000		Huntingdon.
<i>d</i> Small Tea Field.....	4,190	1,800	1,530	860		41,250,900	24,866,000	3,316,000		Huntingdon.
<i>d</i> Lanoraie.....	7,500	3,966	2,830	500	204	72,627,700	35,636,000	4,751,000		Berthier and Joliette.
<i>d</i> St. Hyacinthe.....	3,890	1,394	1,390	1,074	32	44,026,300	27,490,000	3,666,000		St. Hyacinthe and Bagot.

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Peat Bogs Investigated in Canada—Continued

QUEBEC—Concluded

Peat Bogs	Approx. area	Less than 5 feet deep	5 to 10 feet deep	10 to 15 feet deep	Over 15 feet deep	Approx. contents	Estimated workable volume	Estimated fuel production with 25 per cent moisture	Estimated litter production with 25 per cent moisture	County or district
	acres	acres	acres	acres	acres	cub. yds.	cub. yds.	tons	tons	
dRiviere du Loup.....	7,220	893	1,500	2,900	1,927	140,425,000	{19,360,000} {94,579,000}	12,611,000	1,928,000	Temiscouata.
dCacouna.....	845	262	215	264	104	15,290,000	8,343,000	.....	626,000	Temiscouata.
dLeparc.....	615	124	148	239	14	7,458,100	5,370,000	716,000	.....	Temiscouata.
dSt. Denis.....	315	34	63	177	141	7,127,000	6,003,000	.....	388,000	Kamouraska.
dRiviere Ouelle.....	4,520	802	879	919	1,920	90,268,000	{36,440,000} {21,910,000}	2,921,000	2,624,000	Kamouraska.
eL'Assomption.....	1,565	263	722	555	25	16,809,000	13,200,000	1,760,000	.....	L'Assomption
eSt. Isidore.....	1,230	.....	.....	.....	.....	.....	16,817,000	2,242,000	.....	Laprairie, Napierville and Chateauguay.
eHolton.....	6,180	2,703	3,477	.....	.....	51,050,000	22,400,000	2,999,000	.....	Chateauguay, Napierville and Huntingdon.
gFarnham.....	5,100	.....	.....	.....	.....	.....	59,874,000	7,983,000	.....	Iberville and Missisquoi.
gCanrobert.....	2,000	.....	.....	.....	.....	.....	36,260,000	4,835,000	.....	Rouville.
gNapierville.....	7,200	.....	.....	.....	.....	.....	57,112,000	7,615,000	.....	Napierville.
gGirard.....	3,105	.....	.....	.....	.....	.....	26,539,000	3,539,000	.....	St. Johns and Napierville.
Pont Rouge.....	125	.....	.....	.....	.....	.....	524,000	69,000	.....	Portneuf.
kClair.....	2,600	758	882	916	44	.....	25,261,000	3,368,000	.....	Bellechasse.
kSt. Joseph.....	1,550	.....	.....	.....	.....	.....	14,575,000	1,944,000	.....	Dorchester.
kIsle Verte.....	540	.....	.....	.....	.....	.....	5,006,000	668,000	.....	Temiscouata.
kSt. Arsene.....	2,160	.....	.....	.....	.....	.....	11,422,000 8,493,000 3,691,000	1,132,000	856,000	Temiscouata.
kSt. Anaclet.....	3,250	.....	.....	.....	.....	.....	3,807,000	508,000	276,000	Rimouski.
kSt. Luc.....	5,680	.....	.....	3-7 ft.	.....	.....	19,925,000	2,657,000	.....	Champlain.
Sagamite.....	340	.....	.....	.....	.....	.....	2,706,000	361,000	.....	Quebec.
Breakville.....	1,780	.....	.....	.....	.....	.....	7,521,000	1,004,000	.....	Levis.

St. Jean.....	270					1,695,000	226,000		Levis.
Ste. Therese.....	1,070					3,456,000	461,000		Terrebonne.
	80,110						76,176,000	6,698,000	

