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DOMINION OF CANADA, DEPARTMENT OF AGRICULTURE

# ORGANIC SOILS OF SOUTHWESTERN QUEBEC

By

R. R. MCKIBBIN and P. C. STOBBE

First Report of the Quebec Soil Survey Committee



Published by authority of the Hon. JAMES G. GARDINER, Minister of Agriculture  
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# Organic Soils of Southwestern Quebec

## INTRODUCTION

The existence of a considerable acreage of organic soils in southwestern Quebec has been known of for a long time, but until the carrying on of the survey reported in this publication there has been no knowledge of their total extent, the location and the limits of the areas, the quality, the cropped acreage, nor of the cultural and fertilization practices. The possession of this knowledge, and an appreciation of the possibilities of such valuable lands, should permit of their rational development. The cultivators of this land should be benefited and their living conditions improved by its more intelligent utilization.

In this report descriptions are published of the main muck and peat soil areas in that region of Quebec south of the St. Lawrence and west of the Richelieu river. Detailed maps are given of eight large areas of organic soil that occur in this district, and a full description of each. Complete descriptions of a number of other areas are published but the maps of these areas, though prepared, are not printed. In that part of Quebec covered in this survey more than 50,000 acres of peats and mucks of depth exceeding eighteen inches have been mapped. More than 40,000 acres of this total are found within a circle whose radius is about 12 miles, in the counties of Napierville, Chateauguay, Laprairie, St. John, and eastern Huntingdon. Within this circle are the following seven areas that are described and mapped in detail in this report:—

1. Sherrington-Ste. Clothilde, about 17,000 acres;
2. Napierville, about 10,000 acres;
3. Hemmingford, about 6,000 acres;
4. St. Blaise-St. Valentin, about 4,200 acres;
5. St. Edouard, about 2,800 acres;
6. St. Isidore, about 3,100 acres;
7. St. Philippe, about 1,000 acres.

All of these seven areas lie less than 45 miles from Montreal, the greatest city in Canada, and 75 per cent within 35 miles from that market. Another large area of about 10,000 acres extent is found at Ste. Barbe in the west end of Huntingdon county, near the town of Huntingdon and about 60 miles from Montreal.

There is a number of small muck and peat areas in the vicinity of Montreal, the soils of which vary from excellent to worthless.

In the key map, which shows on a small scale the muck and peat occurrences mentioned in this report, all the areas surveyed are portrayed. In this key map merely the location of each area is given, while in the eight detailed maps soil variations are shown on a scale of two inches to one mile.

## PRESENT UTILIZATION OF ORGANIC SOILS IN THE DISTRICT SURVEYED

A detailed discussion is given under each area of the present utilization of the soils mapped. Undoubtedly the chief crop now cultivated on these soils is potatoes, several thousands of acres of which are grown. On the areas immediately around Montreal there is a considerable acreage of celery grown for the late summer and autumn market. At present the chief potato-growing areas are those of St. Edouard, St. Isidore, St. Philippe and Napierville. The

chief celery-growing area is that of St. Léonard de Port Maurice, both ends of which lie in Montreal city, the west end in Ahuntsic, the east end in Rosemont. The largest single truck-crop development is on the St. Hubert muck area, where 170 acres of lettuce, onions, carrots, celery, spinach, beets and other garden crops are grown under one management. On the small muck soil occurrences of Ile Jésus and Montreal Island there is some development of truck crop production. There is a considerable acreage devoted to the growing of hay, grain and pasture crops on the areas farthest from Montreal.



FIG. 1.—A drain through acid, semi-decomposed peat which has been surface burned. Tree cover, white birch. Ditcher in left centre background.

### POSSIBILITIES OF DEVELOPMENT

While the results obtained from some of the scattered horticultural crop plantings are surprisingly good, it is evident that better results could be got. It would appear that three things are needed in order to develop quality as well as quantity production from these magnificent soils. The first is the exact information obtainable from controlled experimental work carried out under representative conditions. This information must cover each phase of production, marketing and storage. The second thing needed is the development of an efficient organization to convey this information to the practical growers. The third and central need would appear to be the encouragement of the growing of horticultural crops in the most suitable soil areas.

Unfortunately, in some sections of the cropped muck soil areas closest to Montreal, practices have been followed that in many cases reduce the value of the muck land and of the crops grown on it. Among these bad practices are the burning of surface muck land, the use of lime on muck, the unlimited use of barnyard manure with the belief that it fulfils the muck soils' fertilizer needs, the use of chemical fertilizer mixtures deficient in the most-needed elements and over-rich in less-needed elements, the inefficient control of insect pests and plant diseases in the field and in storage, the lack of irrigation and the misunderstanding of proper methods of irrigation and drainage, the use of farm machinery unsuited to muck soils, inefficient cultural practices, and the planting of poorly adapted crops and varieties. These things are not intended to be listed in the order of their importance, nor is the list complete.

The Sherrington-Ste. Clothilde occurrence is outstandingly most important among the areas discussed in this bulletin, both in total extent and in acreage of high quality land. Situated as they are, in a definite section, most of the larger organic soil areas in this part of the province are grouped so closely together that they would lend themselves to development almost as a single area.

This group of areas lies in the most southern part of the province, in a district where there has been great development of canning crops on the mineral soils. These areas of muck soils are largely unspoiled by bad practices. It is predictable that the future will see much development of these valuable lands.

## HISTORY

It is supposed that the muck areas in this section of the province were, centuries ago, shallow lakes that were left after the retreat of the waters of the Champlain sea. These were filled with stagnant water and had no free-flowing outlets. As evaporation of the water from these lakes proceeded, water plants started to grow along their outside edges. As soon as the water plants covered the surface of the water near the edges, sedges and other marsh grasses came in. Some of the remains of water plants settled to the bottom and gradually filled the lakes from the outer edges. As the filling in of the lakes from the edges continued towards the centre, swamp bushes and trees of a mixed coniferous and deciduous nature appeared along the edges and gradually followed the encroaching marsh grasses. The nature of the soil on the surrounding ridges and the underlying mineral soil has had an important influence on the nature of the vegetation that has formed these organic deposits. The mineral soils on the ridges are calcareous in nature. Limestone and calcareous sandstone are very common on the ridges. The lime and other minerals that were washed into the lake, and later into the organic soils near the edges of the ridges, favoured decomposition of the organic materials and also favoured the growth of deciduous trees and shrubs. The minerals were in the main absorbed by the organic deposits before they reached the centre of the lakes. As a result, sphagnum moss, cottongrass and other acid-tolerant species established themselves at the centres of the deposits. These latter species resist decomposition to a much greater extent than the marsh species closer to the edges of the ridges. Furthermore, better drainage conditions and a higher lime content of the muck near the ridges favours activity of the soil micro-organisms much more than in the centres of the deposits. As a result, raw peat bogs have been formed at the centres of the areas, while well decomposed muck soils have been formed around these peat deposits.

## EVALUATION OF PEATS AND MUCKS

In order to evaluate the different muck and peat areas, the following points were considered. These points are not necessarily of the same importance.

- (a) *Depth*.—At least four feet depth of muck or peat is wanted for first class organic soil for truck gardening.
- (b) *Source of Organic Matter*.—Wood and carex remains form the best muck soils and are superior to carex and sphagnum moss alone or in a mixture.
- (c) *Drainage*.—Present conditions, their reflection on soil quality, and the ease with which they can be improved were considered.
- (d) *Degree of Decomposition*.—Three classes were established.
  - (1) Black muck with no fibrous remains at the surface.
  - (2) Brown to reddish muck with fibrous remains at surface shading into peat.
  - (3) Raw moss-covered peat.



FIG. 2.—A half-grown field of oats on muck soil. The man in the foreground is standing in a burned-over patch where muck is 12 in. deep; the man in the background stands on unburned muck about 36 in. deep.



FIG. 3.—Acid, semi-decomposed peat, over 6 ft. deep, derived mainly from *Carex*. The peat rests on clay subsoil.

- (e) *Chemical Composition.*—Arbitrary values have been assigned in interpreting the significance of these chemical analyses. Since full analytical results are given in the tables in this report, any reader can assign other values if he wishes and therefrom draw his own conclusions. Three subgroups:
- (1) Acidity and alkalinity, including pH, lime requirement and total ash. A pH value over 5.0, a relative lime requirement of less than 5,000 pounds CaO per acre, and a total ash content between 8.0 per cent and 20 per cent were considered in these areas to be indications of a good soil.
  - (2) N, P<sub>2</sub>O<sub>5</sub> and SO<sub>3</sub>. Nitrogen above 1.5 per cent is usually found in a good muck soil, while the percentages of P<sub>2</sub>O<sub>5</sub> and SO<sub>3</sub> vary considerably. It is possible that in these muck soils both N and SO<sub>3</sub> are excessive in amount. Muck soils with less than 0.5 per cent P<sub>2</sub>O<sub>5</sub> have arbitrarily been designated as deficient in phosphorus.
  - (3) CaO, K<sub>2</sub>O, Mn<sub>3</sub>O<sub>4</sub> and MgO. A calcium content above 3 per cent was considered as good, while the other constituents vary greatly. The potash is very low in all soils of this area, independent of the quality otherwise. Muck soils with less than 1 per cent K<sub>2</sub>O, less than 0.5 per cent MgO, and less than 0.08 per cent Mn<sub>3</sub>O<sub>4</sub> have been arbitrarily considered as likely deficient in the element considered.
- (f) *Mineral soil* in muck profile was considered as an undesirable factor, e.g., layers of sand or mixed in sand or clay. Points were deducted in the case of badly burned soils.
- (g) *Percentage cleared land present.*—Land under cultivation or previously cultivated arable pasture land.
- (h) *Distance from hard road.*—This was evaluated from the standpoint of access from a hard road to each part of a section.

### SHERRINGTON-STE. CLOTHILDE AREA

*Surveyed during the months of August and September, 1934*

This muck area lies in a southwesterly direction from Montreal. The distance from Ste. Clothilde, which lies near the centre of this area, is about 30 miles to the Montreal market. This means that a return trip to the market could easily be made by truck from farms in this district in half a day. This muck area is the largest within a radius of 50 to 60 miles from Montreal and lies in the centre of a number of smaller areas, as shown on the general map. The Napierville, St. Edouard, St. Isidore, St. Philippe, Hemmingford and St. Blaise areas are only a few miles distant and in some places almost connect with the Sherrington-Ste. Clothilde area. This means that demonstrations and experiments conducted in the Sherrington-Ste. Clothilde area would also be accessible and of value to the farmers in the surrounding muck areas.

Some market garden development has already started in this area. At present this development is mainly confined to the eastern section, in Napierville county. (See sections "A" and "B" on the map.) The most common garden crops grown here are potatoes, onions and carrots, while potatoes are grown quite extensively in all other cultivated parts of this area. The extent to which this development has taken place is seen by a report of the Rural Economics Service No. S.A. 203, dated 1933, of the Quebec Department of Agriculture, on the fertilizers bought by the farmers of the province of Quebec. More fertilizers were bought in Napierville county than in any other county of the province. The growers on the islands of Montréal and Jésus, together, bought in 1933 only 250 tons more fertilizers than those in Napierville county.



FIG. 4.—A wild meadow on virgin muck land typical in southwestern Quebec.



FIG. 5.—“Savane”—a typical wild peat bog in southwestern Quebec.

alone. Furthermore, the increase in fertilizers used in 1933 over 1932 was greater in Napierville than in any other county of the province. Farmers apparently have realized the value of fertilizers; however, the present knowledge of proper cultural methods and of fertilizer requirements is very limited. It is felt that by carefully conducted experiments much money could be saved for the farmers in the use of fertilizers. The interest of the people, who are 99 per cent of French-Canadian stock, in further development of agricultural products, is seen by the fact that canning factories have been established at Napierville, St. Rémi and Ste. Martine. Although the crops used for canning purposes at present are grown on ridge soils, there is no reason to believe that crops grown on muck soils, with proper handling, could not likewise be processed.

The Sherrington-Ste. Clothilde area lies in the most southerly section of Quebec province. The climate is most suited of that in any region of Quebec for the growing of market garden crops. Although the elevation is fairly low (less than 200 feet above sea level), the frost-free period is relatively long. Unfrozen fields of corn were seen on these muck lands towards the end of September, 1934. The fairly low elevation, relative to the country lying south of it, should make possible the solving of irrigation problems in this area; while drainage outlets are also present, chiefly towards the north and west.

The area has a high percentage of good quality muck soil. The muck soil is in most cases deep or with comparatively small sections of shallow muck (2 to 4 feet deep) to be found. It must be pointed out that *during this survey only muck deeper than 1½ feet was mapped* as potential market garden muck soil. The state of decomposition of the muck soil is usually very good to a depth of 2 feet or more. A considerable portion of the soil in this area is in a semi-decomposed condition. With improved drainage it is predictable that the quality of this semi-decomposed muck will increase greatly.

#### GENERAL REMARKS

##### *Area A.*

This area lies in the northeast part of the large area, largely in Napierville county. It includes all the muck east of the Gasperin road and north of the road from Gasperin to Sherrington. This is probably the most settled district. Vegetable crops such as potatoes, onions and carrots are grown quite widely. Oats and buckwheat are two other common crops. This whole area comprises 2,200 acres of good black soil. Most of this is cleared; only small patches of woods remain; the total land in woods does not exceed 300 acres. However, not all the cleared land is under cultivation; some of it is used for permanent pastures which are in poor condition. The muck in this area is of high quality, usually well decomposed in the surface 2 to 3 feet with less well decomposed material below. There is no raw peat in this area whatever. The muck here has originated mainly from carex and trees.

The depth generally is over 4 feet and in most cases extends to 6 and 8 feet, except on the outsides toward the ridges where it gets shallower. In most cases the depth increases very rapidly away from the ridges.

The three isolated pieces of muck are, respectively, about 300 acres and two of 50 acres each in extent. These are fairly shallow. There the muck seldom reaches a depth of 4 feet or more and in most cases varies from 2 to 3 feet. These latter three isolated pieces have been drastically burned over many years ago, hence the shallow muck. The samples taken are very representative of conditions in the area.

##### *Area B.*

This area lies in Napierville county and includes all the muck along the Sherrington road and south of it. It comprises an area of 2,140 acres. By no means all of this land is under cultivation. Along the Sherrington road an area

of approximately 600 to 650 acres is fairly intensively cultivated. Potatoes, onions, carrots, oats and buckwheat are the most important crops grown. The garden crops are generally in good condition and only occasionally scabbed potato fields are found. The muck here is in a good state of decomposition and is almost invariably over 4 feet deep. It is very similar to Section A. Samples 59 and 60 are representative of this area.

The area immediately south of this 650 acres along the Sherrington road is in a poorer state of decomposition. This part of Area B comprises about 1,000 acres. A large part of this is still wooded or just recently cleared. The cultivated area is mainly devoted to potato and grain growing and to pastures. The potato yields are usually heavy and clean, although some isolated scab-infested fields were encountered. The oat crops grown are tall, with a tendency to lodge before filling out. The pastures are in a poor state, mostly very hummocky and with poor sod covering. The muck in this 1,000 acres, as stated, is in a poorer state of decomposition; undecomposed carex and moss remains are almost invariably found from the surface downward. Samples 50 and 51 represent this 1,000 acres. It is more acid than the soil of the 600 acres nearer to the Sherrington road. An area of 200 to 300 acres, marked on the map, consists of raw peat with its characteristic flora. Sample 49 is representative of this raw peat area.

The muck along the southern and south-eastern limits of this Area B, about 400 acres in extent, is in a better state of decomposition and is similar to the muck along the Sherrington road. Most of this last 400 acres area is cleared and under cultivation.

Samples 46, 47 and 48 are representative of the soil of this 400 acre section.

The isolated piece on the extreme east covers approximately 300 to 350 acres. The largest part of this area is wooded or else in permanent pasture and only very little is under cultivation.

The muck in general is in a poor state of decomposition; a good part of it is raw peat. The muck in this 300 acre section in general is not very deep; only rarely is it deeper than 4 feet, usually varying between 2 and 3 feet.

A brown jelly-like layer is almost invariably found above the mineral soil, which can be classified as a "sedimentary" peat.

Sample 61 is representative of the soil of this area.

#### *Area C.*

This section lies in the centre of the entire Sherrington-Ste. Clothilde area and comprises 3,100 to 3,200 acres.

There is no cultivated land in this section. The entire area is either wooded or has just been recently cleared and is used as pasture or hay meadow. An area of 300 to 400 acres along the river has probably never been wooded. It is used as a hay meadow during dry years. Although the vegetation is very luxuriant in this open river flat, it consists chiefly of marsh grasses of poor feed value. Sample 89 represents this river meadow soil.

Almost half of "C" area is covered by sphagnum peat with its characteristic flora. The peat development is centred in three places as marked on the map. From a vegetable gardening point of view this peat is at present worthless. Samples 56, 88 and 129 represent these peat areas.

In the areas connecting the raw peat bogs the muck is medium well decomposed. The decomposition gradually improves, as one gets further from the peat bogs. Samples 87, 100 and 92 represent this medium well decomposed muck.

The muck on the open river flat is usually very well decomposed to 2 to 3 feet depth. This section, however, is subject to flooding and can only be used as a meadow during dry years.

The entire "C" section is poorly drained and the water table is invariably high. With improved drainage some of the medium decomposed muck between the peat bogs could be brought under cultivation.

The depth of the peat deposit is invariably great in this "C" section, running probably deeper than in any of the other parts of the area.

#### *Area D.*

This section lies at the northern edge of the muck area in Chateauguay county west of Gasperin. It consists of an area of 1,300 acres. About 300 to 400 acres along the northern edge and along the road from Ste. Clothilde to Holton Station are under cultivation. The crops grown are chiefly oats, hay and potatoes. The potato crops are in good condition, producing good yields of potatoes free from scab.

The largest part of this area is in woods or else just recently cut over bush. Samples 90 and 91 represent the soils of this section.

Along the river an area of approximately 200 acres is clear (probably never been heavily wooded) and is used as hay meadows during dry years.

The muck of all the cultivated land is very well decomposed and usually well drained. It is very similar to the muck in the "A" section. The muck in the wooded section north of the river is in medium to well decomposed condition. The drainage is generally not so good, which is partly responsible for the poorer decomposition and the fact that the land has not been cleared. In the wooded section south of the river the muck is fairly well decomposed and is represented by samples 102 and 121. On the eastern side where it approaches the peat bogs of the "C" section, it is only medium well decomposed.

The drainage south of the river is not very good, causing the muck to be sticky. The muck in the isolated small area west of the Ste. Clothilde-Holton Station road, represented by sample 101, is only poorly decomposed and comparatively shallow. The muck of the open river flat is very well decomposed in the surface two feet but due to flooding cannot be brought under cultivation at present.