NEW BRUNSWICK

<i>a</i> Seeley Cove.....	125	74		49	12-20 ft.		1,297,000	24,000	84,000	Charlotte.
<i>a</i> Pennfield.....	70						271,000		20,000	Charlotte..
<i>a</i> Hunter.....	95		3-10 ft.				834,000	14,000		Charlotte.
<i>a</i> Pocolagan.....	350	245	5- 7 ft.	105	12-16 ft.		3,190,000	180,000	139,000	Charlotte.
<i>a</i> Musquash.....	290						2,714,000		204,000	St. John.
<i>a</i> Hayman.....	60		3-17				834,000	83,000		Charlotte.
<i>a</i> St. Stephen.....	155	82	3-12	71	12-30 ft.		2,241,000	62,000	135,000	Charlotte.
<i>i</i> Canaan.....	880		4-13				7,232,000		543,000	Westmorland.
<i>i</i> "A" Peat Fuel Bog.....	50		3-14				290,000	39,000		Westmorland.
<i>i</i> "B" Peat Litter Bog.....	105		4-16				832,000		62,000	Westmorland.
<i>i</i> Hicks.....	250		4-20				2,794,000		210,000	Westmorland.
<i>i</i> Gades.....	825		4-22				9,838,000		737,000	Westmorland.
<i>i</i> Cudmore.....	350						1,788,000		134,000	Westmorland.
	3,605							499,000	2,268,000	

NOVA SCOTIA

<i>e</i> Caribou.....	890	345	215	130	200	10,789,000	{ 5,815,000 1,960,000 }	362,000	349,000	Kings. .
<i>e</i> Cherryfield.....	160	27	46	30	57	2,796,000	2,240,000	299,000		Lunenburg.
<i>e</i> Tusket.....	235	82	105	48		2,576,000	1,936,000	258,000		Yarmouth.
<i>e</i> Makoke.....	460	120	240	100		5,445,000	3,560,000	475,000		Yarmouth.
<i>e</i> Heath.....	2,175	825	1,212	134	4	21,419,000	{ 1,384,000 13,350,000 }	1,646,000	104,000	Yarmouth.
<i>e</i> Port Clyde.....	1,665	954	552	159		13,690,000	7,560,000	1,021,000		Shelburne.
<i>e</i> Latour.....	850	273	420	157		8,855,000	5,660,000	755,000		Shelburne.
<i>e</i> Clyde.....	2,240	1,390	520	180	150	18,225,000	11,595,000	1,545,000		Shelburne.
	8,675							6,188,000	453,000	

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Peat Bogs Investigated in Canada—Continued

PRINCE EDWARD ISLAND

Peat Bogs	Approx. area	Less than 5 feet deep	5 to 10 feet deep	10 to 15 feet deep	Over 15 feet deep	Approx. contents	Estimated workable volume	Estimated fuel production with 25 per cent moisture	Estimated litter production with 25 per cent moisture	County or district
	acres ^a	acres	acres	acres	acres	cub. yds.	cub. yds.	tons	tons	
<i>c</i> Black Marsh.....	550						1,370,000	183,000		North.
<i>e</i> Portage.....	775	267	360	110	38	8,719,000	6,220,000	500,000	184,000	Prince.
<i>e</i> Miscouche.....	2,900	2,411	386	103		14,298,720	4,940,000	415,000	137,000	Prince.
<i>e</i> Muddy Creek.....	60	60					347,000			Prince.
<i>e</i> Black Banks.....	885	255	180	215	235	14,413,000	11,180,000		839,000	Prince.
<i>e</i> Mermaid.....	185	83	94	8		1,459,000	960,000	115,000		Queens.
	5,355							1,213,000	1,160,000	

MANITOBA

<i>c</i> Lac du Bonnet.....	250	180	70			1,258,400	445,280	59,000		Tp. 14 10 E.
<i>c</i> Transmission.....	1,375	1,375				10,648,900	7,022,840	936,000		Tp. 15 12 E.
<i>c</i> Corduroy.....	100	100				649,000	322,660	43,000		Tp. 15 12 E.
<i>c</i> Boggy Creek.....	660						4,257,050	568,000		Tp. 15 12-13 E
<i>c</i> Rice Lake.....										Tp. 15 13 E.
<i>c</i> Mud Lake.....	140		140			2,011,700	1,564,630	209,000		Tp. 15 14 E.
<i>c</i> Litter.....	110		28	40	42	2,116,500	1,389,740	48,000	104,000	Tp. 15 14 E.
							361,390			
<i>c</i> Julius.....	3,900	1,000	1,954	946		44,382,500	32,651,750		2,449,000	Tp. 11-12 10 E.
	6,535							1,863,000	2,553,000	

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Totals

Province	No. of bogs	Approximate area	Est. peat fuel 25 per cent moisture	Moss litter
		acres	tons	tons
Ontario.....	46	124,087	113,513,000	518,000
Quebec.....	27	80,110	76,176,000	6,698,000
New Brunswick.....	13	3,605	499,000	2,268,000
Nova Scotia.....	8	8,675	6,188,000	453,000
Prince Edward Island.....	6	5,355	1,213,000	1,160,000
Manitoba.....	7	6,535	1,863,000	2,533,000
	107	228,367	199,452,000	13,650,000