The depth of the muck in the "D" section is generally very great (6 to 14 feet) except for the isolated little area at the western edge.

#### *Area E.*

This section lies in the south-east corner of Chateauguay county and the north-east corner of Huntingdon county. It consists of an area of 2,000 acres of muck. Approximately 500 to 600 acres of this area are under cultivation. Potatoes are quite extensively grown. Samples 125 and 127 were taken here. The largest cultivated area is situated near the corner where the three county lines meet, and is a continuation of the cleared, cultivated land in "B" section. Sample 95 represents this. Half of the uncultivated land is either in woods or cut over bush, while the other half is open marsh meadow along Norton Creek.

The muck at the surface of the cultivated land is very well decomposed, black in colour and well drained. In the meadows at the north end of this section the muck surface layer is decomposed fairly well, except where it approaches the peat bog of "C" section where the decomposition is poor. The drainage conditions are poor in this wooded or cut over land. In some cases newly cleared land of good quality cannot be broken on account of excess of moisture. Sample 96 is representative of this land. The wooded sections near the Grand Trunk Railroad and along Norton Creek are usually somewhat better drained and in a fairly good state of decomposition. Samples 126 and 113 represent this region of section "E." The wooded, isolated area south of Barrington is not very well drained. The muck here is well decomposed and very deep. Some shell marl was found at the northwestern edge of this area. Samples 123 and 124 were taken in this area.

The muck in the open flats along the river is not in as good condition as in the river flats in "C" and "D" sections. Although it is fairly well decomposed, it is usually sticky and often swampy due to insufficient drainage. Samples 118 and 128 were taken from this river flat muck of "E" section.

The depth of the muck in the "E" section is good except at the southern end where it gets quite shallow.

#### *Area F.*

This section as outlined on the map lies west of "E," south of "C," east of "H" and north of "G" sections.

It comprises an area of 2,200 acres, of which approximately 1,000 acres is cultivated land. Potatoes, oats and hay crops are commonly grown. Most of the remainder of the land is in woods or cut over bush. The open swamp meadows along Cranberry Creek are only narrow or sometimes absent altogether until the river reaches the Grand Trunk Railroad. North of the railroad tracks is an area of 100 to 150 acres of swamp meadow.

The muck on the open 1,000 acre area of cultivated land is well decomposed and of high quality. Samples 89, 120, 119, 122 and 99 are representative of this muck. The depth usually increases rapidly away from the ridges. The drainage generally is good, except in the vicinity of the river, where it is flooded in wet years.

In the wooded section at the extreme north the muck is only medium well decomposed with poor drainage. The quality improves towards the cultivated land in the south, which is represented by sample 94. In the scattered sections of wood and cut over shrub the muck is in a medium well to well decomposed condition as represented by sample 105. Some isolated sections of newly cleared land have been severely burned along the ridges; however, the total burned area is not very great.

The swamp meadows are very poorly drained. The winding course of Cranberry Creek retards the flow of water and causes its muck and peat banks to cave in. Samples 93 and 97 were taken in the open marsh meadows.

#### *Area G.*

This section lies at the extreme south end of the whole muck area, south of "F" area and comprises 1,400 acres.

Almost the entire section is wooded and only about 250 acres are under cultivation. The cultivated land is scattered in small pieces and is very well decomposed and of high quality. All the remainder of this land is in woods or cut over shrub. This area consists of five separated pieces. The largest of these, in the northeastern corner of this section, is represented by samples 112, 114 and 115. The muck in this region is well decomposed and drainage is fairly good. The depth of the muck is in most cases more than 6 feet.

The second largest area of "G" section is represented by samples 109 and 110. The muck of this area on the whole is well decomposed and fairly deep, 4 feet and over.

The remaining three isolated pieces are small, and from east to west, respectively, only 140, 130 and 20 acres in size. Approximately half of the eastern piece is cleared. The muck in this area is well decomposed and fairly well drained with the exception of the southern arm, which is very swampy. Sample 117 is representative of the good muck of this area.

The muck in the other two isolated areas is well decomposed but not very deep, seldom reaching a depth of 6 feet.

Sample 116 was taken in the central one of the three isolated muck areas at the south of section "G."

*Area H.*

This section lies at the extreme west of the whole area, and occupies nearly 3,000 acres. Only about 250 acres of this whole section are under cultivation. The remainder is covered with wood and stumps.

A considerable part of the wooded area (600 to 800 acres), as marked on the map, is sphagnum peat. Sample 108 was taken from it. It is similar in all respects to the peat in "C" section. The drainage in this peat bog is poor. Over an equal area surrounding this peat bog the muck is in only a medium well decomposed condition, with wood and carex remains in the surface and carex and sphagnum moss remains in the subsoil. The muck is sticky and the water table high, due to poor drainage. Sample 111 represents this. The muck on the outer edges towards the ridge is in a fairly good state of decomposition. The degree of decomposition gradually decreases towards the centre. The water table towards the edges is much lower and the drainage fairly good.

The depth of the muck and peat in this whole section is great, in most cases exceeding 8 feet. Four samples, 103, 104, 106 and 107 were taken from the better-drained and fairly well decomposed muck in the west and north of section "H".

TABLE I

EVALUATION OF THE LETTERED AREAS WITHIN THE 17,000 ACRES OF MUCK SOIL OF THE SHERRINGTON-STE. CLOTHILDE AREA  
(See text for explanation of assigned values)

| Area   | Depth of soil<br>(a) | Source of organic matter<br>(b) | Drainage present or possible<br>(c) | Degree of decomposition<br>(d) | Chemical composition<br>(e) |                                      |  | Mineral soil mixed in muck, and "burning"<br>(f) | Cleared muck land<br>(g) | Ease of access to area from a hard road<br>(h) |
|--------|----------------------|---------------------------------|-------------------------------------|--------------------------------|-----------------------------|--------------------------------------|--|--|--------------------------|--|
|        |                      |                                 |                                     |                                | Acidity relations<br>(e.1)  | Nitrogen phosphorus sulphur<br>(e.2) | Calcium potash magnesia manganese<br>(e.3) |  |                          |  |
| A..... | 8                    | 10                              | 8                                   | 10                             | 10                          | 7                                    | 5  | 9  | 9                        | 10   |
| B..... | 8                    | 7                               | 6                                   | 7                              | 6                           | 6                                    | 4  | 9  | 5                        | 8  |
| C..... | 10                   | 4                               | 3                                   | 3                              | 3                           | 5                                    | 3  | 9  | 1                        | 1  |
| D..... | 8                    | 8                               | 7                                   | 7                              | 6                           | 6                                    | 5  | 9  | 4                        | 8  |
| E..... | 8                    | 8                               | 6                                   | 8                              | 10                          | 6                                    | 5  | 7  | 5                        | 6  |
| F..... | 7                    | 9                               | 6                                   | 9                              | 10                          | 6                                    | 6  | 8  | 4                        | 7  |
| G..... | 7                    | 9                               | 7                                   | 9                              | 7                           | 6                                    | 5  | 9  | 2                        | 6  |
| H..... | 8                    | 6                               | 5                                   | 4                              | 6                           | 6                                    | 4  | 8  | 1                        | 4  |

*(a) Depth*

Ten points were given to an area with muck soils deeper throughout than 4 feet. In section "A", 500-600 acres are only 2 to 4 feet in depth and therefore only 8 points were given to this section as a whole. This shallower muck is found in the three isolated pieces mapped, and along the ridges, especially the northern and eastern tongues of black soil.

Section "B" was awarded 8 points out of 10 because shallower muck was found in the isolated piece at the east and along the ridges, especially at the south-east corner.

"C" was given full points for depth. The peat and muck in this area is deep throughout.

"D." The muck on the outer edges of this section, especially at the north and north-east and on the isolated piece at the west, is only 2 to 4 feet in depth and therefore 8 points were given to this section as a whole.

"E." Eight points were given to section E because the muck at the southern end along the river and near the ridges is between 2 and 4 feet deep.

"F." This section was given only 7 points for depth because a large number of ridges in this section are surrounded by muck 2 to 4 feet deep and patches of this shallower muck are found in the woods along the Grand Trunk Railroad.

"G." Much of the muck in the isolated areas at the south is only 2 to 4 feet deep. Some of this shallower muck was also found along the narrow tongues of black soil in the larger sections of muck and therefore section "G" as a whole was given only 7 points for depth.

"H." This section was awarded 8 points for depth. Shallow muck (2 to 4 feet deep) occurs along the narrow channel at the northeast and along the outside ridges of this section.

(b) *Source of Organic Matter*

A section in which the muck throughout has originated from wood and carex remains was given 10 points.

"A." On the above basis, section "A" was given full points.

"B." This section contains a considerable area in which the parent material of the muck and peat is carex and moss remains, and it was, therefore, only given 7 points for source of organic matter. The carex and moss are found in the isolated piece at the east and in and around the peat area marked on the map.

"C." The largest part of this area consists of moss peat or muck in which sphagnum moss and carex are the dominant soil forming materials. On this basis it was only given 4 points.

"D." This section was awarded 8 points for source of organic matter, 2 points being deducted because carex and moss are found to be dominant in the muck and peat in the isolated piece at the west and in the eastern part of the woods south of the river.

"E." Carex and moss remains were found to be quite common in the northern part of this section and 8 points out of 10 were given to section "E" as a whole.

"F." Most of the muck in this area has been formed from tree and carex remains. Some moss and carex remains were found in the eastern part of this section and it was therefore given 9 points for source of organic matter.

"G." Moss remains were only rarely found in this section and 9 points were given.

"H." A large percentage of the land in this section is sphagnum moss peat and the muck surrounding this peat area has originated from carex and moss. The section as a whole was, therefore, only given 6 points for the source of organic matter.

(c) *Drainage*

An area that is at the present well drained would be given 10 points. The ease with which the drainage could be improved was also considered in assigning points.

"A." On the above basis, section "A" was given 8 points. The drainage as a whole is rather good. Some of the poorly drained soil in this area could be easily improved by cleaning and deepening of some of the small ditches present or by digging small new ditches.

"B." The cultivated area in this section is fairly well drained. Better drainage, however, is needed in the poorer peat section and this would no doubt improve the condition and quality of the muck surrounding the peat bog. Only 6 points were, therefore, given to this section for drainage.

"C." The entire "C" section is very poorly drained at present and in order to improve drainage an extensive drainage system would be needed. It would probably involve a lowering of the level of the whole river. Taking these points into consideration, only 3 points could be given for drainage in this section.

"D." Although the cultivated land in this section is fairly well drained, quite a number of side ditches and very likely a lowering of the river bed at the Ste. Clothilde bridge would be necessary to drain most of the wooded land and prevent extensive flooding of the river flat. Seven points were awarded to the section as a whole for drainage.

"E." Most of the cultivated land is at present well drained. The northern end of this section, however, needs considerable drainage at present. Most of the remaining area can be improved in drainage only by the lowering of the river bed and the establishment of side ditches. The isolated piece of muck soil will need drainage before it can be cultivated. Only 6 points could be given to this area for drainage conditions.

"F." The eastern end of this section needs drainage badly. Lowering of the river bed will very likely be necessary to improve the drainage of the rest of the area. This section as a whole received 6 points for drainage conditions.

"G." At the time of examination, in September, the muck in this section as a whole was in a fairly dry condition. In view of the fact that practically the whole area is wooded and only very few drains are present, it was considered that more may be necessary if the land is cleared. Therefore, 7 points out of 10 were given to this section for drainage conditions.

"H." The large peat area in this section is very badly drained, which affects the quality of the muck in the surrounding area. Very few drainage ditches are present in the entire wooded section. Good drainage of this section will involve considerable work and only 5 points were given out of 10.

#### *(d) Degree of Decomposition*

A whole section in which the muck is well decomposed in the surface layer would receive 10 points.

"A." The muck in this section is very well decomposed and only rarely are a few carex remains found near the surface. Full points were awarded to this section for degree of decomposition of the muck. It is very likely that the better drainage and cultivation are to a large extent responsible for the good state of decomposition of the muck in this section.

"B." This section was given only 7 points for degree of decomposition on account of the raw peat area and the surrounding poorly decomposed muck.

"C." Most of this section is raw peat or poorly decomposed muck between the peat areas. Only very little well decomposed black muck is present and this mainly in the open river flat. Only 3 points could, therefore, be given for degree of decomposition.

"D." The muck in the "D" section is fairly well decomposed except for the isolated piece in the west and the eastern section south of the river.

"E." In "E" section the muck is fairly well decomposed except for the northern part. Here the decomposition is not very good. This section as a whole was given 8 points.

"F." Except for the eastern end, the muck in this section is well decomposed and 9 points were given.

"G." The muck in this section as a whole is well decomposed and 9 out of 10 points were awarded. Scattered patches of just medium well decomposed muck were found.

"H." The largest part of this section is raw peat and medium well decomposed muck; therefore only 4 points could be given for the degree of decomposition of the muck in "H" section as a whole.

#### *(e) Chemical Composition*

(1) *Acidity relationships—pH, relative lime requirement and total ash.*—A section with soils having a pH value above 5.0; a relative lime requirement below 5,000 pounds of CaO per acre, and a total ash content between 8 per cent and 20 per cent was given 10 points.

"A." This section was given full points on the above basis.

"B." Three samples in this section from the raw peat and the medium well decomposed peat were too acid (below pH 5·0), had too low a percentage of total ash (below 8 per cent) and too great a lime requirement. Only 6 points out of 10 were, therefore, given to this section.

"C." Three samples from this section were very acid, had a very high lime requirement and an abnormally low total ash content. These samples came from locations that were described as poor from all the other standpoints. This section as a whole, therefore, was allowed only 3 points under this head.

"D." One sample from the extreme western part is too acid, has too high a lime requirement and too low a total ash content, while another sample from the woods south of the river also is somewhat low in total ash and has a high lime requirement. Six points were given to section "D" as a whole. The field data and the analyses for pH, lime requirement and total ash agree fairly well.

"E." This section was given full points under this head.

"F." This section was given full points under this head.

"G." One sample from this section was too acid, had too great a lime requirement and too low a total ash content. Several of the other samples were somewhat high in their lime requirements. Only 7 points were given to this section.

"H." The samples taken from the peat bog and its near vicinity were too acid, too low in total ash and had too high a lime requirement. Only 6 points were given to this section.

(2) *Nitrogen, Phosphorus and Sulphur.*—As pointed out before, the total nitrogen and sulphur content of all these muck soils is very high, not considering the quality of the soils from other standpoints. Under the conditions, it is probable that, in many cases, these elements are present in too great quantity for proper soil balance. The phosphorus and sulphur contents vary greatly. Although no direct evidence is available from this area as yet, arbitrary values were assigned for the different elements based on previous experience of the writers. Almost full points had to be given for total N and SO<sub>3</sub> content in many cases and deductions had to be made for total P<sub>2</sub>O<sub>5</sub> content on account of the relatively low percentages throughout.

It must be remembered that muck soils are very light, and high percentages, based on weight, are necessary to make up a definite weight of the element in amount which may be necessary for crop use.

"A." Although the nitrogen content in all the samples from this area is over 1·5 per cent, deductions had to be made for P<sub>2</sub>O<sub>5</sub>. Only one sample had a P<sub>2</sub>O<sub>5</sub> content of 0·5 per cent. Seven points were, therefore, given to this section.

"B." One sample from "B" section was low in N, while the P<sub>2</sub>O<sub>5</sub> content varied from 0·043 per cent to 0·523 per cent. Only 6 points out of 10 were awarded to this section as a whole under this head.

"C." The percentages of P<sub>2</sub>O<sub>5</sub> were considerably lower than in the samples from the other sections and only 5 points could be given to this section, although the nitrogen content is high.

All the other sections, namely, "D," "E," "F," "G," and "H," were given 6 points out of 10 for N, P<sub>2</sub>O<sub>5</sub> and SO<sub>3</sub>. The deductions in every case were made for the low P<sub>2</sub>O<sub>5</sub> contents.

(3) *Calcium, Potash, Magnesium, and Manganese.*—The arbitrary values showing total percentages of these elements, below which a muck soil was considered to be deficient, have been given above. Just a glance at the tables is sufficient to convince one's self that all the muck soils are deficient in K<sub>2</sub>O and Mn<sub>3</sub>O<sub>4</sub>. The CaO contents in all the better soils is very good, while the percentages of MgO vary considerably. The low values in the table for these elements are mainly due to the deficiencies in potash and manganese.

"A." The lime content in all the samples from this section is rather good, except for two subsoils where it is just below the limit set. The MgO in half the samples is below 0.5 per cent, while the potash in all samples is deficient, and the manganese in all samples but one. Only five points were given to the section as a whole under this head.

"B." The section was given only four points for the mineral elements. Two samples were extremely low in lime, while potash and manganese were deficient in all samples.

"C." Only half of the samples from this section have a lime content above 3 per cent and practically all are deficient in the other elements, therefore only 3 points could be given to this section as a whole.

"D" and "E." These two sections were given 5 points for mineral constituents. The lime content in all the samples but one, from the "D" section, is very good. Most of the samples have also a reasonably good amount of magnesium.

"F." All the samples from this section are high in lime and only one complete sample is low in magnesium, while potash and manganese are deficient in all the samples. This section as a whole is higher in mineral content than any other area and it received, therefore, 6 points.

"G." Only one subsoil in this section had a CaO content below 3 per cent, while in half of the samples the percentage of MgO is below 0.5 per cent. Only 5 points were given to the section as a whole.

"H." One third of the samples from this section were very low in lime content and half were deficient in magnesium. The potash and manganese were deficient again in all samples. Four points were given to this section as a whole.

(f) *Mineral Soils in Muck Profile and Extent of Burning*

Small quantities of mineral soil are sometimes found to be mixed in with the muck. This is usually found along river channels where the mineral soil (usually sand) has been carried in by the water, or towards the edges, especially in the arms and lands where the muck soil is only shallow and mineral soil has been blown in by wind or carried in by water. High total ash contents (20 per cent and over) are good indications of the presence of mineral soils. In several cases where the muck has been burned severely, leaving deep holes, exposing stones and rocks, or where the well decomposed muck has been burned off, exposing raw peat, deductions were made for burning.

"A." This section was deducted one out of 10 points because some sand is mixed into the muck along a water channel in the northeast corner and on the isolated pieces at the north and east. These latter areas were also burned over a number of years ago.

"B." Some mineral soil has been washed in along the edges of the ridges and 1 point was taken off for this.

"C." Severe burning has exposed stones and rocks around the ridge at the southwest corner. Only 9 points were therefore given to this section as a whole.

"D." One point was deducted from this section because the muck has been burned in a few places exposing poorly decomposed muck.

"E." Sand and clay has been mixed with the muck along the river channel, especially at the southern end. Seven points were given for the section as a whole.

"F." Some mineral soil has mixed in along the edges of the ridges and severe burning has exposed rocks in several places as indicated on the map. Two points were deducted for these reasons.

"G." Only very little muck is mixed with mineral soil in this section, therefore 9 points were awarded.

"H." This section was deducted two points out of 10 because certain parts along the northern edge were burned.

(g) *Percentage of Cleared Muck Land*

Under this heading, by cleared land is meant all the land that is under cultivation at present. It also includes all pastures that have not been ploughed for several years but where shrubs have not had a chance to grow. One point was given for every 10 per cent of cleared muck soil of the entire section.

"A." Most of the land in this area is cleared land and 9 points were given to this section.

"B." Only about 50 per cent of this section is cultivated or in old pasture. The cleared land is at the north and south of the area as indicated on the map. Five points were given to this section.

"C." Only 1 point could be given to section "C" under this heading. The cleared land in this section is not under cultivation at present and consists of old meadows that had been broken several years ago and are gradually reverting to bush. The open river flat is not considered as cleared land.

"D." Approximately 40 per cent of this section is under cultivation or is cleared permanent pasture.

"E." In this section about 50 per cent of the muck soil has been cleared. Some of the cleared land is used for meadow or pasture and is reverting to bush.

"F." The bulk of the uncleared land in this section is at the eastern end as shown on the map and only 4 points were given to this section as a whole.

"G." The largest part of this section is in woods or cut over scrub bush. The cultivated area is scattered in small patches as indicated on the map. Only two points could be given to the section as a whole.

"H." Almost the entire section "H" is wooded, so that only 1 point out of 10 could be given under this heading. The cleared land is found along the ridges especially at the northeast corner of this section.

(h) *Access to Muck from Hard Road*

In view of the fact that the access to a muck area seems to be an important factor in market gardening, it was thought advisable to evaluate the different sections from this standpoint. The roads were considered in their present condition. If a section has a road passing only along one side of it and the other side is difficult to get to, deductions in points were made.

"A." This section was given full points for access to muck from road. A first class highway passes along the northern edge and two second class roads go right through the section. There is no muck in this area that is further than three-quarters of a mile from a good hard road.

"B." Only one second class road passes through the northern part of this section. A rather poor road passes through the southern section. Eight points were given to this section as a whole.

"C." The land in this section is difficult to reach. Only one trail passes through the entire section and even this was not passable by car during August and September, 1934. Only one point could be given to this section from the standpoint of access to the muck.

"D." A good highway borders the western and northwestern part of this section, while a poor road reaches the extreme east corner at Gasperin. A considerable area south of the river is difficult to reach. Seven points were given to the entire section.

"E." This section was given 6 points under this heading. A good highway just touches the outer edge at the north. The remaining roads shown on the map are in a poor condition.

"F." The muck east of the Grand Trunk Railroad is difficult to reach; there is no road leading to it. The section as a whole was given 7 points for access to muck from a hard road.

"G." Two second class roads pass along the northern and southern limits of this section but the centres of the larger areas are difficult to reach, therefore only 6 points could be given to section "G."

"H." The muck in this section can only be reached by road at the north-east and southeast corners. The distance from the nearest road to the muck soil in all other directions is between one-quarter mile and one mile. The area as a whole only received 4 points.

#### SUMMARY OF SHERRINGTON-STE. CLOTHILDE AREA

In presenting the results of this survey, the area is divided into 8 parts, which are designated by the capital letters A to H. On the map of the main Sherrington-Ste. Clothilde area which accompanies this report, the boundaries of these 8 subdivisions are marked. Wherever a sample of soil was taken within each of these areas there is a number marked on the map.

Field observations and chemical analyses are given in the tables of the report under the 8 lettered sub-divisions. A table is given evaluating each of these 8 sub-divisions as they now exist, under the following headings:—

1. Depth of organic soil in the area.
2. Source of organic matter of the soils.
3. Drainage, present and possible.
4. Degree of decomposition of the muck and peat.
5. Chemical composition:
  - (a) Acidity relationships: per cent ash, pH value, and lime requirement.
  - (b) Nitrogen, phosphorus and sulphur percentages.
  - (c) Potassium, magnesium, calcium and manganese percentages.
6. Mineral soil mixed in with muck and severe burning.
7. Percentage of cultivated muck land in the area.
8. Ease of access to a hard road from the muck area.

Full account is given in the text of the assignment of values under each heading in the case of each of the 8 sub-divisions. Also the methods of diagnosing the soil conditions are described as fully as possible.

The strategic position of this splendid black soil area is stressed with regard to the following points:—

1. Good quality of soil. This is equal or superior to the soil of any other area examined in this province.
2. Great area of good soil.
3. Nearness to market and the linkage with Montreal by fine roads.
4. The climate is the most favourable for truck crops to be found in the province.
5. The present trends of fertilizer use in the province indicate that this area is rapidly developing.
6. Three canning factories now exist in this general area.
7. Effective drainage and irrigation should both be possible because of the location and elevation of the area.

Under the heading "Chemical composition" it should be noted that while these mucks are as good as those to be found anywhere, yet they are deficient, according to our standards, in potassium, phosphorus, and manganese. They are so rich in nitrogen and in sulphur that the mineral balance, as is true in all muck soils, must be strongly emphasized in making fertilizer applications. In general, these mucks are very rich in lime.

While some development in the growing of truck crops has already taken place in this area, yet there is great need of experimental work and of extension work to convey the experimental findings to the farmers. A centre is needed

in this black soil region of Quebec province from which correct cropping, fertilizer, cultural, disease and insect pest control, drainage and irrigation practices on these soils will be spread.

The mineral soil underlying and surrounding the muck area is of the same general nature throughout, namely, derived from calcareous sandstone. The texture of this underlying material throughout is loam rather than clay or sand, although in parts the loam is lighter or heavier. In some particular small areas, as pointed out in the text of this report, the soil underlying the muck is sand. In general, however, the mineral soil underlying the muck of this area is stony loam of such a texture that very rapid drainage is prevented, but some drainage can occur.

Taking into consideration all the factors involved, it appears that area A, of the Norton Creek black soil region, is at present the most promising section. It must be noted that area B on the east and area D on the west immediately adjoin area A, and that certain parts of these two areas also are of high quality. It appears that area C and area H, are of least value for truck crops at present. Area G is nearly all wooded, although the soil is good. Area F, apart from its eastern end, is very good. It needs drainage, but the soils are deep and valuable. The northern couple of hundred acres of E area that join with the cultivated part of area B are excellent, but drainage is badly needed over a large part of this area.

TABLE II

CHEMICAL ANALYSIS—Oven Dry Basis—A = Surface 12"; B = Subsoil, 12"-24" deep

## A. NORTHEAST PART OF SHERRINGTON-STE. CLOTHILDE AREA

| Sample No. | pH value | Lime requirement<br>lb. CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>3</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations   |
|------------|----------|----------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|--|
| 52 A.....  | 6.24     | 1260                             | 15.50       | 5.27  | 0.916 | 0.085                            | 0.096              | 0.513                           | 1.43              | 2.47             | Open pasture; black muck at surface, 1-3' deep of well decomposed material, drainage good, shallower towards outside. Subsoil light-brown muck, 3-4' semi-decomposed, depth 6' and greater; origin wood, carex. Limestone on ridge.  |
| B.....     | 5.95     | 1836                             | 12.68       | 4.56  | 0.523 | 0.068                            | 0.052              | 0.470                           | 1.76              | 2.40             |  |
| 53 A.....  | 6.08     | 2916                             | 10.59       | 7.93  | 0.66  | trace                            | 0.023              | 0.310                           | 0.78              | 1.84             | Surrounded by potato fields (a flat $\frac{1}{2}$ mile wide). Dark-brown muck, well decomposed.  |
| B.....     | 5.95     | 3780                             | 8.92        | 4.65  | 0.39  | trace                            | 0.018              | 0.140                           | 1.07              | 2.39             | Subsoil well decomposed, numerous roots and stumps. Very deep muck, carex and wood remains.  |
| 55 A.....  | 5.82     | 4500                             | 10.68       | 3.08  | 1.32  | 0.028                            | 0.037              | 0.294                           | 1.389             | 2.39             | Old pasture; brownish-black well decomposed muck to 3' or more; depth 6' and deeper. At 8" grayish, flaky bark remains. (Willow, birch, maple, elm.) Potatoes scabby.  |
| B.....     | 5.46     | 5940                             | 8.20        | 2.94  | 0.78  | 0.021                            | 0.034              | 0.299                           | 1.37              | 2.58             |  |
| 54 A.....  | 6.03     | 2376                             | 15.15       | 5.65  | 0.960 | 0.070                            | 0.111              | 0.242                           | 1.36              | 2.48             | Virgin, cleared narrow strip on wide area 1.5 miles of muck. Black muck, well decomposed to 3' deep. Few carex remains and wood debris (birch, willow, spiraea). Very deep muck 8-10'.   |
| B.....     | 5.89     | 2664                             | 10.30       | 5.95  | 0.565 | 0.045                            | 0.054              | 0.165                           | 0.58              | 3.14             |  |
| 58 A.....  | 5.95     | 4320                             | 12.95       | 5.94  | 0.499 | 0                                | 0.106              | 0.312                           | 0.37              | 1.88             | Old pasture, small bush, elder, birch, spiraea, raspberry, tamarack. Muck black, well decomposed, tree remains. Very deep.   |
| B.....     | 5.98     | 4320                             | 11.75       | 5.47  | 0.410 | 0                                | 0.042              | 0.297                           | 0.35              | 1.76             |  |
| 57 A.....  | 6.14     | 1980                             | 21.41       | 4.46  | 0.179 | 0.030                            | 0.137              | 0.220                           | 4.20              | 1.73             | Old open pasture. Muck black; well decomposed. This area was severely burned over. Sand at 2' depth. In other place muck 3-5' deep with sand below. Jelly layer varies in thickness. Potatoes not badly scabbed. This sample is from the isolated 300 acres area.                                |
| B.....     | 5.08     | 3405                             | 16.19       | 2.80  | 0.206 | 0.020                            | 0.078              | 0.141                           | 4.52              | 2.20             |  |
| 86 A.....  | 5.77     | 4500                             | 10.10       | 3.08  | 0.51  | 0.038                            | 0.025              | 0.302                           | 1.23              | 2.21             | Virgin soil (birch, elder, spiraea). Muck well decomposed at surface; subsoil decomposed fairly well. Four feet and more deep, with poor decomposition below 4'. Numerous tree remains above 4'; below that more carex and moss; depth at least 8' and greater with water table at 4' in August. |
| B.....     | 5.80     | 5652                             | 6.53        | 3.22  | 0.44  | 0.021                            | 0.018              | 0.150                           | 1.01              | 1.98             |  |

TABLE III  
CHEMICAL ANALYSIS—OVEN DRY BASIS—A = Surface 12"; B = Subsoil, 12"-24" deep  
B. EASTERN PART OF SHERRINGTON-STE. CLOTHILDE AREA

| Sample No. | pH value | Lime requirement<br>lb. CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>2</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations   |
|------------|----------|----------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|--|
| 60 A.....  | 6.25     | 2088                             | 17.40       | 5.01  | 0.937 | trace                            | 0.135              | 0.523                           | 1.12              | 2.40             | Old pasture, muck well decomposed. Carex and wood remains in subsoil. Depth 4' and more. Vegetable crops in good condition. White birch cover.   |
| B.....     | 5.86     | 3600                             | 9.80        | 3.56  | 0.430 | trace                            | 0.062              | 0.224                           | 1.93              | 1.86             |  |
| 59 A.....  | 6.29     | 2196                             | 13.31       | 3.91  | 0.36  | 0.057                            | 0.126              | 0.376                           | 1.28              | 2.00             | Hay field (Pinsonneault). Well decomposed, wood remains, little carex. Vegetable crops in good condition. Depth very great.  |
| B.....     | 6.06     | 3405                             | 8.64        | 3.47  | 0.54  | 0.030                            | 0.043              | 0.166                           | 1.38              | 1.88             |  |
| 50 A.....  | 5.16     | 7524                             | 11.10       | 4.25  | 0.925 | 0.018                            | 0.122              | 0.492                           | 0.87              | 2.04             | Hay field. Brown muck; semi-decomposed. Wood and carex remains. Depth good, at least 6' and more.  |
| B.....     | 5.20     | 10368                            | 7.40        | 4.56  | 0.299 | 0.013                            | 0.038              | 0.385                           | 0.95              | 1.88             |  |
| 49 A.....  | 4.10     | 18800                            | 3.96        | 1.01  | 0.23  | trace                            | 0.013              | 0.291                           | 0.57              | 2.70             | Bush (white birch, raspberry.) Peat, poorly decomposed. Surface mixed with leaf mold. Wood remains common at 2', some carex. Below 2' mostly sphagnum. Water table at 3' in August.                      |
| B.....     | 4.90     | 13220                            | 3.72        | 1.83  | 0.28  | trace                            | 0.016              | 0.201                           | 0.73              | 1.87             |  |
| 51 A.....  | 4.77     | 16020                            | 6.11        | 2.43  | 0.62  | trace                            | 0.006              | 0.260                           | 0.63              | 1.81             | Virgin land. Surrounding bush, birch, tamarack, pine. Muck semi-decomposed. Subsoil fairly raw, carex and sphagnum; depth 6' and greater. Potatoes clean.  |
| B.....     | 4.92     | 14230                            | 5.08        | 2.75  | 0.23  | trace                            | 0.014              | 0.146                           | 0.68              | 2.02             |  |
| 48 A.....  | 6.00     | 1836                             | 14.25       | 4.48  | 1.043 | trace                            | 0.116              | 0.418                           | 1.21              | 2.34             | Virgin (spiraea and poplar and birch). 18" of muck at surface well decomposed. Subsoil—carex remains; depth at least 7'; potatoes fairly clean.  |
| B.....     | 5.91     | 3816                             | 9.65        | 3.61  | 0.599 | 0.028                            | 0.013              | 0.200                           | 1.76              | 2.10             |  |
| 46 A.....  | 6.35     | 684                              | 14.05       | 6.29  | 0.910 | 0.061                            | 0.108              | 0.363                           | 1.23              | 2.09             | Virgin pasture. Muck well decomposed; both surface and subsoil contain well preserved wood and root remains. Depth 5-6'. Water table low in August.  |
| B.....     | 5.91     | 2376                             | 9.80        | 5.41  | 0.539 | 0.025                            | 0.022              | 0.292                           | 1.90              | 2.13             |  |
| 47 A.....  | 5.82     | 4140                             | 10.23       | 4.85  | 1.02  | 0.014                            | 0.036              | 0.208                           | 0.44              | 2.96             | Virgin near bush (tamarack, cedar, ash, birch, willow). Well decomposed muck at surface. Subsoil semi-decomposed. Depth 6' and more. Potatoes fairly clean.  |
| B.....     | 5.91     | 5580                             | 9.09        | 4.40  | 1.02  | trace                            | 0.018              | 0.147                           | 0.64              | 1.65             |  |
| 61 A.....  | 4.62     | 15840                            | 8.19        | 1.80  | 0.67  | trace                            | 0.060              | 0.043                           | 0.636             | 1.09             | Bush (birch, cedar, willow, tamarack). Poorly decomposed brown, peaty material; water table at 4' in August. Mainly carex, some wood and sphagnum moss. Depth 4'. Shallower, 2.5', toward edges of muck. |
| B.....     | 4.57     | 15840                            | 12.11       | 2.79  | 0.99  | trace                            | 0.134              | 0.097                           | 2.56              | 1.08             |  |

TABLE IV  
CHEMICAL ANALYSIS—Oven Dry Basis—A = Surface 12"; B = Subsoil, 12-24" deep  
C. CENTRE OF SHERRINGTON-STE. CLOTHILDE AREA

| Sample No. | pH value | Lime requirement<br>lb.<br>CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>3</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations   |
|------------|----------|-------------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|--|
| 56 A.....  | 3.56     | 27000                               | 3.48        | 0.54  | 0.415 | trace                            | 0.040              | 0.176                           | 0.946             | 1.50             | Swampy peat bog (blueberries, laurel, spruce, pine, cedar, birch, labrador tea, sphagnum.) Wood remains scarce; some carex; water table high. Surrounding area burned.   |
| B.....     | 3.81     | 27000                               | 2.27        | 0.63  | 0.088 | trace                            | 0.040              | 0.190                           | 0.946             | 1.51             |  |
| 87 A.....  | 5.63     | 8280                                | 8.75        | 3.73  | 0.447 | 0.019                            | 0.042              | 0.228                           | 0.715             | 1.91             | Old swampy meadow (spiraea). Bush nearby (birch and poplar). Surface 18" of black muck, well decomposed; some wood remains. Subsoil semi-decomposed carex remains. Very deep. Drainage not very good. Towards east some moss, semi-decomposed peat; latter is a continuation of peat bog from county line.             |
| B.....     | 5.40     | 9360                                | 10.17       | 2.72  | 0.234 | trace                            | 0.024              | 0.224                           | 0.727             | 2.20             |  |
| 100 A..... | 5.30     | 9612                                | 6.87        | 3.12  | 0.62  | 0                                | 0.053              | 0.221                           | 0.550             | 2.77             | Scrub woods (elder, willow, birch, poplar, swamp maple, spiraea.) Muck brownish-black, fairly well decomposed to 2.5' deep, below that carex and moss; drainage poor. Towards west, away from river, it is a peat bog (spruce, cedar, tamarack cover). Very deep peat.   |
| B.....     | 5.81     | 8172                                | 5.73        | 3.08  | 0.54  | 0                                | 0.033              | 0.112                           | 0.528             | 2.09             |  |
| 129 A..... | 4.10     | 22680                               | 3.63        | 0.94  | 0.44  | trace                            | 0.062              | 0.175                           | 0.47              | 2.00             | Peat bog (black spruce, cedar, tamarack, laurel, blueberry, labrador tea, etc. Sphagnum moss a foot deep). Very raw peat. Water table high. Depth very great. H <sub>2</sub> S gas noticeable in subsoil.  |
| B.....     | 4.46     | 21492                               | 3.48        | 1.27  | 0.49  | trace                            | 0.048              | 0.121                           | 0.50              | 1.74             |  |
| 92 A.....  | 5.74     | 6048                                | 10.00       | 4.39  | 0.712 | trace                            | 0.084              | 0.248                           | 0.62              | 2.03             | Taken in woods (2nd and 3rd growth; alder, poplar, birch, swamp cedar and maple spruce). Muck deep. Fairly well decomposed to 3'; below that carex and moss. Drainage not very good. Lies near edge of peat bog.   |
| B.....     | 5.86     | 6048                                | 10.70       | 5.37  | 0.561 | trace                            | 0.074              | 0.191                           | 0.58              | 1.54             |  |
| 89 A.....  | 5.96     | 3816                                | 9.45        | 4.75  | 0.725 | trace                            | 0.052              | 0.358                           | 0.80              | 2.10             | Open river flat (swamp vegetation). Muck black, very well decomposed to 3' deep, friable and granular. Below 3' brown and sticky. Water table 4'. Subject to flooding. Depth 10' and more. No tree remains. Towards the east there are woods in which muck is poorly decomposed and gradually joins peat bog at south. |
| B.....     | 5.84     | 5756                                | 8.06        | 3.70  | 0.377 | trace                            | 0.028              | 0.267                           | 0.74              | 2.14             |  |
| 88 A.....  | 3.93     | 20370                               | 2.61        | 0.42  | 0.19  | 0                                | 0.015              | 0.221                           | 0.53              | 2.26             | Peat bog with fully developed associated flora. Water table very high. Moss very deep. Towards the woods at either side the development of peat bog is less characteristic.  |
| B.....     | 3.92     | 19800                               | 2.00        | 0.50  | 0.13  | trace                            | 0.023              | 0.191                           | 0.50              | 2.09             |  |