Chemical Analysis and Shipping Facilities of Peat Bogs Investigated

ONTARIO

Peat Bog	Partial volatile matter	Analysis of absolutely dry peat			Calorific value B.Th.U	Location and shipping facilities
		Fixed carbon	Ash	Nitrogen		
	per cent	per cent	per cent	per cent	per lb.	
Mer Bleu.....	68.0	25.0	7.0	1.26	9,100	Eight miles from Ottawa on C.P.R. and G.T.R.
Alfred.....	68.0	27.0	5.0	1.7	8,700	Near Alfred station, Prescott county, on C.P.R., 42 miles from Ottawa.
Welland.....	71.0	24.0	5.0	1.4	8,700	Six miles from Welland on Welland canal.
Newington.....	67.0	26.0	7.0	1.7	8,500	At Newington station on N.Y. and O. Railway, 40 miles from Ottawa.
Perth.....	71.0	25.0	4.0	1.8	9,100	One and a half mile from Perth station, Lanark county, C.P.R.
Victoria Road.....	70.0	25.0	5.0	.....	8,600	One mile from Victoria Road station, Midland division, G.T.R.
Brunner.....	64.0	25.0	11.0	1.7	8,800	Eight miles from Stratford. Traversed by G.T.R.
Komoka.....	61.0	21.0	19.0	1.6	7,500	Two miles from London, on C.P.R. and G.T.R.
Brockville.....	66.0	22.0	12.0	2.4	8,200	Three miles from Brockville on C.P.R.
Rondeau.....	61.0	23.0	16.0	2.7	7,900	Six miles from Blenheim on lake Erie.
Holland.....	64.0	26.0	10.0	2.6	8,500	Just east of Bradford in Simcoe and York counties.
Coney island.....	.....	.....	.....	.....	.....	On Coney island in lake of the Woods, 1 mile west of Kenora.
Crozier.....	.....	.....	.....	.....	.....	Six miles southwest of Fort Francis, Rainy River district.
Fort Francis.....	62.0	29.0	9.0	.....	8,900	One mile west of Fort Francis, Rainy River district.
Richmond.....	61.0	28.0	11.0	2.0	8,500	Two and a half miles south of Richmond, Carleton county.
Luther.....	62.0	27.0	11.0	1.6	8,400	Seven miles from Grand Valley, Dufferin county (2½ miles from C.P.R.).
Amaranth.....	60.0	27.0	13.0	.....	8,700	Four miles from Crombie station, Dufferin county.
Durham.....	.....	.....	.....	.....	.....	.....
Cargill.....	52.0	22.0	26.0	.....	7,400	.....
Westover.....	56.0	24.0	20.0	2.3	7,900	Four miles south of C.P.R.
Marsh Hill.....	61.0	27.0	12.0	2.2	8,100	Extends from 1 mile north of Uxbridge to 1½ mile south of Can- nington.
Sunderland.....	61.0	28.0	11.0	2.0	8,300	One mile north of Sunderland.
Manilla.....	60.0	29.0	11.0	2.1	8,100	Two miles from Mariposa station (G.T.R., ½ mile from bog).
Stoco.....	61.0	23.0	16.0	2.3	7,800	Half a mile from Stoco station, Bay of Quinte Railway.
Clairview.....	.....	.....	.....	.....	.....	Four miles from Erinville station, Bay of Quinte Railway.
Tweed.....	.....	.....	.....	.....	.....	One mile south of Tweed station.
Buller.....	.....	.....	.....	.....	.....	One mile from Buller station.
Moose Creek.....	60.2	29.4	10.4	.....	8,460	Two miles N.E. of Casselman, 1½ mile N.W. of Moose creek on G.T.R., which traverses bog.
Westmeath.....	52.4	30.0	7.6	.....	9,360	One mile south of Westmeath, 1½ mile north of Beachburg, C.N.R. 1½ mile to south.