TABLE V

CHEMICAL ANALYSIS—Oven Dry Basis—A = Surface 12"; B = Subsoil, 12-24" deep

## D. NORTH OF SHERRINGTON-STE. CLOTHILDE AREA

| Sample No. | pH value | Lime requirement<br>lbs. CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>3</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations   |
|------------|----------|-----------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|--|
| 91 A.....  | 6.32     | 1404                              | 12.27       | 4.42  | 0.62  | 0.040                            | 0.109              | 0.231                           | 1.63              | 2.69             | Old meadow (bush nearby, of birch, elm, willow, elder, poplar, red maple). Muck well decomposed to 3-5' deep and below that carex and moss remains. Depth of 10' and more. Water table at 4.5' in August. Wood remains. Burning in newly cleared parts of this area. |
| B.....     | 6.36     | 1980                              | 10.34       | 4.12  | 0.49  | 0.020                            | 0.101              | 0.128                           | 2.94              | 2.62             |  |
| 90 A.....  | 6.12     | 2088                              | 13.50       | 4.60  | 0.70  | 0.037                            | 0.112              | 0.440                           | 1.83              | 2.54             | Old pasture. Surface 1' deep of muck, black, well decomposed, compact. Subsoil decomposed fairly well. Carex remains. Surface has been burned off many years ago. (Nearby woods are birch, poplar, maple, elm.) This is very deep muck.                              |
| B.....     | 5.79     | 3528                              | 10.75       | 4.74  | 0.395 | 0.032                            | 0.007              | 0.231                           | 1.98              | 3.34             |  |
| 121 A..... | 5.06     | 12240                             | 7.56        | 3.45  | 0.314 | 0.010                            | 0.061              | 0.330                           | 0.66              | 2.07             | Virgin, at edge of bush (elder, birch, willow, elm, maple, poplar.) Muck brownish, decomposition fair, drainage poor, wet. Numerous tree remains. River flat 150 yards away subject to flooding but well decomposed. Deep muck.                                      |
| B.....     | 5.40     | 13320                             | 7.75        | 3.68  | 0.379 | 0.020                            | 0.020              | 0.275                           | 1.10              | 2.32             |  |
| 102 A..... | 5.84     | 5364                              | 9.32        | 3.78  | 0.85  | 0.010                            | 0.038              | 0.301                           | 0.64              | 2.18             | Hay field (muck black, very well decomposed. Tree remains.) Nearby bush, pine, willow, birch. Depth 6' and greater.  |
| B.....     | 5.84     | 6480                              | 8.49        | 3.94  | 1.15  | trace                            | 0.052              | 0.139                           | 0.79              | 2.07             |  |
| 101 A..... | 4.26     | 22572                             | 6.10        | 1.18  | 0.364 | trace                            | 0.051              | 0.170                           | 0.57              | 1.71             | Virgin soil (birch and poplar). Muck brown, poorly decomposed, damp. Mainly carex, some wood remains; at 2' depth carex entirely. Total depth around 3 ft.   |
| B.....     | 4.20     | 18324                             | 3.10        | 0.92  | 0.114 | 0.022                            | 0.020              | 0.143                           | 0.48              | 1.57             |  |

TABLE VI  
CHEMICAL ANALYSIS—oven dry basis—A = Surface 12"; B = Subsoil, 12-24" deep  
E. SOUTH-EAST OF SHERRINGTON-STE. CLOTHILDE AREA

| Sample No. | pH value | Lime requirement<br>lbs. CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>3</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations  |
|------------|----------|-----------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|---|
| 96 A.....  | 6.03     | 5652                              | 11.80       | 4.45  | 0.443 | 0.018                            | 0.081              | 0.305                           | 1.17              | 2.00             | Scrub bush, birch, ash, elder, willow, elm, poplar, swamp grasses. Muck black, well decomposed to 3'; wood remains.   |
| B.....     | 5.85     | 5400                              | 9.32        | 4.25  | 0.423 | 0.012                            | 0.036              | 0.194                           | 1.00              | 1.96             | Sticky. Drainage poor. Very deep. Representative of large area.   |
| 95 A.....  | 6.62     | 1404                              | 11.44       | 5.21  | 0.67  | 0.037                            | 0.048              | 0.260                           | 1.19              | 1.58             | Open pasture. Muck well decomposed to 3'. Wood remains numerous, fairly well decomposed. Depth 10' and greater. Drainage good. Potatoes nearby in very good condition.  |
| B.....     | 6.33     | 2556                              | 10.48       | 5.10  | 0.67  | 0.014                            | 0.042              | 0.154                           | 1.57              | 1.56             |   |
| 126 A..... | 6.53     | 972                               | 15.15       | 7.94  | 0.665 | 0.013                            | 0.069              | 0.382                           | 1.17              | 2.01             | Virgin. Muck black, very well decomposed throughout. Depth 4' and greater. Somewhat damp and appears to be flooded in spring.   |
| B.....     | 6.50     | 972                               | 15.05       | 7.39  | 0.679 | 0.015                            | 0.010              | 0.129                           | 1.78              | 1.85             |   |
| 128 A..... | 6.01     | 2664                              | 37.40       | 4.23  | 0.448 | 0.031                            | 0.315              | 0.484                           | 2.00              | 2.36             | Taken in swampy scrub bush. Drainage poor. Swamp vegetation, elder, willows, elm, birch, poplar. Surface has been periodically burned. Black soil only 2.5-3' deep. Well decomposed.  |
| B.....     | 6.14     | 2376                              | 23.90       | 4.91  | 0.409 | 0.022                            | 0.330              | 0.319                           | 3.36              | 2.41             |   |
| 127 A..... | 7.00     | 160                               | 19.00       | 7.54  | 0.530 | 0.038                            | 0.006              | 0.277                           | 1.10              | 1.99             | Old pasture. Muck black, well decomposed to 3' or deeper. Some tree remains. Continuation of river flat. Drainage fair. Good crops. Deep.   |
| B.....     | 6.41     | 684                               | 16.65       | 6.21  | 0.380 | 0.014                            | 0.032              | 0.182                           | 1.73              | 1.44             |   |
| 125 A..... | 6.88     | 396                               | 13.30       | 7.48  | 0.787 | 0.020                            | 0.110              | 0.308                           | 1.63              | 2.11             | Virgin (willow, cedar, maple, birch). Muck black, well decomposed. Wood remains. Drainage good. Depth 4'  |
| B.....     | 6.35     | 2088                              | 11.00       | 5.93  | 0.580 | 0.028                            | 0.098              | 0.288                           | 2.48              | 2.44             | and greater.  |
| 124 A..... | 6.53     | 108                               | 17.20       | 7.30  | 0.424 | 0.019                            | 0.090              | 0.165                           | 1.88              | 1.63             | Virgin land surrounded by bush (poplar, birch, elm, maple and variety of other trees). Growth very good. Surface 2' of black, well decomposed muck; at 2-4' some carex and moss remains; at 4' and below raw peat. Depth 10' and more. 200 yards W. of here shell marl under jelly layer. |
| B.....     | 5.88     | 684                               | 14.70       | 6.58  | 0.191 | trace                            | 0.078              | 0.135                           | 2.62              | 2.05             |   |
| 123 A..... | 6.66     | 1224                              | 14.45       | 7.29  | 0.564 | 0.015                            | 0.064              | 0.232                           | 2.10              | 1.57             | Same as above. Richest tree growth in whole area. Muck well decomposed, black. Wood debris. Deep. Drainage questionable. This is an isolated area; looks very good but so far nothing cleared on it.  |
| B.....     | 6.53     | 1512                              | 16.50       | 7.45  | 0.710 | 0.009                            | 0.049              | 0.110                           | 2.38              | 1.91             |   |
| 118 A..... | 5.39     | 2088                              | 41.35       | 3.62  | 1.140 | 0.018                            | 0.097              | 0.621                           | 1.07              | 2.33             | Meadow—River flat. Decomposition medium. Water table at 1.5'. Depth probably not more than 4' at the greatest.  |
| B.....     | 5.30     | 5796                              | 18.30       | 3.15  | 0.530 | 0.075                            | 0.205              | 0.272                           | 1.28              | 2.73             |   |
| 113 A..... | 6.92     | 396                               | 12.30       | 6.97  | 1.540 | 0.010                            | 0.230              | 0.423                           | 3.33              | 2.27             | Virgin and bush (ash, elm, spruce, birch). Surface muck well decomposed. Subsoil medium decomposed; carex remains at depth of 4'. Depth 4' and greater.   |
| B.....     | 5.78     | 4320                              | 11.10       | 4.98  | 0.605 | trace                            | 0.109              | 0.185                           | 5.61              | 2.56             |   |

TABLE VII

CHEMICAL ANALYSIS—Oven Dry Basis—A = Surface 12"; B = Subsoil 12-24" deep

## F. SOUTH CENTRE OF SHERRINGTON-STE. CLOTHILDE AREA

| Sample No. | pH value | Lime requirement<br>lb. CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>3</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations  |
|------------|----------|----------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|---|
| 93 A.....  | 6.45     | 3405                             | 11.69       | 3.66  | 0.66  | trace                            | 0.096              | 0.216                           | 1.26              | 3.15             | River flat (swamp grasses); heavy sod mat. Muck black, well decomposed to 2' deep, friable. Subsoil medium decomposed; carex remains, sticky. No tree remains. Subject to flooding. Deep muck.    |
| B.....     | 6.27     | 3780                             | 9.68        | 3.22  | 0.62  | trace                            | 0.086              | 0.140                           | 2.05              | 2.68             |   |
| 94 A.....  | 5.99     | 2952                             | 12.05       | 4.67  | 0.81  | 0.028                            | 0.108              | 0.363                           | 1.49              | 2.22             | Scrub bush (elder, willow, spiraea, ash, poplar, birch and swamp grasses). Muck black, well decomposed to 2.5' deep. Sticky. Poor drainage. Deep muck.  |
| B.....     | 5.98     | 2088                             | 11.60       | 4.58  | 0.623 | 0.020                            | 0.051              | 0.258                           | 1.79              | 1.69             |   |
| 97 A.....  | 5.67     | 5400                             | 10.20       | 3.88  | 0.603 | trace                            | 0.064              | 0.312                           | 1.58              | 3.00             | River flat (swamp vegetation). Muck medium decomposed. Little wood debris. This muck is from carex and moss. Subject to flooding. Water table high. Deep muck. Severely burned at edges of ridge. |
| B.....     | 5.74     | 6048                             | 8.78        | 4.09  | 0.637 | trace                            | 0.136              | 0.286                           | 1.36              | 2.62             |   |
| 98 A.....  | 6.35     | 2376                             | 13.10       | 5.02  | 0.831 | 0.028                            | 0.107              | 0.282                           | 1.17              | 2.02             | Virgin (birch, elder and raspberries). Indications of burning years ago. Well decomposed to 3' deep. Chocolate brown. Deep muck. Drainage only fair.  |
| B.....     | 6.05     | 3816                             | 15.00       | 6.35  | 0.899 | 0.023                            | 0.104              | 0.099                           | 1.92              | 1.95             |   |
| 105 A..... | 5.64     | 8280                             | 10.45       | 4.77  | 0.430 | trace                            | 0.065              | 0.316                           | 0.77              | 2.33             | Virgin near bush (white birch, hardhack, tamarack). Fairly well decomposed, with wood remains. Depth from 4-6' up. Signs of burning a long time ago.  |
| B.....     | 5.79     | 7164                             | 10.10       | 4.47  | 0.625 | trace                            | 0.044              | 0.205                           | 0.70              | 1.94             |   |
| 120 A..... | 5.90     | 2952                             | 11.40       | 4.60  | 0.378 | 0.048                            | 0.068              | 0.283                           | 1.15              | 2.49             | Virgin near bush (birch). Muck fairly well decomposed in surface to 1.5' depth. Carex and some moss below. Deep muck. Drainage not any too good.  |
| B.....     | 5.67     | 4392                             | 10.00       | 4.23  | 0.287 | 0.043                            | 0.028              | 0.253                           | 1.27              | 2.35             |   |
| 119 A..... | 5.50     | 5256                             | 11.00       | 3.61  | 0.626 | trace                            | 0.083              | 0.286                           | 1.15              | 1.93             | Virgin. Decomposition fair. Wood remains. Deep. Drainage good.  |
| B.....     | 5.73     | 6012                             | 9.60        | 3.77  | 0.220 | trace                            | trace              | 0.171                           | 1.27              | 1.69             |   |
| 122 A..... | 6.13     | 2556                             | 9.94        | 3.97  | 0.89  | trace                            | 0.083              | 0.229                           | 0.81              | 1.79             | Open meadow. Muck black, well decomposed to 2' deep, brownish black, friable, wood remains. Below 2' some carex remains. Drainage good. Deep. Shallow towards edges of ridges.                    |
| B.....     | 6.07     | 5364                             | 10.10       | 3.89  | 1.12  | trace                            | 0.047              | 0.147                           | 1.65              | 1.76             |   |
| 99 A.....  | 5.82     | 2088                             | 13.75       | 4.52  | 0.623 | 0.028                            | 0.107              | 0.353                           | 2.33              | 2.00             | Virgin (edge of bush—birch, poplar, elm, willow, ash). Well decomposed; brownish black; tree remains. Deep muck. Drainage not very good.  |
| B.....     | 6.01     | 3204                             | 12.90       | 4.90  | 0.547 | 0.011                            | 0.050              | 0.187                           | 3.80              | 2.44             |   |

TABLE VIII

CHEMICAL ANALYSIS—Oven Dry Basis—A = Surface 12" of soil; B = Subsoil 12-24" deep

## G. SOUTH OF SHERRINGTON-STE. CLOTHILDE AREA

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| Sample No. | pH value | Lime requirement<br>lb. CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>3</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations   |
|------------|----------|----------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|--|
| 110 A..... | 5.75     | 4392                             | 8.55        | 3.68  | 0.550 | 0.021                            | 0.093              | 0.240                           | 1.47              | 2.66             | Bush (birch.) Muck medium decomposed. Deep. Numerous wood remains. Drainage only fair.   |
| B.....     | 5.89     | 4392                             | 6.74        | 3.84  | 0.247 | 0.013                            | 0.038              | 0.149                           | 1.60              | 2.15             |  |
| 115 A..... | 4.66     | 14400                            | 6.10        | 2.44  | 0.270 | 0.020                            | 0.087              | 0.282                           | 1.44              | 1.79             | Virgin (white birch). Muck fairly well decomposed. Numerous wood remains. Subsoil medium decomposed; carex and wood remains. Deep.   |
| B.....     | 5.40     | 9520                             | 10.10       | 4.09  | 0.468 | 0.020                            | 0.082              | 0.176                           | 1.99              | 1.59             |  |
| 114 A..... | 5.59     | 6084                             | 9.58        | 4.11  | 0.326 | trace                            | 0.072              | 0.398                           | 0.89              | 1.95             | Virgin (bush—white birch). Well decomposed. Numerous wood remains. Depth 4' and greater.   |
| B.....     | 5.48     | 7524                             | 6.74        | 4.24  | 0.370 | trace                            | 0.039              | 0.297                           | 1.36              | 1.60             |  |
| 109 A..... | 5.74     | 3600                             | 12.70       | 4.10  | 0.704 | 0.020                            | 0.145              | 0.480                           | 1.25              | 2.39             | Virgin (surrounded by elm, birch, ash, maple, basswood). Muck fairly well decomposed. Numerous wood remains. Depth 4' and greater.   |
| B.....     | 5.75     | 5400                             | 11.00       | 4.98  | 0.351 | 0.027                            | 0.051              | 0.169                           | 2.61              | 2.43             |  |
| 112 A..... | 6.01     | 3780                             | 11.24       | 3.22  | 1.22  | 0.020                            | 0.128              | 0.223                           | 1.34              | 1.97             | Virgin (birch). Muck fairly well decomposed. Carex remains in subsoil. Burned many years ago. Very dry on surface. Water table 4-7' deep in August. Muck very dry.           |
| B.....     | 5.52     | 8748                             | 8.01        | 3.78  | 0.67  | 0.010                            | 0.026              | 0.129                           | 1.88              | 1.82             |  |
| 116 A..... | 5.54     | 5256                             | 12.45       | 4.79  | 0.631 | 0.028                            | 0.089              | 0.383                           | 1.00              | 2.56             | Virgin (elm, tamarack, cedar, pine, birch, spiraea). Surface medium decomposed. Subsoil—decomposition fair. Jelly layers between the two. Water table at 3'. Muck 4-6' deep. |
| B.....     | 5.85     | 4104                             | 13.65       | 5.61  | 0.733 | 0.014                            | 0.016              | 0.176                           | 3.61              | 2.35             |  |
| 117 A..... | 5.84     | 3600                             | 13.60       | 5.15  | 0.808 | trace                            | 0.137              | 0.279                           | 1.91              | 1.89             | Bush (white birch). Surface well decomposed; friable. Subsoil poorly decomposed. Carex remains. Depth 4' and greater.  |
| B.....     | 5.25     | 10800                            | 14.00       | 4.41  | 0.327 | trace                            | 0.030              | 0.179                           | 1.67              | 2.02             |  |

TABLE IX

CHEMICAL ANALYSIS—Oven Dry Basis—A = Surface 12" of soil; B = Subsoil 12–24" deep

## H. WEST PART OF SHERRINGTON-STE. CLOTHILDE AREA

| Sample No. | pH value | Lime requirement<br>lb.<br>CaO/acre | Total Ash % | CaO % | MgO % | Mn <sub>3</sub> O <sub>4</sub> % | K <sub>2</sub> O % | P <sub>2</sub> O <sub>5</sub> % | SO <sub>3</sub> % | N <sub>2</sub> % | Field Observations  |
|------------|----------|-------------------------------------|-------------|-------|-------|----------------------------------|--------------------|---------------------------------|-------------------|------------------|---|
| 103 A..... | 6.27     | 2556                                | 10.70       | 4.28  | 0.72  | 0.031                            | 0.033              | 0.291                           | 1.03              | 2.27             | In hayfield near bush (birch, maple, some cedar). Muck black, well decomposed to 3'. Wood remains. Very dry to 2' in September. Depth 4-6' and greater. |
| B.....     | 6.11     | 4500                                | 8.87        | 3.36  | 0.72  | 0.023                            | 0.019              | 0.198                           | 1.20              | 1.80             |   |
| 104 A..... | 5.84     | 5760                                | 11.10       | 4.53  | 0.468 | 0.036                            | 0.075              | 0.275                           | 0.94              | 2.02             | Bush (birch, poplar, pine, maple, raspberry). Muck medium decomposed; wood remains. Fairly dry. Water table low. Depth 8' and greater.                  |
| B.....     | 5.91     | 5400                                | 9.72        | 4.49  | 0.429 | 0.012                            | 0.028              | 0.257                           | 1.05              | 2.03             |   |
| 107 A..... | 6.10     | 2376                                | 10.80       | 4.97  | 0.514 | 0.029                            | 0.100              | 0.249                           | 1.37              | 2.57             | Bush (birch, willow and laurel). Muck black, fairly well decomposed at surface. Wood remains. Water table at 2' in August. Good depth. All wooded.      |
| B.....     | 5.82     | 2952                                | 8.65        | 5.58  | 0.328 | 0.032                            | 0.029              | 0.167                           | 1.14              | 1.89             |   |
| 106 A..... | 6.04     | 3405                                | 10.48       | 4.29  | 0.75  | 0.031                            | 0.018              | 0.475                           | 0.75              | 2.38             | Virgin, recently cleared (white birch, elm, cedar). Muck well decomposed. Numerous wood remains. Very deep. Damp.                                       |
| B.....     | 5.97     | 3960                                | 7.95        | 3.22  | 0.66  | trace                            | 0.034              | 0.223                           | 1.03              | 2.00             |   |
| 108 A..... | 4.84     | 11988                               | 4.40        | 1.62  | 0.244 | trace                            | 0.057              | 0.282                           | 0.65              | 2.77             | Centre of peat bog with its characteristic flora. Water table high.   |
| B.....     | 5.50     | 6876                                | 2.94        | 1.36  | 0.211 | trace                            | 0.034              | 0.235                           | 0.62              | 2.93             |   |
| 111 A..... | 4.22     | 23040                               | 4.89        | 1.05  | 0.83  | trace                            | 0.104              | 0.239                           | 0.51              | 1.73             | Bush (white birch). Medium decomposed; wood remains. Has been burned. Just on edge of large raw peat area.  |
| B.....     | 4.37     | 23040                               | 2.96        | 1.13  | 0.75  | trace                            | 0.041              | 0.112                           | 0.58              | 1.68             | Very deep muck; 8 to 10 feet and greater.   |

## ESTABLISHMENT OF A MUCK SOIL TRUCK CROPS EXPERIMENTAL SUB-STATION

A new sub-station was started in 1935 by the Dominion Experimental Farms system to undertake studies of the problems of truck crop production on the muck lands of the southwestern region of Quebec. The establishment of this sub-station is a direct outgrowth from the work of the Quebec Soil Survey. A small committee was named, representing the Quebec Department of Agriculture, Macdonald College and the Dominion Experimental Farms system of the Dominion Department of Agriculture in order to recommend a suitable site for this sub-station. A similar co-operative committee has been named to advise in regard to the experimental work which will be undertaken.

The new sub-station comprises a property of approximately 85 arpents, about 12 of which are mineral soil and the remainder muck of high quality. It is close to the village of Ste. Clothilde and close to the water of Norton Creek. It is situated on an asphalt paved road. A considerable part of the muck on this property is virgin soil.

### NAPIERVILLE AREA

*Surveyed July 12 to 22, 1934*

The "Napierville" muck area lies about 28 miles south of the Montreal Jacques Cartier bridge. The eastern edge of this area lies just 3 miles south of the village of Napierville and the western edge comes within 1 to 1½ miles to the east of Barrington Station. The Petite Montreal River flows through the middle of this whole section from west to east. The entire area consists of 9,500 to 10,000 acres. The elevation of the muck is less than 200 feet above sea level and in the central part less than 175 feet. The drainage is very good on the southern side of the area where large sections of the land are cultivated and on the edges of the northern side. In the central section, nearer to the river, and especially at the western end, west of the Grand Trunk Railway tracks, the drainage is very poor. It has, however, been somewhat improved with the cleaning and deepening of the river a few years ago. Some small areas that were too wet a few years ago have been brought under cultivation during the last two or three years.

The underlying mineral soil is heterogeneous. In most cases it consists of a mixture of grayish sand, silt and gravel with large boulders of sandstone and some limestone. In some cases, however, it is almost pure sand, while in others it is more like a loam or clay. The water does not seem to penetrate the mixed sandy subsoil very easily. In many cases a jelly-like, rubbery layer has been formed at the bottom of the muck between mineral soil and organic deposit. This is very often mixed with the upper few inches of the mineral soil. It seems to be deposited in layers and when dry, peels off in laminae. This layer keeps the water from rapid penetration through the sub-soil and in cases where it is 6 inches thick it appears quite impervious.

On the southern side and the corner of the western and northwestern sides, the muck is surrounded by fairly abrupt ridges. These ridges are rich in calcareous material and numerous calcareous sandstone and limestone fragments cover them.

The muck forms many long, narrow tongues which extend between the ridges.

On the northern and eastern sides the muck is enclosed by gently sloping ridges. There are on this side only a few "tongues" of muck. The boundary lines of the muck deposit are gently curving rather than abrupt. The mineral soil here is a medium loam with very few boulders scattered around and these are chiefly sandstone.

The well-drained muck on the southern side and on the edges of the northern side is very well decomposed in the surface layer, sometimes extending down to 2 and 3 feet. No traces of undecomposed carex can be found in the

surface, but wood remains (birch, pine, cedar) are numerous. In the subsoil some poorly decomposed carex remains are found. The reaction of this well decomposed muck is slightly acid (pH 5.5 to 7.0). Most of this soil is cultivated, although considerable areas of this well decomposed muck are still in woods.

Further away from the outer edges, especially on the northeastern side, the decomposition is only fair. The depth of the decomposed layer is not so great. The muck is usually brownish in colour and a larger proportion of carex remains is present. This medium well decomposed muck is almost invariably covered with trees or small bush or else has been recently cleared, but only very little is under cultivation. The poor drainage is usually a factor that has stopped its development. This type of muck is a little more acid in reaction than the well decomposed muck, viz: pH 5.0 to 6.0.

An area of at least 500 acres in the north centre of the area consists of raw moss peat. This peat is very acid in reaction and very poorly drained. Wood remains are scarce in this raw section. There is a small lake covering 4 to 5 acres in the middle of this raw peat.

Very little burning had been practised in this area up to the time when the survey was made in July, 1934.

The depth of the muck varies considerably. On the outsides it is quite shallow, but gets deeper very quickly away from the ridges. The muck on most of the cultivated land is deep, usually over 5 feet and frequently extending to a depth of 10 feet and more.

The vegetation in the wooded areas consists chiefly of white birch, poplar, willow, alder, swamp maple, tamarack and cedar. On the mossy peat, stunted spruce trees, blueberries, laurel, Labrador tea, and "hard hack," (*Spiraea tomentosa*), are prevalent.

Approximately one quarter (2,400 to 2,500 acres) of this entire area is cultivated, while the remainder is in woods or "swamp meadow." The latter is at present too poorly drained for cultivation and is only accessible during dry years for hay.

A considerable portion of the cultivated land is devoted to pastures, which are usually in a miserably poor condition, deeply rutted and hummocked by the tramping of cattle. Potatoes are quite extensively grown, especially near the roads (highway No. 9 and Baigneul). The potato crops looked well and very little scab was found. Occasionally good crops of onions, lettuce and carrots were seen here also. Oats and hay are the chief crops grown along the sides farther away from the roads.

Very little chemical fertilizer has been used in this area, and barnyard manure is still the chief fertilizer applied to the crops.

The acidity of the average samples from this area is not as great as that of those from the St. Edouard and St. Isidore areas. All samples except one have a pH value higher than 5.0 and range to pH 7.4. Sample No. 23 was taken from an area of raw sphagnum peat. It is very acid and has a tremendous lime requirement. The lime requirement of all other samples varies from about one ton of CaO per acre on the neutral soils to  $7\frac{1}{2}$  tons of CaO per acre on the more acid soils.

The total ash content of all the samples except No. 23 indicates fairly good decomposition and varies from 8 per cent to 20 per cent.

All samples are well supplied with calcium and magnesium, while the manganese and potash contents are very low.

The phosphorus content varies considerably (0.23 per cent to 1.1 per cent). In general the higher phosphorus content is found in the better decomposed soils, although this is not always true.

The sulphur content is of the same order as that in the St. Isidore and St. Philippe areas, while the total nitrogen is somewhat lower than in any of the other areas. A comparatively low nitrogen content was found in sample No. 23, from the raw peat section.

TABLE X

CHEMICAL ANALYSES OF SAMPLES FROM NAPIERVILLE AREA. A=Surface 12" of soil. B=Subsoil 12-24" deep  
Oven dry basis.

| Sample No. | Hygroscopic moisture | pH value | Lime requirement<br>lb. CaO per acre | Total ash | CaO  | MgO  | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes   |
|------------|----------------------|----------|--------------------------------------|-----------|------|------|--------------------------------|------------------|-------------------------------|-----------------|----------------|---|
| 12 A       | 16.01                | 5.06     | 13,500                               | 8.27      | 3.57 | 2.76 | trace                          | 0.069            | 1.10                          | 1.51            | 1.64           | Bush (willow, birch, poplar). Decomposition fairly good. Some carex and wood remains. Drainage not very good. |
| B          | 16.69                | 5.21     | 14,150                               | 8.14      | 3.96 | 2.42 | trace                          | 0.032            | 0.75                          | 1.53            | 1.60           | Decomposition medium. Some carex, mostly moss remains. Watertable at 3'. Depth 6'.                            |
| 13 A       | 16.65                | 5.30     | 11,625                               | 9.89      | 4.08 | 3.52 | trace                          | 0.047            | 0.48                          | 1.20            | 1.60           | Permanent pasture. Decomposition good. Muck black and friable.  |
| B          | 15.28                | 5.38     | 12,600                               | 8.22      | 2.83 | 1.92 | trace                          | 0.041            | 0.82                          | 1.01            | 1.00           | Decomposition medium. Wet. Depth over 5'.   |
| 14 A       | 17.83                | 7.37     | 2,150                                | 22.0      | 6.89 | 3.48 | 0.036                          | 0.037            | 1.44                          | 1.78            | 1.33           | Old hay field. Decomposition very good. Muck black and friable. Earthworms present.                           |
| B          | 17.16                | 6.43     | 2,520                                | 15.82     | 4.40 | 1.31 | 0.024                          | 0.059            | 0.87                          | 3.12            | 1.63           | Decomposition fair. Wood remains. Depth over 4'.  |
| 15 A       | 17.97                | 6.06     | 5,100                                | 14.76     | 6.89 | 3.80 | 0.024                          | 0.053            | 0.78                          | 1.28            | 1.55           | Old pasture. Decomposition very good. Muck brownish black.  |
| B          | 17.95                | 5.76     | 9,140                                | 14.40     | 7.00 | 3.46 | trace                          | 0.033            | 0.77                          | 1.50            | 1.26           | Decomposition good. Some tree remains. Well drained. Depth great.   |
| 16 A       | 17.60                | 7.41     | 3,280                                | 15.74     | 6.82 | 1.84 | 0.065                          | 0.081            | 0.26                          | 2.32            | 1.83           | Near edge of woods, close to limestone ridge. Decomposition fair. Wood and carex remains.                     |
| B          | 15.56                | 6.46     | 6,780                                | 8.02      | 4.07 | 1.52 | 0.009                          | 0.033            | 0.15                          | 1.88            | 1.82           | Decomposition medium. Carex and moss remains. Drainage poor. Watertable 2.5'. Depth over 8'.                  |
| 17 A       | 16.44                | 7.34     | 2,530                                | 15.00     | 7.24 | 2.33 | 0.010                          | 0.101            | 0.19                          | 2.09            | 1.19           | Old pasture. Decomposition good. Muck black and friable.  |
| B          | 13.65                | 6.44     | 3,440                                | 11.92     | 4.63 | 2.35 | 0.007                          | 0.083            | 0.37                          | 1.97            | 1.63           | Decomposition medium. Carex and wood remains. Drainage not very good. Watertable at 3'. Depth great.          |
| 18 A       | 17.75                | 6.79     | 2,740                                | 18.05     | 8.75 | 2.08 | 0.046                          | 0.082            | 0.29                          | 2.05            | 1.40           | Old pasture. Decomposition good. Drainage good.   |
| B          | 14.58                | 6.27     | 5,700                                | 11.47     | 5.15 | 1.77 | 0.018                          | 0.073            | 0.16                          | 2.04            | 1.37           | Decomposition good. Wood remains. Depth over 5'.  |
| 19 A       | 13.73                | 6.03     | 6,920                                | 18.44     | 4.75 | 1.47 | 0.039                          | 0.097            | 0.30                          | 2.49            | 1.72           | Old pasture. Decomposition fairly good.   |
| B          | 16.37                | 5.83     | 8,230                                | 9.85      | 5.21 | 1.66 | 0.025                          | 0.068            | 0.30                          | 3.07            | 1.82           | Decomposition medium. Sedge remains. Depth over 6'.   |
| 20 A       | 14.45                | 6.41     | 5,270                                | 14.63     | 3.99 | 1.47 | 0.028                          | 0.130            | 0.40                          | 2.31            | 1.47           | Old hayfield. Decomposition good. Drainage good.  |
| B          | 14.67                | 6.70     | 4,790                                | 14.50     | 4.17 | 1.37 | 0.028                          | 0.140            | 0.33                          | 2.52            | 1.51           | Decomposition fairly good. Wood and carex remains. Depth 4'.  |

## CHEMICAL ANALYSES OF SAMPLES FROM NAPIERVILLE AREA. A=Surface 12" of soil. B=Subsoil 12-24" deep—Concluded

Oven dry basis.

| Sample No. | Hygroscopic moisture | pH value | Lime requirement<br>lb. CaO per acre | Total ash | CaO        | MgO   | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes   |
|------------|----------------------|----------|--------------------------------------|-----------|------------|-------|--------------------------------|------------------|-------------------------------|-----------------|----------------|---|
|            | %                    |          |                                      | %         | %          | %     | %                              | %                | %                             | %               | %              |   |
| 21 A       | 15.45                | 5.52     | 15,400                               | 11.71     | 3.50       | 1.70  | 0.015                          | 0.098            | 0.39                          | 1.54            | 1.42           | Woods (birch and raspberry). Decomposition medium. Not very well drained.                       |
| B          | 14.04                | 5.25     | 17,550                               | 7.94      | 3.49       | 1.52  | 0.007                          | 0.063            | 0.30                          | 1.64            | 1.23           | Decomposition poor. Carex and moss remains. Depth great. (10' or more).                         |
| 22 A       | 13.54                | 6.21     | 4,140                                | 22.40     | 4.53u      | 2.01  | 0.037                          | 0.230            | 0.47                          | 2.24            | 1.27           | Old pasture. Decomposition good. Drainage good.   |
| B          | 10.68                | 5.67     | 7,530                                | 24.98     | 3.94       | 1.71  | 0.026                          | 0.250            | 0.28                          | 2.49            | 1.51           | Decomposition fair. Depth 5'.   |
| 23 A       | 11.66                | 4.03     | 54,900                               | 4.44      | Insuffici- | 0.010 | .....                          | .....            | 0.26                          | 2.62            | 0.70           | Taken in raw peat bog. Spruce, blueberry, cranberry, Labrador tea and moss dominant vegetation. |
| B          | 12.17                | 4.04     | 34,100                               | 4.77      | sample     | trace | .....                          | .....            | 0.31                          | 3.39            | 0.88           | Raw moss and carex peat. Very wet. Depth great.   |
| 24 A       | 13.01                | 7.14     | 1,775                                | 19.00     | 5.10       | 2.22  | 0.041                          | 0.156            | 0.73                          | 2.36            | 1.49           | Hay field. Decomposition good. Has been top burned.   |
| B          | 12.48                | 5.60     | 8,500                                | 20.80     | 3.22       | 2.58  | 0.023                          | 0.210            | 0.24                          | 3.78            | 1.70           | Decomposition poor. Depth 3-4'  |
| 25 A       | 15.23                | 5.85     | 8,280                                | 13.45     | 4.50       | 1.46  | 0.012                          | 0.109            | 0.15                          | 1.35            | 1.27           | Cleared but uncultivated land. Decomposition good.  |
| B          | 14.47                | 5.97     | 7,160                                | 11.02     | 4.13       | 1.27  | 0.012                          | 0.049            | 0.21                          | 1.59            | 1.02           | Well decomposed. Depth 4'.  |
| 26 A       | 14.58                | 5.95     | 3,440                                | 19.30     | 8.33       | 1.48  | 0.015                          | 0.116            | 0.29                          | 1.91            | 1.65           | Old pasture. Decomposition good. Drainage good.   |
| B          | 16.23                | 6.39     | 5,300                                | 16.15     | 7.28       | 1.42  | trace                          | 0.059            | 0.28                          | 2.38            | 1.43           | Decomposition good. Depth 5'.   |
| 27 A       | 13.17                | 5.31     | 14,100                               | 12.20     | 4.31       | 1.43  | 0.010                          | 0.084            | 0.23                          | 2.12            | 1.48           | Swamp meadow on river flat. Decomposition medium to poor.                                       |
| B          | 14.80                | 5.49     | 11,300                               | 12.11     | 5.18       | 1.31  | 0.007                          | 0.045            | 0.16                          | 1.36            | 1.44           | Decomposition poor. Drainage poor.  |

## STE. BARBE AREA

*Surveyed September 21 to October 3, 1934*

This area is located north of Huntingdon. It crosses the so-called "Plank road" which runs from Huntingdon to Port Lewis. The whole area may be divided into two sections:—One, about 4,500 acres in size, which crosses the "Plank road" about 2.5 miles north of Huntingdon and is 2 miles wide at the road, and the other about 5,500 acres in size, which lies parallel to the first section and just 1 mile north of it.