Meath.....	56.9	22.7	20.4	7,960	Half a mile west of Meath station.
Thedford.....	55.0	23.0	22.0	6,530	Four and a half miles N.E. of Thedford.
Nellie Lake.....	65.0	28.5	6.5	8,230	One mile west of Nellie Lake on T. and N. O. Railway.
Drinkwater.....	63.0	27.0	10.0	7,500	Near Drinkwater station, on T. and N. O. Railway.
Cochrane.....	65.5	29.0	5.5	8,020	" Cochrane " " "
Brower.....	64.0	29.0	7.0	9,240	" " " " "
St. John.....	62.0	28.5	9.5	8,610	" " " " "
Maybrooke.....	61.0	29.5	9.5	7,530	" Maybrooke " " "
Beverly.....	49.0	30.0	21.0	7,470	Two and a half miles west of Freelon.
Halton.....	52.5	24.5	23.0	6,770	Directly south of Guelph junction.
Aberfoyle.....	57.0	24.5	18.5	7,100	Half a mile N.E. of Aberfoyle.
Pelée Point.....	60.0	26.0	14.0	7,925	Six and a half miles south of Leamington.
Harrowsmith.....	62.5	31.0	6.5	8,160	Three miles N.W. of Harrowsmith junction.
Arthur.....	57.7	28.8	13.5	7,620	Nine miles west of Fort William. Traversed by C.P.R. and C.N.R.
William.....	63.2	25.5	11.3	8,630	Near Fort William and Port Arthur.
Twin Cities.....	62.4	29.0	8.6	8,730	Within limits of Fort William and Port Arthur.
Verona.....	61.6	23.6	14.8	8,180	One mile south of Verona. Touches C.P.R. east end and C.N.R. west end.

QUEBEC

Large Tea Field.....	65.5	29.0	5.5	2.0	9,400	Two miles northwest of Huntingdon station, Huntingdon county.
Small Tea Field.....	64.5	29.0	6.5	2.0	9,200	Four and a half miles from Huntingdon station, 1½ mile from Port Lewis wharf.
Lanoraie.....	65.0	28.0	7.0	2.0	9,000	At Lanoraie station, 40 miles from Montreal. Traversed by C.P.R.
St. Hyacinthe.....	63.0	30.0	7.0	2.0	8,800	Two miles from St. Hyacinthe station on C.P.R.
Rivière du Loup.....	68.0	29.0	3.0	1.0	9,200	One mile south of Riviere du Loup station, Temiscouata county.
Cacouna.....						At Cacouna station and traversed by C.P.R.
Leparc.....	69.0	28.0	3.0	1.0	9,000	Near Cacouna station and traversed by C.P.R.
St. Denis.....						One mile from St. Denis wharf, on branch line of I. C. Railway.
Rivière Ouelle.....	68.0	29.0	3.0	1.0	9,200	One mile from Riviere Ouelle station, and on I. C. Railway.
L'Assomption.....	67.0	29.0	4.0	2.0	9,700	Two miles from L'Epiphanie station, L'Assomption county.
St. Isidore.....	62.0	32.0	6.0	2.0	8,900	Three miles south of St. Isidore station.
Holton.....	59.0	27.0	14.0	2.0	8,500	Two miles east of Holton station.
Farnham.....	66.0	29.0	5.0	1.7	9,700	One mile east of Ste. Brigide station, 3 miles west of Farnham.
Canrobert.....	66.0	29.0	5.0	1.6	9,500	Two and a half miles east of Canrobert station on C.P.R., 2½ miles west of Angeline station on C.N.R.
Napierville.....	63.0	28.0	9.0	2.0	8,700	Four miles north of Hurrysburgh station on G.T.R., 4 miles south of Napierville station on D. and H.
Girard.....	61.0	30.0	9.0	1.7	9,100	One and three-quarter mile northwest of Girard station, 8 miles south of St. John.
Pont Rouge.....	67.0	30.0	3.0	1.4	9,300	
Clair.....	68.0	29.0	3.0	1.0	8,300	Eight miles east of Quebec.
St. Joseph.....	67.0	29.0	4.0	1.0	8,400	
Isle Verte.....	64.0	31.0	5.0	0.9	8,200	One mile north of Isle Verte.

Chemical Analysis and Shipping Facilities of Peat Bogs Investigated—Continued

ONTARIO—Continued.

Peat Bog	Partial volatile matter	Analysis of absolutely dry peat			Calorific value B.Th.U	Location and shipping facilities
		Fixed carbon	Ash	Nitrogen		
	per cent	per cent	per cent	per cent	per lb.	
St. Arsene.....	65.0	31.0	4.0	0.8	8,200	One mile north of St. Arsene.
St. Anaclet.....	64.0	31.0	5.0	1.3	8,200	Seven miles east of Rimouski.
St. Luc.....	63.5	27.5	9.0	2.0	9,400	One and a half mile north of Champlain station.
Sagamite.....	51.2	21.9	26.9	1.8	7,580	
Breakeyville.....	67.4	26.8	5.8	1.5	10,100	
St. Jean.....	69.7	25.3	5.0	1.6	10,300	
Ste. Therese.....	63.7	26.5	9.8	1.5	10,100	