The muck in the larger part of this area is underlain by lacustrine buff-coloured clay. In most cases, especially in the northern section and in the wide flats of the southern section, very little stone is present in the underlying clay. At the southern edge, however, especially between the ridges, large stones and boulders are present under the muck. The rocks consist mainly of sandstone, and no limestone was found under the entire area.

The muck on the southern side of this area and along the ridges in the northern section has been mainly formed from decayed wood and carex remains. The main body of this muck area, however, has been formed from sedges, cotton-grass and moss. Wood remains are scarce in the central sections. The muck varies from the best grades to raw undecomposed peat. In most cases the quality has been greatly modified by severe burning.

Well decomposed black muck was found in the southwestern corner of the southern section and about  $\frac{1}{2}$  mile east of the Plank road in the northern section. The burning in these sections had not been as severe up to the time of survey (September 1934) as in the other parts of the area, although, in some places, even here, deep holes had been burned out. Large areas, several thousand acres in extent, of well decomposed muck had been burned severely at the eastern end of both sections of the area. The burning, in many instances, has been to the clay or else the surface well decomposed layer of muck has been burned off leaving a layer of ashes 6 to 10 inches deep over the raw peat, which consists chiefly of carex and moss remains.

By far the larger part of the whole area consists of raw peat or poorly decomposed peat. Considerable top burning has been practised, but due to an excess of moisture in the lower layers only the surface and best decomposed layer has burned off. In general it may be said that there is hardly a place in the entire area where at least some burning has not been done. The size of the muck area has been considerably decreased during the last few years by burning. In some places where the burning has been completely to the clay, good crops are grown on the mineral soil.

The depth of the muck in this area varies greatly. Originally the organic soil has been very deep from all appearances: Indications are that about 6 to 8 feet of muck and peat have been burned off in the eastern section and here still 2 to 3 feet of peat are left unburned. On the western end in the raw peat area where the burning has not been so severe due to excess of moisture, the depth is great (6 to 10 feet and more). The muck gradually gets shallower toward the edges.

The drainage in this area is fairly good on the well decomposed muck. The subsoil of the muck and peat soils, however, has an excess of moisture, which does not permit deep burning.

The soil samples obtained from the Ste. Barbe area in 1934 during the survey were not analysed due to insufficient time; however, some analytical data on samples obtained in 1932 and 1933 are available and these are presented. From this table of chemical analyses it is seen that four of the samples have high pH values with correspondingly low lime requirements. These soils had been severely burned and the ashes that were mixed with the surface layer are probably largely responsible for the high pH value. The subsoils and the other three samples were taken from poorly decomposed muck and peat and they are consequently more acid and have a greater lime requirement.

The total ash of the poorly decomposed muck and peat is very low, while it is considerably higher on the severely burned muck. The total ash of the subsoil of sample No. 154 is very high due to intermixing with the mineral subsoil.

The lime content of the poorly decomposed muck is very low, while in the somewhat better decomposed and severely burned soils it is fairly good. The magnesium content of the surface soil of sample No. 152 is very high, while in the remainder it is low. The potash and phosphoric acid content is very low in all samples except for the potash content of sample No. 154. This is largely due to the mixture of mineral soil present in this shallow sample. The sulphur and nitrogen contents of the poorly decomposed muck and peat are considerably lower than in the better decomposed samples. This latter condition of lower nitrogen and sulphur in ill-decomposed peat is generally true in all the areas.

Approximately 4,000 acres of the entire area is under cultivation or permanent pasture. Most of this land has been burned to some extent at least. Very few potatoes are grown in this area. Oats and hay are the main crops cultivated.

The uncultivated area is either in woods, consisting chiefly of white birch and some poplar, elm, red maple and willow, or burned over peat covered with low growing shrubs such as: blueberries, cranberries, laurel, Labrador tea, willow, spruce and tamarack. Mosses, cottongrass and sedges are also abundant on the peat bogs.

From general observations one is forced to conclude that the farmers in this district desire a mineral soil and are determined to get it sooner or later by continued burning. Taking into consideration the poor quality of most of the muck, the extent of burning that has been done on most of the better quality muck and the underlying clay flat in the central and northern sections of the area, it seems that burning to the clay would be the most advisable thing to do, in the largest part of the area. Before the raw peat can be burned completely, better drainage of the subsoil will have to be provided.

At present only a comparatively small area of good quality muck is left that is fit for market gardening purposes. Unless the burning of this type of muck can be stopped immediately, it is useless to advocate extensive market gardening schemes for the area. Three or four dry seasons like the past summer would undoubtedly clean up all the good quality muck if practices are continued along the present trend. Already several of the muck soils sampled, for which analyses are here presented, have been burned away completely.

TABLE XI

CHEMICAL ANALYSIS OF MUCK SOIL SAMPLES FROM STE. BARBE AREA. A=Surface  
-12" of soil. B=Subsoil 12-24" deep

Oven dry Basis

| Sam-<br>ple<br>No. | Hygro-<br>scopic<br>mois-<br>ture | pH<br>value | Lime<br>require-<br>ment<br>lb. CaO<br>per acre | Total<br>ash | CaO  | MgO  | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | —            |
|--------------------|-----------------------------------|-------------|---|--------------|------|------|--------------------------------|------------------|-------------------------------|-----------------|----------------|--------------|
|                    | %                                 |             |   | %            | %    | %    | %                              | %                | %                             | %               | %              |              |
| 152 A              | 21.23                             | 7.57        | 0   | 19.77        | 6.83 | 2.63 | 0.005                          | 0.15             | 0.19                          | 1.32            | 1.97           |              |
| B                  | 33.28                             | 6.58        | 980   | 12.67        | 6.74 | 0.96 | trace                          | 0.014            | 0.07                          | 2.35            | 1.99           |              |
| 153 A              | 20.30                             | 7.76        | 75  | 14.82        | 5.24 | 0.71 | 0.006                          | 0.11             | 0.15                          | 1.12            | 2.38           |              |
| B                  | 31.15                             | 5.74        | 4,390   | 8.31         | 3.49 | 0.54 | trace                          | 0.06             | 0.07                          | 1.72            | 2.55           |              |
| 154 A              | 11.60                             | 7.76        | 410   | 22.1         | 5.23 | 0.67 | .....                          | 0.32             | 0.24                          | 0.60            | 2.56           | Shallow      |
| B                  | 7.55                              | 5.76        | 4,000   | 46.0         | 3.37 | 0.55 | .....                          | 0.89             | 0.19                          | 0.48            | 2.10           | Clay present |
| 155 A              | 9.13                              | 4.82        | 17,200  | 7.95         | 1.63 | 0.34 | .....                          | 0.13             | 0.15                          | 0.38            | 1.54           | Cultivated   |
| B                  | 9.84                              | 4.09        | 13,887  | 3.6          | 1.97 | 0.30 | .....                          | 0.03             | 0.05                          | 0.12            | 2.35           |              |
| 156 A              | 8.93                              | 4.06        | 23,025  | 3.9          | 1.33 | 0.18 | .....                          | 0.05             | 0.06                          | 0.15            | 0.99           | Cultivated   |
| B                  | 12.16                             | 5.24        | 11,687  | 6.8          | 3.56 | 0.51 | .....                          | 0.01             | 0.06                          | 0.15            | 1.90           |              |
| 157 A              | 9.08                              | 3.74        | 27,050  | 3.85         | 0.62 | 0.23 | .....                          | 0.04             | 0.12                          | 0.30            | 1.64           | Virgin       |
| B                  | 9.74                              | 4.11        | 27,975  | 2.80         | 1.36 | 0.16 | .....                          | 0.01             | 0.06                          | 0.15            | 1.03           |              |
| 158 A              | 13.72                             | 7.84        | 410   | 18.6         | 7.16 | 0.81 | .....                          | 0.06             | 0.24                          | 0.60            | 2.03           |              |
| B                  | 13.73                             | 6.78        | 1,280   | 14.35        | 6.08 | 0.74 | .....                          | 0.03             | 0.09                          | 0.22            | 2.14           |              |

Samples were obtained in 1932 and 1933.

## HEMMINGFORD DISTRICT

*Surveyed July 17 to 27, 1935*

Hemmingford village lies about 40 miles south of Montreal and  $2\frac{1}{2}$  miles north of the Canada-United States boundary line. The muck soil areas surveyed in this district lie just east of Hemmingford and altogether consist of about 6,700 acres. The muck is divided into 5 isolated pieces, two of which are only separated by a narrow ridge about 100 yards wide.

The south-western section of the muck soil lies due south of Hemmingford village and crosses the Canadian National Railway tracks. It occupies approximately 1,400 acres. The Petite Montreal River has its beginning in this muck area. There is no cultivated land in this section and almost the entire area is either heavily wooded or cut-over bush with small underbrush. Only a few small sections of swamp meadow were found. The woods are mixed, consisting mainly of elm, cedar, spruce, tamarack, pine, poplar, white birch, elder and willow.

The muck in this section is medium well decomposed in the surface layer. Only along the northern side of the area is the decomposition fairly good. The undecomposed remains are chiefly carex, sphagnum moss and wood. The drainage in this section is very poor and in many places the water table was found to be near the surface. The depth of the muck is not very great. In most cases it varies between 2 feet and 4 feet and but seldom exceeds 5 feet. The underlying mineral soil is sandy clay, while the surrounding ridges are more loamy and are rich in lime. A considerable amount of limestone and of calciferous sandstone was found on the ridges.

The second, central, section consists of about 1,000 acres. More than half of this area is under cultivation and is fairly well decomposed muck. It is chiefly wood and carex remains. The remainder is covered with mixed woods and here the muck is but medium well decomposed. The wooded section is very poorly drained, while the cultivated land is fairly well drained. According to the settlers in the district and from all appearances, the entire area was burned over about 25 years ago. In some places where the burning has been very severe or of more recent date, poorly decomposed peat is found below the surface 6 to 10 inches. Large sections surrounding the muck have been burned off to about 4 to 6 inches from the mineral soil, and these were not mapped. The depth of the muck in most cases is 2 to 3 feet and seldom reaches 5 feet. The underlying mineral soil is in most cases sandy clay. In many cases a layer of sedimentary muck, one to four inches thick, was found just above the mineral soil. This sedimentary muck varies in colour from greenish to reddish brown and has the consistency of jelly when wet. When dry it is quite hard and peels off in thin layers.

The third, south-eastern, section comprises about 1,800 acres. About 150 acres in the extreme south-east corner are under cultivation, while the remainder is in woods or swamp meadow. The drainage of this area is very poor and in many places stagnant water was found standing on the surface. Even the cultivated section is not well drained.

The muck under cultivation is very well decomposed in the surface 2 feet with some wood remains present. The remainder of the muck is only medium well decomposed, with carex and other sedges as dominant remains. The depth of the muck varies from 4 to 8 feet in the central and southern parts, but is quite shallow, 2 to 3 feet, along the northern side. The underlying mineral soil is clay loam.

The two areas in the northeast corner of the district occupy about 2,400 to 2,500 acres. The larger part of these areas (approximately 1,800 acres), consists of fairly well decomposed muck in the surface layer, most of which is under cultivation. Most of the medium well decomposed muck is in woods or

cut-over bush. The drainage in this soil is very poor. Evidence of severe burning many years ago is noticed almost over the entire area. This has reduced the depth of the muck considerably in many places. The depth in most places varies between 2 and 4 feet, although it reaches 6 feet in some places. The underlying mineral soil is similar to that of the other areas in the district.

From the chemical analyses in the accompanying table it is seen that all the samples taken in this area are slightly acid in reaction. The surface soils vary in reaction from pH 5.5 to pH 6.7. The lime requirement is comparatively low and only three of the samples have a relative lime requirement of over two tons of CaO per acre.

The total ash content varies from 6 per cent to 21 per cent, indicating that the muck is fairly well decomposed. Top burning many years ago may, in some cases, be responsible for some of the high values of total ash.

All samples are exceedingly high in lime and magnesium. This is probably due to the abundance of lime in the surrounding mineral soil. The potash content of all samples is very low, which is characteristic of all muck soils so far analysed in Quebec. The  $P_2O_5$  content of all samples is reasonably high and ranges from 0.206 per cent to 0.45 per cent. The sulphur varies from 0.7 per cent to 4.9 per cent, expressed as  $SO_3$ . There does not seem to be a close relationship between the sulphur content and the degree of decomposition of the muck.

TABLE XII  
CHEMICAL ANALYSIS OF MUCK SOIL SAMPLES FROM HEMMINGFORD AREA.

Oven Dry Basis

A = Surface 12" of soil. B = Subsoil 12-24" deep

| Sample No. | Hygroscopic moisture | pH value | Lime requirement<br>lb. CaO per acre | Total ash | CaO   | MgO  | Mn <sub>2</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes |
|------------|----------------------|----------|--------------------------------------|-----------|-------|------|--------------------------------|------------------|-------------------------------|-----------------|----------------|-------------|
| 1 A        | 16.77                | 6.09     |                                      | 360       | 14.61 | 6.91 | 1.39                           | 0.067            | 0.077                         | 0.307           | 1.855          | 2.11        |
| 1 B        | 15.33                | 5.74     |                                      | 4,720     | 14.09 | 5.56 | 1.23                           | 0.026            | 0.093                         | 0.329           | 3.792          | 2.28        |
| 2 A        | 15.85                | 6.06     |                                      | 1,450     | 12.08 | 6.00 | 1.07                           | 0.057            | 0.084                         | 0.452           | 1.550          | 2.36        |
| 2 B        | 22.53                | 6.46     |                                      | 540       | 12.82 | 5.03 | 1.34                           | 0.044            | 0.062                         | 0.295           | 2.063          | 2.22        |
| 3 A        | 14.72                | 6.09     |                                      | 910       | 21.76 | 8.54 | 1.13                           | 0.103            | 0.100                         | 0.376           | 4.082          | 2.08        |
| 3 B        | 13.76                | 4.50     |                                      | 13,790    | 10.66 | 3.65 | 0.85                           | 0.015            | 0.045                         | 0.227           | 4.970          | 2.24        |
| 4 A        | 14.23                | 5.58     |                                      | 6,170     | 11.18 | 4.90 | 1.15                           | 0.006            | 0.055                         | 0.384           | 0.728          | 1.68        |
| 4 B        | 13.4                 | 5.29     |                                      | 10,890    | 6.01  | 2.75 | 0.75                           | trace            | 0.034                         | 0.327           | 0.724          | 1.35        |
| 5 A        | 15.65                | 6.76     |                                      | 180       | 19.44 | 8.00 | 1.01                           | 0.077            | 0.120                         | 0.450           | 1.854          | 1.93        |
| 5 B        | 15.23                | 5.94     |                                      | 2,180     | 17.57 | 5.12 | 1.06                           | 0.027            | 0.070                         | 0.218           | 2.840          | 2.64        |
| 6 A        | 13.8                 | 5.56     |                                      | 4,350     | 16.09 | 5.10 | 1.21                           | 0.041            | 0.103                         | 0.408           | 2.285          | 2.88        |
| 6 B        | 14.76                | 5.06     |                                      | 8,790     | 16.45 | 4.88 | 0.86                           | 0.026            | 0.130                         | 0.241           | 4.621          | 2.62        |
| 7 A        | 18.0                 | 6.19     |                                      | 1,810     | 16.81 | 7.70 | 1.20                           | 0.010            | 0.082                         | 0.363           | 1.415          | 2.93        |
| 7 B        | 14.9                 | 6.00     |                                      | 3,630     | 9.41  | 5.12 | 0.91                           | 0.008            | 0.035                         | 0.206           | 2.252          | 2.72        |
| 8 A        | 14.7                 | 5.95     |                                      | 1,810     | 14.97 | 6.73 | 0.99                           | 0.078            | 0.127                         | 0.344           | 2.667          | 2.90        |
| 8 B        | 14.37                | 5.72     |                                      | 4,720     | 11.79 | 5.33 | 0.81                           | 0.039            | 0.074                         | 0.232           | 3.678          | 2.82        |
| 9 A        | 15.94                | 5.74     |                                      | 5,800     | 17.80 | 6.31 | 1.00                           | 0.128            | 0.117                         | 0.305           | 3.215          | 2.21        |
| 9 B        | 15.15                | 5.02     |                                      | 9,800     | 10.79 | 3.71 | 0.64                           | 0.032            | 0.083                         | 0.231           | 3.005          | 2.57        |
| 10 A       | 18.99                | 6.52     |                                      | 1,810     | 16.60 | 7.49 | 1.05                           | 0.026            | 0.100                         | 0.370           | 1.195          | 2.38        |
| 10 B       | 18.26                | 6.62     |                                      | 1,450     | 14.78 | 7.96 | 1.06                           | 0.013            | 0.059                         | 0.253           | 1.538          | 2.17        |
| 11 A       | 17.47                | 6.22     |                                      | 2,180     | 12.29 | 8.18 | 0.92                           | 0.013            | 0.058                         | 0.364           | 1.317          | 2.24        |
| 11 B       | 18.52                | 6.44     |                                      | 2,610     | 13.97 | 8.78 | 1.04                           | trace            | 0.049                         | 0.258           | 1.427          | 1.89        |
| 12 A       | 17.91                | 6.03     |                                      | 2,180     | 9.75  | 7.95 | 0.90                           | 0.036            | 0.057                         | 0.266           | 0.827          | 2.47        |
| 12 B       | 17.8                 | 6.09     |                                      | 3,260     | 9.99  | 6.78 | 0.97                           | 0.014            | 0.041                         | 0.238           | 1.105          | 1.87        |

## ST. BLAISE AREA

Surveyed July 28 to August 2, 1935

The St. Blaise peat area lies about 28 miles south of Montreal and consists of about 4,200 acres. It is situated east of Napierville, north of St. Valentin and west of St. Blaise villages. Roads lead all around this area but do not quite touch it. The elevation of the surrounding mineral soil is about 175 feet above sea level, and the entire area is saucer-shaped, with a small stagnant lake in the centre.

The larger part of this area is wooded, or has been top burned during recent dry years and this latter burned section is covered with small shrubs 4 feet to 6 feet high. The only cultivated land was found in the northwestern and southwestern corners. It consists of about 600 to 700 acres. The crops grown in 1935 were chiefly oats and hay, while potato fields were but seldom seen.

The cultivated muck soil in this area is fairly well decomposed in the surface layer. The largest part in the centre of the area consists of acid raw moss and carex peat, which is surrounded by somewhat better decomposed peat. The drainage of the entire area, with the exception of the cultivated soil, is very poor. This has restricted the burning of the peat. At the time of the survey a big dredge was being used to dig a canal, which it is hoped will drain the entire area. As soon as the peat has been dried sufficiently the farmers intend to burn it off to the underlying mineral soil. The depth of the peat over the larger part of the area varies from 5 to 6 feet. Towards the edges the depth is less than 5 feet in most cases and the cultivated black muck hardly ever exceeds a depth of 4 feet. The muck in the northwestern corner of the area is underlain by sandy clay and blue boulder clay. The larger part of the organic deposit is underlain by sandy loam soil. The ridges of the surrounding mineral soil are slightly rising and the soil varies from sandy loam to loam. Some limestone and calcareous sandstone rocks occur in the southwestern corner of this area.

The chemical analysis shows that all the samples of soil obtained from this area are very acid. This is, without doubt, the most acid area surveyed in this part of the province. The only two samples with a pH value of 5.0 or more were taken from the well decomposed muck. The lime requirement of the soils is correspondingly high. Some of the more acid soils have a lime requirement as high as 12 and 13 tons of CaO per acre.

The low total ash content of all samples except Nos. 13 and 16 reveals very clearly the poor state of decomposition of the peat, in spite of the fact that surface burning has been practised. The lime content of all samples, except Nos. 13 and 14 from the well decomposed muck, is very low. The magnesium content varies in these soils from 0.38 per cent to 0.68 per cent MgO independently of the general quality of the soil.

Potash and manganese are very low in all samples from this area, while the  $P_2O_5$  and  $SO_3$  contents are somewhat higher in the better decomposed samples than in the poorly decomposed samples. The nitrogen content of all samples is fairly high and nitrogen also is found to be slightly higher in samples 13 and 16 from the well decomposed soils.

In this area, as is true in other similar areas, the farmers will be well advised not to burn the last foot or so of organic soil, which should rather be cropped and gradually incorporated with the clay, loam or sandy loam mineral soils beneath.

TABLE XIII  
CHEMICAL ANALYSIS OF MUCK SOIL SAMPLES FROM ST. BLAISE AREA

Oven Dry Basis

A=Surface 12" of soil. B=Subsoil 12-24" deep

| Sample No. | Hygroscopic moisture | pH value | Lime requirement<br>lb. CaO per acre | Total ash | CaO  | MgO  | Mn <sub>2</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes  |   |
|------------|----------------------|----------|--------------------------------------|-----------|------|------|--------------------------------|------------------|-------------------------------|-----------------|----------------|--|---|
|            |                      |          |                                      |           |      |      |                                |                  |                               |                 |                | %  | % |
| 13 A       | 12.94                | 5.60     | 3,990                                | 21.73     | 3.89 | 0.46 | 0.072                          | 0.110            | 0.481                         | 1.407           | 2.15           | Open old meadow. Black, fairly well decomposed to depth of 20". Wood and carex remains.        |   |
| 13 B       | 12.02                | 4.97     | 8,640                                | 9.25      | 3.82 | 0.58 | 0.038                          | 0.074            | 0.198                         | 2.048           | 1.83           | Decomposition medium at 20-36" and poor at 36-48". Blue clay at 50".                           |   |
| 14 A       | 11.80                | 4.17     | 24,670                               | 5.11      | 1.75 | 0.55 | 0.007                          | 0.056            | 0.260                         | 1.141           | 1.43           | Near edge of bush (birch). Dark brown, medium decomposed. Wood and carex remains.              |   |
| 14 B       | 11.60                | 3.99     | 25,041                               | 4.55      | 1.65 | 0.38 | trace                          | 0.043            | 0.173                         | 1.190           | 1.20           | Decomposition poor. Carex and moss remains. Depth 5'. Underlain by sand.                       |   |
| 15 A       | 11.73                | 3.82     | 20,680                               | 5.96      | 1.47 | 0.66 | 0.011                          | 0.079            | 0.320                         | 0.780           | 1.62           | Burned over bush. At present poplar and birch bushes 3' high. Decomposition poor to 3' depth.  |   |
| 15 B       | 13.43                | 4.63     | 11,610                               | 4.96      | 2.34 | 0.46 | 0.007                          | 0.067            | 0.591                         | 0.733           | 1.99           | Decomposition below 3' depth slightly better. Carex, sphagnum and cotton-grass. Depth 8'.      |   |
| 16 A       | 12.84                | 5.06     | 6,170                                | 14.39     | 3.22 | 0.47 | 0.034                          | 0.085            | 0.418                         | 2.942           | 2.18           | Hay meadow. Well decomposed black muck. Wood remains.  |   |
| 16 B       | 13.27                | 4.43     | 9,800                                | 12.41     | 3.72 | 0.62 | 0.026                          | 0.150            | 0.302                         | 4.670           | 2.34           | Poorly to medium decomposed. Moss and sedge remains. Depth 4'. Underlain by blue clay.         |   |
| 17 A       | 12.82                | 3.56     | 24,310                               | 4.34      | 0.97 | 0.57 | 0.006                          | 0.066            | 0.311                         | 0.910           | 2.01           | Raw peat bog, birch, blueberry, cranberry, Labrador tea and sphagnum moss dominant vegetation. |   |
| 17 B       | 11.97                | 3.50     | 19,860                               | 2.66      | 0.95 | 0.44 | trace                          | 0.057            | 0.136                         | 0.895           | 1.76           | Reddish moss and carex peat. Very wet. Depth 10'.  |   |
| 18 A       | 12.56                | 3.72     | 17,780                               | 3.17      | 0.65 | 0.39 | 0.005                          | 0.029            | 0.224                         | 0.596           | 1.51           | Taken in bush (birch, poplar). Decomposition medium. Drainage poor.                            |   |
| 18 B       | 12.15                | 3.72     | 22,130                               | 2.64      | 0.67 | 0.55 | trace                          | 0.064            | 0.112                         | 0.554           | 1.56           | Decomposition poor. Depth 4'.  |   |
| 19 A       | 12.42                | 3.62     | 26,850                               | 4.40      | 1.12 | 0.44 | 0.005                          | 0.066            | 0.155                         | 0.842           | 1.62           | Burned over bush (birch and spiraea). Decomposition poor. Top burned.                          |   |
| 19 B       | 11.27                | 3.81     | 23,220                               | 4.61      | 1.30 | 0.68 | trace                          | 0.042            | 0.184                         | 3.280           | 1.57           | Decomposition poor. Depth over 9'. Moss and carex remains.                                     |   |

## ST. ISIDORE AREA

Surveyed July 25 to 28, 1934

The St. Isidore area lies about 20 to 25 miles in a southerly direction from the Honoré Mercier Bridge at Caughnawaga. The village of St. Isidore is 4 miles due north of the muck. This section comprises an area of about 3,000 acres and is situated partly in Laprairie county, partly in Napierville county and partly in Chateauguay county, chiefly in Laprairie.

The elevation is between 150 to 175 feet above mean sea level with a gradual slope to the north and northwest. The drainage in the whole area seems to be fairly good. On the southeastern and southern sides it is bounded by sharp rising ridges consisting of drift material with numerous sandstone and some limestone boulders. On the northern and northwestern sides gently rising loam and sandy clay ridges enclose the muck area. The underlying mineral soil on the northern side consists of sandy clay varying to heavy clay, while on the southern side it is more loamy, with, in places, considerable sand and rocks mixed in.

On the northeastern side the muck is very well decomposed and black in the surface layer (2 feet) while below 2 feet it is poorly decomposed, with raw peat at 4 feet deep. The reaction here is around pH 6.0. From the northwestern side and towards the centre of the area the decomposition is very poor and in the centre raw peat was found right at the surface. The raw peat covers an area of 300 to 400 acres. The reaction of this poorly decomposed organic material is very acid (pH 4.0 to 5.0). Along the southern side the muck is medium to well decomposed in the surface layer and the reaction varies between pH 5.0 and 6.0. The depth of the muck on the north and northeast sides is not very great, seldom extending to over 4 feet. In the centre and on the southern side the depth is quite great, often more than 8 feet.

A considerable amount of burning has been practised on the northeastern and northern sides of this area. Large areas have been burned down to the clay leaving small isolated patches of muck. Over one-half (1,600 to 1,700 acres) of this area is still in woods, while the remainder is under cultivation or in permanent pastures. The woods consist chiefly of white birch, poplar, red maple, ash, alder, spiraea, willow and raspberry bushes. A large part (at least one-half) of the cultivated area is devoted to potato growing. Some of the potato fields were found to be quite acid and in poorly decomposed, brown peat, but the crops seemed to be thriving very well. A little scab was found on the potatoes in the very acid raw areas as well as in the well decomposed sections.

From the data showing analytical results for samples from this area it is seen that the muck soil in this St. Isidore district is quite acid. Three samples taken from the poorly decomposed part have a pH value less than 5.0, while the samples from the better decomposed areas vary between pH values 5.5 and 6.5. The lime requirement in the acid samples is very great (over 15,000 lbs. CaO per acre), while in the less acid soils it varies from  $\frac{1}{2}$  ton to 3 tons of CaO per acre. The acid samples have a low total ash content, indicating poor decomposition of the organic debris. The calcium supply in these samples is very good except in the three acid samples, where the lime content is relatively low.

The potash, magnesium and manganese contents of all the samples from this area are very low. This is especially so in the case of the potash.

All except two of the very acid samples are comparatively well supplied with phosphorus. The  $P_2O_5$  content in the soils that are better in this regard varies between 0.44 per cent and 1.2 per cent.

The sulphur content of the muck soil samples from this area is somewhat lower than in the other areas in this locality, while the nitrogen content is of the same order as that of the St. Edouard and St. Philippe areas.

TABLE XIV  
CHEMICAL ANALYSIS OF SAMPLES FROM ST. ISIDORE AREA. A=Surface 12" of soil. B=Subsoil 12-24" deep

Oven Dry Basis

| Sample No. | Hygroscopic moisture | pH value | Lime requirement lb. CaO per acre | Total ash | CaO  | MgO  | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes   |
|------------|----------------------|----------|-----------------------------------|-----------|------|------|--------------------------------|------------------|-------------------------------|-----------------|----------------|---|
|            | %                    |          |                                   | %         | %    | %    | %                              | %                | %                             | %               | %              |   |
| 37 A       | 14.92                | 4.30     | 17,204                            | 7.55      | 3.10 | 0.35 | trace                          | 0.044            | 0.33                          | 0.48            | 1.81           | Woods (birch, poplar, red maple, blueberry). Decomposition medium.                |
| B          | 15.68                | 4.58     | 17,472                            | 7.44      | 3.63 | 0.22 | trace                          | 0.056            | 0.56                          | 0.48            | 1.60           | Decomposition medium to poor. Below 3' raw peat. Depth 8'.                        |
| 38 A       | 15.00                | 5.50     | 5,913                             | 12.33     | 5.30 | 0.42 | 0.065                          | 0.058            | 0.44                          | 0.4             | 2.07           | Woods (birch, alder, poplar, willow). Decomposition good. Dark brown muck.        |
| B          | 17.01                | 5.44     | 8,064                             | 12.31     | 5.50 | 0.35 | 0.049                          | 0.058            | 0.19                          | 0.98            | 1.74           | Decomposition good. Wood remains. Watertable at 3'. Drainage poor.                |
| 39 A       | 15.83                | 5.98     | 2,419                             | 19.08     | 6.50 | 0.29 | 0.150                          | 0.101            | 0.90                          | 1.04            | 2.11           | Old pasture. Decomposition good. Muck dark brown. Drainage good.                  |
| B          | 16.23                | 5.36     | 3,064                             | 12.65     | 7.00 | 0.27 | 0.048                          | 0.056            | 0.20                          | 0.85            | 2.27           | Decomposition good. Depth 3'.   |
| 40 A       | 12.87                | 3.50     | 24,730                            | 11.85     | 2.64 | 0.40 | 0.029                          | 0.114            | 0.36                          | 0.65            | 1.68           | Bush (birch, red maple, cedar, raspberries). Raw, undecomposed moss peat.         |
| B          | 13.56                | 3.95     | 27,956                            | 6.60      | 2.91 | 0.34 | 0.007                          | 0.042            | 0.16                          | 1.16            | 1.81           | Raw, undecomposed peat. Depth 4'.   |
| 41 A       | 14.97                | 6.06     | 2,957                             | 17.42     | 7.12 | 0.53 | 0.127                          | 0.122            | 0.89                          | 1.46            | 2.32           | Old pasture. Decomposition good. Drainage good.                                   |
| B          | 13.71                | 5.32     | 8,871                             | 12.02     | 4.33 | 0.27 | 0.035                          | 0.047            | 1.16                          | 2.36            | 2.50           | Decomposition medium; below 3' carex peat. Depth over 4'.                         |
| 42 A       | 16.03                | 6.18     | 3,064                             | 11.08     | 3.37 | 0.22 | 0.072                          | 0.081            | 1.09                          | 0.70            | 1.85           | Old pasture. Decomposition good.  |
| B          | 14.26                | 6.14     | 4,838                             | 8.84      | 6.34 | 0.58 | 0.029                          | 0.020            | 1.15                          | 0.83            | 2.58           | Decomposition medium. Carex and moss remains. Depth over 5'.                      |
| 43 A       | 16.44                | 6.52     | 1,344                             | 21.14     | 9.46 | 0.58 | 0.147                          | 0.051            | 1.20                          | 1.03            | 1.81           | Cleared, uncultivated land. Decomposition good.                                   |
| B          | 15.65                | 5.80     | 3,064                             | 13.47     | 6.80 | 0.30 | 0.036                          | 0.030            | 0.62                          | 1.42            | 1.99           | Decomposition medium. Carex and moss remains. Depth over 5'.                      |
| 44 A       | 11.59                | 4.37     | 24,193                            | 4.90      | 1.55 | 0.21 | trace                          | 0.036            | 0.75                          | 0.36            | 1.32           | Bush (birch, red maple, blueberries). Decomposition poor, carex and moss remains. |
| B          | 14.10                | 4.33     | 34,139                            | 4.70      | 2.02 | 0.11 | trace                          | 0.020            | 0.8                           | 0.57            | 1.48           | Raw carex and moss peat. Indications of burning. Depth 6'.                        |

## ST. EDOUARD AREA

Surveyed July 22 to 25, 1934

The St. Edouard muck area comprises about 2,800 acres and lies approximately 25 miles south of the Montreal Cartier bridge, in Napierville county. The village of St. Edouard is situated 1½ miles northeast and the village of St. Michel 1½ miles northwest of the muck area.

The elevations at which the muck is found are less than 200 feet above sea level. On the eastern and northern side the muck is surrounded by gently sloping shore lines, the mineral soil of which is sandstone drift with only a few pieces of sandstone rock scattered around. On the northern and western sides the muck is bordered by fairly steep ridges with numerous tongues of black soil extending between the ridges. Numerous calcareous sandstone and some limestone fragments litter the ridges. The underlying material consists of a fine silty drift, with, in some cases, a little sand mixed in.

The drainage on the outer edges of cleared land is good, but in the central section and along the northwest arm the drainage is rather poor. The La Tortue river has its beginning in the centre of this muck and flows through its eastern arm. Here the drainage of the muck land is somewhat better.

The muck in the surface layer (1 to 2 feet) in the eastern part of the area and along the edges in the western part is very well decomposed. It has been formed chiefly from carex and wood remains. The subsoil in these sections is only medium to poorly decomposed. The reaction of the well decomposed muck is acid (pH 5·0 to 6·0). The larger part of the western side (approximately 1,000 acres) consists of very poorly decomposed peat and raw moss peat. The reaction of this material is very acid (around pH 4·0). The peat consists chiefly of sphagnum moss and carex remains.

Very little burning has been done in this area. Small burned patches were encountered on the eastern and northeastern edges.

The depth of the muck and peat varies considerably. Near the outer edges it is only 1½ feet deep. But the depth increases rather rapidly away from the ridges. In most of the cultivated fields the muck varies from 3 to 5 feet in depth. Towards the centre in the raw peat areas the depth of the organic deposit extends to 6 feet and in some instances to 8 feet and more.

At least one-half or more of the entire area is still in woods. The dominant trees on the medium and well decomposed muck are white birch, willow, with same alder bushes, Virginia creeper and raspberries for underbrush. In the more acid peaty sections sphagnum moss, blueberries and laurel form a thick undercover.

Approximately 1,200 to 1,400 acres of the muck soil in this area are under cultivation or permanent pasture. The pastures generally were in a poor condition. At least one-half of the cultivated land was in potatoes, while the remainder was in oats and hay. The potato crops were mainly grown on the eastern and northern sides. The crops looked very well at the time of the survey. Some potato fields were slightly infected with scab, while others were clean.

Very little commercial fertilizer has been used in this area and barnyard manure has been applied to the potato fields in many instances.

The soil in the St. Edouard area is quite acid. Half of the surface soil samples from this area, as seen in the table, have a pH value below 5·0 and the highest value of all the samples is only pH 6·09. The lime requirement of these soils is very great, only three surface samples showing a lime requirement of less than 5,000 pounds of CaO per acre.

The low total ash content in most of the subsoils and in three of the surface soils indicates a poor state of decomposition of the muck, which is in close agreement with the field observations. The high total ash content in the subsoil of sample No. 31 coincides with a shallow soil, and here clay has been mixed in with the muck sample.

The lime content in the samples from this area is low in comparison with other areas. The potash is remarkably low in all samples except No. 31 B, which is mixed with mineral soil. The manganese oxide content is also very low and varies from 0·0 to 0·035 per cent. The magnesium oxide content varies from 0·26 per cent to 0·93 per cent. Sample No. 31 is very low in total  $P_2O_5$ , while all other samples seem to be fairly well supplied with phosphorus. There is an abundance of nitrogen in all samples. The sulphur content of sample No. 31 is extremely high (4·65 per cent), while the other samples vary from 0·99 per cent to 2·001 per cent  $SO_3$ .