NEW BRUNSWICK

Seeley Cove.....	59.0	28.0	13.0		8,840	Four miles southwest of road from Pennfield station.
Pennfield.....						Four miles south of St. George, $4\frac{1}{2}$ miles north of Pennfield station.
Hunter.....	67.0	30.0	3.0		9,490	Three miles northeast of Pennfield station.
Pocolagan.....	66.0	31.5	2.5		9,600	Four miles south of Pennfield. C.P.R. traverses eastern part of bog.
Musquash.....						
Hayman.....	63.0	32.0	5.0		9,520	Six miles north of St. Stephen.
St. Stephen.....	65.5	31.0	3.5		9,360	Four miles north of St. Stephen.
Canaan.....						One and a half mile south of Canaan station, traversed by I.C.R.
"A" Peat Fuel Bog.....	65.0	32.0	3.0		8,990	One mile west of Gallagher station.
"B" Peat Litter Bog.....						One mile south of Canaan station.
Hicks.....						One and a half mile north of Canaan station.
Gades.....						Four miles south of Canaan station, 1 mile west of Gallagher station.
Cudmore.....						Three and a half miles west of Canaan station.

NOVA SCOTIA

Caribou.....	65.4	30.4	4.2	1.18	9,600	One and a half mile from Berwick on Dom. Atlantic Railway.
Cherryfield.....	64.0	30.0	6.0	1.10	9,400	Half a mile from Cherryfield station.
Tusket.....	61.0	29.0	10.0	1.70	9,200	Near Tusket station.
Makoke.....	66.0	29.0	5.0	1.55	9,400	One and a half mile south of Tusket station.

Heath.....	64.3	28.7	7.0	1.55	9,400	One mile from Central Argyle station.
Port Clyde.....	66.7	30.0	3.3	1.13	9,700	Three miles from Port Clyde station. Traversed by Halifax and Southwestern Railway
Latour.....	68.0	28.0	4.0	1.10	9,300	One and a half mile from Upper Port Latour.
Clyde.....	64.8	30.2	5.0	1.20	9,500	Two and a half miles from Clyde River village.

PRINCE EDWARD ISLAND

Black Marsh.....	65.0	30.0	5.0	0.85	9,800	Six miles from Tignish.
Portage.....						One mile from Portage station.
Miscouche.....	63.0	30.0	7.0		9,400	One mile from St. Nicholas station. Traversed by P.E.I. Railway.
Muddy Creek.....						Three miles southwest of St. Nicholas station.
Black Banks.....						Five miles south of Alberton.
Mermaid.....	67.0	29.0	4.0		9,800	Two miles from Mount Herbert station on the I.C.R.

MANITOBA

Lac du Bonnet.....	59.4	25.0	15.6		
Transmission.....	56.8	24.2	19.0		
Corduoy.....	56.1	34.8	9.1		
Boggy Creek.....	65.0	26.7	8.3		8,730
Rice Lake.....					
Mud Lake.....	69.1	23.2	7.7		8,760
Litter.....					
Julius.....					

EXTRACTS FROM REPLIES TO QUESTIONNAIRE

After completion of their operations at Alfred, Ont., a questionnaire was addressed by the Peat Committee to purchasers and users of peat fuel. A large number of replies were received which were almost without exception favourable. A number of fairly representative replies follow:—

QUESTIONNAIRE

1. During what years have you used Peat Fuel? 1920, 1921 or 1922?
2. Have you given it a fair trial and endeavoured to study its proper use?
3. Has the quality of peat you received been good? If not, what complaint have you regarding it and during what year was it received?
4. Have you used it in the grate, stove, Quebec heater, or furnace?
5. Did you have any difficulty in controlling the fire?
6. What sized fuel did you get the best results from?
7. From practical use do you consider it an economical fuel for domestic use at \$10 per ton?
8. How much coal do you usually use during the winter?
9. What amount of coal do you think can economically be replaced by peat?
10. What are your general observations regarding peat fuel?

EXTRACTS FROM REPLIES SENT BY THOSE WHO USED PEAT

"Peat fuel in my opinion is more economical than hardwood and less bother, in lumps. Works well with pea coal in furnace, excellent for starting fire or if fire becomes low to raise again, like it very much at least for moderate weather. J. Mackie."

"Peat fuel in my opinion is more economical than hardwood and less bother, it is a good substitute for coal spring and fall use; also, a good substitute for wood for kitchen use in the winter, and is good value at \$10 per ton. J. J. Ramsay, 118 Frank St."

"It appears to me that reasonably priced and prepared in suitable sizes for range, grate and furnace uses, this fuel could very largely make our great country independent of foreign fuels. While my personal experience is as yet quite limited I hear many favourable remarks about this fuel and from observation would encourage its immediate development. (Rev.) A. G. Dover, Peterboro, Ont."

"A valuable asset to the fuel resources of Canada; cannot be surpassed for open grate use and is in my opinion preferable to hard coal or soft coal or hard or soft woods for these purposes. Should prove satisfactory for the regular pattern cookstoves, and probably superior to coal or wood for this purpose. I have seen it used in Quebec heaters—result, excellent, but preferable to use large size after once kindling. The cost is excessive when peat is \$13 per ton and good coal (anthracite) is at \$17.50 per ton. The real value of the peat is approximately \$8.75 per ton in this case. W. H. Pretty, M.Sc., F.R.C.Sc., A.M.I.C.E."

"A free burning fuel, lasts as well or better than hard maple, gives a splendid heat, burns right down to a fine powder, a clean splendid fuel for a grate. If I could procure it in proper condition I would gladly purchase a supply every year at \$10 when coal is the price it is at present. J. N. Tribble."

"A useful and practical fuel, giving a clean bright fire, little ash and no clinker. Needs close attention to drafts to avoid wasteful use. Piled in basement becomes too dry and I believe improved results would be obtained by keeping it moderately damp by use of hose. H. E. M. Kensit."

"It is clean to handle, burns well, gives good heat, desirable fuel for grate, good for hot water furnace in milder months of winter, far less laborious than coal in matter of handling and ashes. A. H. Anderson."

"Peat fuel is an ideal fuel for all home purposes, grate, cook stoves and medium size furnace. We used it in a hot water Gurney Oxford furnace all through October and November, 1921. It lights up easily, burns clean and gives quicker results than coal. It is a very fine fuel and could be used to good advantage in a furnace during the milder months. I have used it personally, therefore can testify to it. Mrs. P. E. Turner, Ottawa."

"I think peat cannot be beaten for domestic use, it is a fuel that burns down to the last and gives a steady heat. It would also do in a furnace for spring and fall. Alec. Baker."

"The finest fuel possible for grates, also very good for starting fire in stoves, etc., and for use in furnace during mild weather when a permanent fire is not required. It is excellent as a booster and mixes with any other fuel if not administered in too large quantities. Cecil H. Burns."

"My conclusions from the short time I have been using peat are all in favour of it as a good economical substitute for coal during four out of the eight months we need furnace fuel. At \$10 a ton it certainly should prove a great economic factor in relieving the heavy burden our every day people are carrying at present from October until May. Elizabeth Kendry, Peterboro."

"It is especially good on days when the furnace fire does not burn well. I use it with wood and furnace coal as an auxiliary. I think it should be developed as the more one uses it the better it is liked. We may need it badly some years. W. M. Hill."

"I think it is wonderful for fall and spring, especially in a furnace when heavy heat during the night is not necessary. Mrs. H. E. White, Peterboro."

"It gives satisfaction. I find it very easy to set the fire in the furnace. This year I hope to save \$100 by burning peat. Rev. J. M. Laflamme."

"If peat can be delivered to the consumer in dry solid blocks at the price you suggest and the householder educated to the proper method of using this fuel, I am satisfied that an enormous benefit would accrue to the Canadian industry in developing our natural resources, spending millions in Canada which is now going to the United States, and making Canada more independent of foreign nations. F. W. Pooler, Ottawa."

"It makes a very hot fire if briquettes are dry; for furnace use the briquettes should be larger. Burns somewhat harder than hardwood. At

\$10 per ton at present it could meet any other fuel on equal footing. E. E. Homey, Peterboro."

"I am very well satisfied. I can say many things in favour of peat. I believe the best size would be from 6 to 8 inches for general use. My experience with coal is far from the best, it is filled with stone and shale, positively fireproof in the greater percentage. R. H. Hunter."

"Peat is a good substitute for coal in the furnace in the spring and fall. It is not advisable to shake the dust out too often or it will burn too fiercely in a furnace. In a grate it is no trouble and as good as coal or wood. We prefer it to either. Have burnt nothing but peat during this month (October) and the house was quite comfortable. A. W. Watts."

"I have found it excellent when used in connection with coal briquettes and also very useful to aid the fire in the morning or any time the fire gets low. I think it would be good substitute to mix with coal for furnace use." D. J. O'Connor."

"I have found it a very satisfactory fuel for the purpose for which I have used it, that is, for grates, cook stoves and starting the furnace and kitchen range, but not for permanent fire. E. H. D. Hall."

"I consider peat fuel to be as 55 per cent to 60 per cent compared to 100 per cent anthracite coal, and for use in the less severe weather, say November and half December and the latter half of March and April, I find it satisfactory. It burns to fast and too hard to keep fire during the night for use during the winter weather. V. L. Lawson, Ottawa."

"A good fuel. I find the best results when used with pea or buckwheat coal. I will be pleased to give any further information if desired."

"It is an excellent fuel, easily lighted, burns well, gives a good heat, not dirty to handle, is perfectly consumed and leaves a small residue of ash." J. L. Payne."

"It is excellent for the range. We use it all winter in that way. In the early fall and up to the middle of November the house may be kept comfortable by lighting the furnace with peat in the morning and letting it burn out, keeping the range going, then in the evening put on a peat fire in the furnace and let the range out. If cold and frosty a couple of shovelfuls of coal on top will assist during the night. F. J. Wood, Ottawa, Ont."

"For use in grate and kitchen range, it is first-class, and superior to coal. G. N. Bobin."

"Excellent for temporary fire in grate, excellent in furnace as kindling to pick up an almost extinct fire. Omar Wilson, M.D., Ottawa."

"Very good in very cold weather when the house is cold to get quick results. A. Drury."

"For all heating and cooking purposes very good, but in the coldest weather and at night when it would get little attention, not so good as coal, owing to the more rapid combustion. C. N. Craik."

"It is a good substitute for hardwood, being more convenient than the latter on account of the size of the bricks. It also burns with much less kindling wood than is necessary for hardwood. De Brisay, Ottawa."

"We consider peat fuel an excellent fuel for the grate. Annie C. Macpherson."

OPINION OF DEALERS

The dealers who handled the fuel this year were all pleased with the quality and stated that their customers were well satisfied. They nearly all, however, complained of the high freight rates. The consensus of opinion is that peat is excellent for fall and spring use in the furnace, a splendid substitute for coal, and can be used all the year round in ranges and in grate fires.

EXTRACTS FROM ANSWERS TO QUESTIONNAIRE SENT TO DEALERS

"Quality good, no complaints, had only 1 car load, could have sold 200 tons more this year. Could handle 300 or 400 tons next year. W. Bingley & Son, Cornwall, Ont."

"We could certainly sell 3,000 tons a year of this peat at \$1 cheaper than the coke in ordinary times; the coke now is sold at \$18 a ton, and in June last we were selling it at \$9 per carload to manufacturers or plants, and \$11.50 to the public. We understand that there is much profiteering in this coke business and we think that steps should be taken to prevent it. E. Leger & Cie, Ltd., Montreal."

"With reference to peat fuel for the coming year. I would like to have the sole agency for Cornwall. I received 1 car this year and had orders for one hundred tons more but you were unable to supply me. Through reports from customers that used same I believe I could handle four or five hundred tons. I am in the coal and wood business and well equipped to handle fuel. W. Bingley, Cornwall, Ont."

"Quality very good, sold 2 cars this year. Could have sold 7 or 8 more if no other dealers handling. For the early fall and spring it is good fuel, especially for range, not much for furnace. If alone in Cornwall could handle 10 cars. J. E. Chevrier, Cornwall, Ont."

"Only had 1 car, quality was good, customers were satisfied. Could have sold ten cars this year if available. Consider can sell ten cars next year. Andre Elie, Montreal, P.Q."

"Received about 60 tons, good quality. In most cases it was pronounced very satisfactory for open fireplaces and for furnaces in moderately cold weather. We have had to refuse a very large number of people on account of not having sufficient. It would appear that were the relative prices of peat fuel, wood, coke and the various coals to remain about the same as now, there should be sale for considerable peat. J. & T. Bal-lantyne, Ltd., Ottawa."

"The quality seemed to be very good, had no complaints, we think peat is a very good substitute for coal and as the people get more accustomed to burning it, it will have a ready sale. Estate T. A. Thompson, Iroquois, Ont."

"Received seven cars, good quality, considerable quantity should be used in ranges throughout the year and in furnaces. We consider it an excellent fuel for fall and spring burning. Farquhar Robertson, Ltd., Montreal."

"On the whole it was well received by the citizens of Belleville. The Schuster Company, Ltd., Belleville."

"Sold 6 cars. I consider it an excellent fuel, but it is too early to give any definite opinions as to the future market here, as people are only first commencing to use same, but several of my customers say they will not burn wood again if they can get peat. W. E. Yolland, St. Anne de Bellevue, Que."

EXTRACTS FROM REPLIES TO QUESTIONNAIRE SENT TO INDIVIDUALS OTHER THAN DEALERS WHO BOUGHT WHOLESALE

"I shall not be able to answer those questions until the spring. Meantime I may state that the peat is thoroughly satisfactory. W. M. Goodwin, Mining Engineer, Gardenvale, Que."

"It is well liked here amongst us and probably in the spring we will order another carload. James Stewart, Postmaster, Kingston."

"So far have not had any complaints but any who used it are highly pleased with it. Could have disposed of another car without any difficulty. T. E. Park, Assistant Postmaster, Hawkesbury, Ont."

"The quality was first class. We received no complaints. I am not in the retail business, but considering the demand for the fuel that I received I should judge four or five carloads could have been sold in this town this fall. Capt. William Henry, Prescott, Ont."

"1922 peat is exceptionally good. 1920 and 1921 not nearly so good. A good handy clean fuel for spring and fall, but I have never tried it out satisfactorily in the very cold winter months in the furnace. The peat manufactured this year should prove much more satisfactory, but to use it in the furnace in the very cold weather would require a great deal more attention than coal. E. McMahon, Ottawa."

"Can use peat comfortably except during excessive cold, say December, January and February. Freight rate too high. Same rate per ton from bog to Braeside as on anthracite from Niagara Gateway. J. Q. Gillies, Braeside, Ont."

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- Mosebladet, Denmark.
- Hedeselskabets Tidskrift, Denmark.
- Finska Mosskultur foreningens arsbok, Finland.
- Mitteilungen des Vereins fur Forderung der Moorkultur in deutschen Reiche, Germany.
- Meddelelser fra det Norske Myrskap, Norway.
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- Torf-wirtschaft, Bavaria.

Net Annual Production of Peat Fuel in Canada since 1900¹

Calendar Year	Tons	Value
		\$
1900.....	400	1,200
1901.....	220	600
1902.....	475	1,003
1903.....	1,100	3,300
1904.....	800	2,400
1905.....	80	260
1906.....	474	1,422
1907.....	50	200
1908.....	60	180
1909.....	60	240
1910.....	841	2,604
1911.....	1,463	3,817
1912.....	700	2,900
1913.....	2,600	10,100
1914.....	685	2,470
1915.....	300	1,050
1916.....	300	1,500
1917.....	Nil	Nil
1918.....	Nil	Nil
1919.....	986	6,561
1920.....	4,550	18,650
*1921.....	1,666	6,604
†1922.....	3,000	14,500

*Gross production in 1921 was approximately 4,000 tons, of which only 1,666 tons were shipped, the remainder having been almost entirely destroyed by fire in the store pile.

†Gross production in 1922—4,700 tons.

¹Compiled from Annual Reports of the Mineral Production of Canada issued by the Department of Mines up to 1920, and since then by the Bureau of Statistics, Department of Trade and Commerce.

Production of Peat Fuel in Various Countries

(METRIC TONS—AIR-DRIED)

NOTE:—"C"=Cut Peat. "M"=Machine Peat

—	Germany	Sweden	Denmark	Holland	Norway	France	Italy	Russia	U.S.A.	Ireland
1902.....			46,760		3,300			4,000,000		
1906.....			68,278							
1909.....		M. 64,925	89,600						1,030	
1910.....			81,865	1,250,000			67,000			
1911.....			M. 79,242 C. 108,000			58,500		2,500,000	1,170	
			187,242							
1912.....			84,788			42,700		3,000,000		
1913.....			93,642					7,000,000		
1914.....	500,000	M. 40,135	86,849		12,500	36,700		7,000,000	1,730	
1915.....		M. 100,000	95,145							
1916.....		150,000	C. 171,673 M. 118,484	880,000						
			290,157							
1917.....		237,688	C. 909,274 M. 397,846		56,000	52,100	150,000			
			1,307,120							
1918.....	650,000	400,000	C. 1,407,435 M. 851,546		88,000	129,000		10,000,000	18,500	7,000,000
			2,258,981							
1919.....	1,000,000	300,000	C. 1,005,983 M. 486,609			71,000	100,607		7,200	
			1,492,592							

Production of Peat Fuel in Various Countries—Continued

(METRIC TONS—AIR-DRIED)

NOTE:—"C"=Cut Peat. "M"=Machine Peat

	Germany	Sweden	Denmark	Holland	Norway	France	Italy	Russia	U.S.A.	Ireland
1920.....	2,500,000	200,000	C 1,572,575 M. 512,636			78,500	147,607		700	
			2,085,211							
1921.....	3,000,000	150,000	C. 600,000 M. 235,085							
			835,085							

Report of the British Fuel Research Board for the year 1922, 1923—First Section: The Production of Air-dried-Peat.

NOTE:—Figures for production cover only the years stated, as ascertained from various sources mentioned in the report of the Fuel Research Board. The production of 7,000,000 tons given for Ireland in 1918, e.g. is an estimated annual production. Vide "The Winning, Preparation and use of Peat in Ireland. Report and other documents H.M. Stationery Office 1921"