TABLE XV

CHEMICAL ANALYSIS OF MUCK SOIL SAMPLES FROM ST. EDOUARD AREA—A=Surface 12" of soil—B=Subsoil 12-24" deep

Oven Dry Basis—

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| Sample No. | Hygroscopic moisture | pH value | Lime requirement lb. CaO per acre | Total ash | CaO  | MgO   | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes  |
|------------|----------------------|----------|-----------------------------------|-----------|------|-------|--------------------------------|------------------|-------------------------------|-----------------|----------------|--|
|            | %                    |          |                                   | %         | %    | %     | %                              | %                | %                             | %               | %              |  |
| 28 A       | 14.69                | 5.66     | 8,814                             | 9.43      | 4.45 | 0.304 | 0.021                          | 0.08             | 0.44                          | 1.64            | 1.98           | Old pasture. Decomposition medium. Wood remains.                                 |
| B          | 13.40                | 5.22     | 9,989                             | 8.65      | 3.76 | 0.40  | 0.028                          | 0.06             | 0.30                          | 2.01            | 1.75           | Decomposition poor. Carex and moss remains Depth 3'.                             |
| 29 A       | 14.96                | 6.09     | 4,701                             | 12.98     | 3.78 | 0.26  | 0.035                          | 0.08             | 0.82                          | 1.77            | 2.10           | Old pasture. Decomposition good. Wood remains.                                   |
| B          | 15.86                | 5.74     | 7,051                             | 6.70      | 3.68 | 0.68  | 0.029                          | 0.03             | 0.28                          | 1.53            | 1.98           | Decomposition poor to medium. Watertable at 3'. Drainage not very good.          |
| 30 A       | 15.87                | 6.00     | 4,113                             | 11.81     | 4.50 | 0.73  | 0.016                          | 0.07             | 0.45                          | 1.35            | 2.01           | Cleared, uncultivated land. Decomposition good.                                  |
| B          | 14.26                | 5.82     | 6,463                             | 6.56      | 4.10 | 0.56  | 0.017                          | 0.01             | 0.24                          | 1.52            | 1.75           | Decomposition good. Peat at 3'. Depth 4-6'.                                      |
| 31 A       | 15.03                | 4.89     | 14,103                            | 13.61     | 4.37 | 0.78  | 0.025                          | 0.07             | 0.25                          | 4.65            | 2.06           | Uncultivated cleared land. Decomposition medium. Top burned.                     |
| B          | 5.36                 | 5.58     | 2,938                             | 53.13     | 2.58 | 0.93  | 0.022                          | 0.63             | 0.29                          | 5.23            | 1.51           | Decomposition poor. Depth 2-0'.  |
| 32 A       | 11.98                | 4.00     | 29,381                            | 3.33      | 1.96 | 0.44  | trace                          | 0.02             | 0.48                          | 0.99            | 1.49           | Moss peat bog. Vegetation—blueberries, laurel, moss, some birch and maple.       |
| B          | 13.97                | 4.56     | 24,386                            | 4.35      | 2.78 | 0.48  | trace                          | 0.02             | 0.38                          | 1.07            | 1.12           | Raw sphagnum peat. Very deep.  |
| 33 A       | 13.73                | 6.05     | 4,701                             | 12.76     | 4.64 | 0.79  | 0.016                          | 0.07             | 0.67                          | 1.08            | 1.82           | Old pasture. Decomposition good. Muck dark brown.                                |
| B          | 14.13                | 5.26     | 12,340                            | 6.22      | 3.18 | 0.84  | 0.017                          | 0.02             | 0.45                          | 1.04            | 1.43           | Decomposition good. Numerous wood remains. Depth over 4'.                        |
| 34 A       | 11.09                | 3.81     | 28,698                            | 3.33      | 4.25 | 0.53  | 0.012                          | 0.03             | 0.52                          | 1.19            | 1.95           | Bush (birch, willow, blueberries, alder). Poorly decomposed carex and moss peat. |
| B          | 11.18                | 3.65     | 26,443                            | 3.26      | 2.25 | 0.66  | 0.0                            | 0.03             | 0.46                          | 1.26            | 1.58           | Raw moss and carex peat. Drainage poor. Depth over 8'.                           |
| 35 A       | 11.41                | 4.22     | 26,443                            | 6.80      | 0.36 | 0.61  | 0.005                          | 0.06             | 0.51                          | 1.25            | 1.64           | Old pasture. Decomposition medium, muck greyish brown.                           |
| B          | 15.64                | 5.13     | 14,397                            | 8.38      | 1.12 | 0.60  | 0.012                          | 0.02             | 0.48                          | 1.31            | 1.59           | Decomposition medium. Wood remains. Ashes mixed in. Depth over 4'.               |

## ST. PHILIPPE DE LAPRAIRIE AREA

Surveyed July 9 to 12, 1934

This muck area is located about 12 miles south of the Victoria Jubilee bridge, across the St. Lawrence, in the county of Laprairie. The village of St. Philippe de Laprairie is just 3 miles north of this muck area and highway No. 9 passes within  $\frac{1}{2}$  mile of the eastern edge of the muck. The size of this area is about 1,000 acres. The muck here is found at an elevation between 125 and 150 feet above mean sea level, with a general slope to the northeast. The entire area seems to be relatively well drained.

The underlying material consists of bluish-grey clay, very sticky when wet, and stony hard when dry. It is similar in nature to the Laprairie clay used for brick manufacturing. The mineral soil towards the north and east of the muck consists of heavy clay, slightly acid in reaction, while just west of the muck, along the 150-foot contour line, the mineral soil consists of sandy loam, littered with limestone and sandstone rocks and boulders. The soluble mineral nutrients from this higher located soil on the ridge wash down into the muck. The effect of this influx of minerals is more noticeable on the western than on the eastern side of the area.

From all appearances, and according to the older settlers in the district, the size of this muck area has been greatly reduced during the last twenty-five years by burning. The burning has been most intensive on the outsides of the area, in some cases as recently as two years ago. This gradual decrease of activity in burning towards the centre of the area has resulted in a very striking appearance of the muck area. There seems to be a slope up towards the centre from the sides to form a knoll and it is 5 to 8 feet higher in elevation in the centre than it is at the outer edges of the muck.

The muck has been formed from sedge grasses and coniferous and deciduous trees. A mixture of these remains is found to a depth of 4 to 5 feet. Below 5 feet carex is found either alone or sometimes with remains of sphagnum moss. The tree remains are mainly birch and pine. The surface one-foot layer is almost invariably well decomposed and is dark brown to black in colour, with some tree remains. From 1 foot deep to  $2\frac{1}{2}$  feet deep the muck is brown in colour and only semi-decomposed, with carex and tree remains present. At greater depths the decomposition is poor and the organic deposit is peaty in nature.

The reaction of the muck varies considerably. Towards the western edge it is neutral in reaction, near the eastern edge it is slightly acid (around pH 6.0) and in the centre quite acid (around pH 5.0).

The depth of the muck varies considerably, from 1 to 2 feet near the outer edges to from 6 to 8 feet in the centre. Most of the muck that is under cultivation at present extends to a depth of 3 to 5 feet.

About 150 acres of land in this area is still in bush. White birch are the dominant trees present with some trembling poplar and willows. About 60 to 80 acres have been cleared of bush but have not yet been brought under cultivation. The remainder of the land, 750 to 880 acres, is under cultivation.

About one-third of the cultivated area was in potatoes in 1934, while the remainder was in hay, oats and buckwheat. The crops seemed to be doing well at the time of the survey, with the exception of crops on several burned areas. The latter were very poor.

Commercial fertilizers have been used only during the last 2 or 3 years. Different farmers have used 3-9-12, 2-8-10, and 4-10-15 mixtures with varying success.

From the data in the table of the chemical analysis of the muck soil samples from the St. Philippe area it is seen that the muck varies from acid to neutral in

reaction. Two of the samples analysed are very acid (below pH 5.0). These samples were obtained from the centre of the area where the drainage is poor and the decomposition somewhat less. The lime requirement varies with the pH value. The lime requirement is, in all samples, greater in the subsoil than in the surface soil.

The total ash content of the muck soils is a reflection of the stage of decomposition and the amount of mineral soil mixed into the muck. It is higher in the surface samples than in the subsoil in all samples from this area. There are no abnormally low or high percentages of total ash in these samples.

The lime content is comparatively good in this area. No abnormally high or low percentages of lime are found in any of the samples.

All samples are deficient in potash and magnesium, while the manganese content varies from a mere trace to 0.38 per cent. The phosphorus content in the two very acid samples is low, while all other samples are fairly high in total phosphorus. All samples are fairly high in total nitrogen and sulphur. The variations in these constituents between the different samples are, however, not very great.

TABLE XVI

CHEMICAL ANALYSIS OF SAMPLES FROM ST. PHILIPPE DE LAPRAIRIE AREA—A=Surface 12" of soil. B=Subsoil 12-24" deep

Oven Dry Basis—

| Sample No. | Hygroscopic moisture | pH value | Lime requirement lb. CaO per acre | Total ash | CaO  | MgO  | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes   |
|------------|----------------------|----------|-----------------------------------|-----------|------|------|--------------------------------|------------------|-------------------------------|-----------------|----------------|---|
|            | %                    |          |                                   | %         | %    | %    | %                              | %                | %                             | %               | %              |   |
| 2 A        | 16.83                | 7.36     | 645                               | 29.33     | 4.1  | 0.16 | 0.38                           | 0.121            | 0.88                          | 1.93            | 1.89           | From unbroken land near edge of potato field. Decomposition good in surface 1'. Surface burned.                     |
| 2 B        | 16.95                | 6.86     | 1,344                             | 18.07     | 2.5  | 0.12 | 0.17                           | 0.134            | 0.82                          | 2.10            | 1.74           | Decomposition medium. Some carex and wood remains. Depth 3'. Drainage good. Underlain by clay—sticky and wet.       |
| 3 A        | 16.33                | 6.00     | 2,496                             | 13.09     | 3.74 | 0.13 | 0.101                          | 0.097            | 0.33                          | 1.89            | 1.62           | Cut over woods. Decomposition good. Surface burned many years ago.  |
| 3 B        | 17.36                | 5.33     | 3,494                             | 12.53     | 4.15 | 0.07 | 0.084                          | 0.062            | 0.59                          | 2.13            | 1.76           | Decomposition medium. Depth over 4'. Water-table at 4'. Earthworms present.   |
| 5 A        | 18.25                | 7.35     | 699                               | 22.88     | 6.42 | 0.12 | 0.24                           | 0.135            | 0.71                          | 2.14            | 2.36           | Old hay meadow. Decomposition good. Surface burned many years ago.  |
| 5 B        | 19.09                | 6.85     | 806                               | 17.15     | 5.00 | 0.13 | 0.139                          | 0.110            | 0.30                          | 1.95            | 2.40           | Decomposition fairly good. Wood remains. Drainage good. Depth 4'.   |
| 6 A        | 17.67                | 6.78     | 3,034                             | 13.88     | 4.52 | 0.07 | 0.11                           | 0.068            | 0.56                          | 1.95            | 1.93           | Cleared, uncultivated land. Decomposition good. Muck black and friable.   |
| 6 B        | 17.95                | 5.72     | 4,408                             | 12.77     | 4.10 | 0.11 | 0.059                          | 0.074            | 0.18                          | 1.83            | 2.06           | Decomposition medium. Carex and wood remains. Depth over 4'. Water-table at 4'.                                     |
| 7 A        | 16.19                | 4.28     | 1,422                             | 12.17     | 4.60 | 0.22 | 0.102                          | 0.071            | 0.23                          | 2.17            | 2.52           | Edge of bush (birch and willow). Decomposition good. Surface burned many years ago.                                 |
| 7 B        | 14.61                | 4.08     | 3,809                             | 9.74      | 3.14 | 0.11 | 0.044                          | 0.081            | 0.14                          | 2.28            | 2.37           | Decomposition medium. Carex and wood remains. Depth over 5'.  |
| 8 A        | 15.80                | 5.81     | 884                               | 24.03     | 6.71 | 0.3  | 0.066                          | 0.128            | 1.41                          | 2.28            | 1.96           | Old pasture. Decomposition good. Surface burned.  |
| 8 B        | 15.17                | 5.50     | 3,463                             | 11.59     | 3.60 | 0.17 | 0.015                          | 0.142            | 0.35                          | 2.50            | 2.19           | Decomposition medium. Depth 3'.   |
| 9 A        | 15.94                | 5.88     | 5,107                             | 11.09     | 3.74 | 0.14 | 0.007                          | 0.068            | 0.86                          | 2.47            | 1.73           | Bush (birch, poplar, willow, raspberry). Decomposition good. Earthworms.  |
| 9 B        | 15.34                | 5.12     | 17,473                            | 9.13      | 3.07 | 0.11 | trace                          | 0.051            | 0.14                          | 2.18            | 1.87           | Decomposition medium. Carex and wood remains. Depth 6'.   |
| 11 A       | 15.84                | 4.85     | 8,840                             | 11.47     | 3.50 | 0.16 | 0.014                          | 0.062            | 0.18                          | 1.77            | 1.93           | Cleared uncultivated land. Decomposition medium. Carex and wood remains. Subsoil—Decomposition poor. Depth over 4'. |
| 11 B       | 16.15                | 4.72     | 12,957                            | 9.17      | 3.08 | 0.11 | 0.034                          | 0.048            | 0.14                          | 1.99            | 1.91           |   |

## MUCK AREAS IN THE VICINITY OF MONTREAL

*Saint Hubert Area*

This muck area is situated about 8 miles east of the Jacques Cartier bridge in Chambly county. The Chambly road passes through the area just east of the village of St. Hubert. The muck covers an area of about 1,000 acres. The elevation at St. Hubert is about 75 feet above mean sea level with a gentle slope to the west. The drainage in this section is good on the cultivated muck land but rather poor in the wooded section. Because of their flat nature, the mineral soils in the district of St. Hubert are as a rule poorly drained.

The underlying parent material is greyish clay, which is very sticky when wet and dries up into hard lumps when ploughed. The muck east of the highway and the western section south of the highway is well decomposed and brownish black in colour in the surface layer and medium decomposed in the subsoil. Most of this section of the muck area is under cultivation. A large section south and west of the road (mainly in bush) is poorly decomposed and very acid. Tree remains and carex are the main plant residues found in the better decomposed muck, while sphagnum moss remains are quite abundant in the poorly decomposed muck. The depth of the muck varies from 6 inches to 6 feet. In general the muck in this area is much shallower than in the other areas south of Montreal. On the extreme western side of the area, about 150 acres of muck varying in depth from 6 inches to 1 foot was mapped as "shallow phase" muck. Most of the muck south of the road varies in depth from 2 to 4 feet, while north and east of the road the muck varies from  $2\frac{1}{2}$  feet to 5 feet in depth.

TABLE XVII  
CHEMICAL ANALYSIS OF MUCK SOIL SAMPLES FROM AREAS IN MONTREAL DISTRICT  
Oven Dry Basis—A = Surface 12" of soil; B = Subsoil 12-24" deep  
ST. HUBERT DE CO. CHAMBLY

| Sample No. | Hygroscopic moisture | pH value | Lime requirement<br>lb. CaO per acre | Total ash | CaO  | MgO   | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes  |
|------------|----------------------|----------|--------------------------------------|-----------|------|-------|--------------------------------|------------------|-------------------------------|-----------------|----------------|--|
| 68 A       | %                    | 4.72     | 11,250                               | 17.65     | 2.78 | 0.127 | 0.028                          | 0.175            | 0.561                         | 1.78            | 1.97           | Old pasture. Decomposition medium. Dry and powdery. Muck dark brown.                                     |
| B          | 10.64                | 4.44     | 21,500                               | 26.87     | 2.16 | 0.173 | 0.029                          | 0.200            | 0.132                         | 3.49            | 2.08           | Decomposition medium. Depth 2-3'.  |
| 69 A       | 13.62                | 6.03     | 3,600                                | 12.03     | 5.56 | 0.131 | 0.021                          | 0.061            | 0.128                         | 1.79            | 2.03           | Bush (willow, alder, poplar, birch, spiraea). Decomposition poor. Very wet.                              |
| (Clay) B   | 1.16                 | 6.53     | 2,700                                | 88.87     | 1.68 | 0.610 | 0.059                          | 0.900            | 0.159                         | 0.27            | 0.28           | Depth 1-5'. Decomposition poor. Water table at 1'. Mineral soil—heavy clay.                              |
| 70 A       | 13.11                | 5.82     | 4,050                                | 11.45     | 4.25 | 0.090 | 0.014                          | 0.064            | 0.210                         | 0.77            | 1.88           | Small bush once cleared; land never cultivated (birch spiraea, poplar, willow). 6" well decomposed muck. |
| B          | 12.44                | 5.51     | 5,550                                | 7.76      | 3.67 | 0.084 | 0.011                          | 0.032            | 0.251                         | 1.50            | 2.15           | Decomposition poor. Carex and moss remains. Depth 2-5'.  |
| 71 A       | 12.37                | 4.76     | 10,700                               | 14.22     | 2.38 | 0.103 | 0.006                          | 0.150            | 0.199                         | 0.76            | 1.62           | Bush (birch, poplar, willow). Decomposition medium to poor.  |
| B          | 11.38                | 4.30     | 18,650                               | 4.33      | 2.98 | 0.072 | trace                          | 0.089            | 0.072                         | 0.70            | 1.49           | Decomposition poor. Carex and moss remains. Depth 3-4'.  |

Burning was practised on the northern and western sides of the area a number of years ago. No signs of recent burning were noticed.

Approximately one-half of the area is still in woods or cut over shrub. The vegetation in the bush consists chiefly of birch, poplar, willow, alder.

The cultivated land is mainly devoted to market gardening. The following crops are successfully grown: Lettuce, onions, celery, carrots, and cabbage. Potatoes are not as extensively grown as in the other muck areas. The muck soils are quite intensively fertilized with barnyard manures. Pig manure and hen manure are used to some extent. Commercial fertilizers are not very much used.

#### *Mount St. Bruno Area*

This area is situated approximately 12 miles northeast of Montreal Jacques Cartier bridge and lies just west of Mount St. Bruno in Chambly and Vercheres counties. The extent of this area is about 1,200 acres. The elevation is less than 100 feet above mean sea level, with a gradual slope to the southwest.

The muck is underlain by heavy clay in most places with some sandy material mixed in at the eastern side.

The organic material is in a poor state of decomposition and consists chiefly of carex and moss remains. Only a small acreage in this section is in a reasonably good state of decomposition. The muck is usually shallow and in most cases badly burned. The larger part of this area is raw sphagnum moss peat of a depth of about 4 feet.

The reaction of the muck and peat is quite acid and ranges in pH value from 4.0 to 5.0 in most places.

The entire area has been burned severely. Large sections on the outer edges have been burned down to the clay. Almost the entire muck area was on fire or had been recently burned at the time of the survey.

The largest part of the area is still in bush or cut over shrub and only about 25 acres are under cultivation. The crops grown are mostly oats and hay. The vegetation in the bush consists chiefly of white birch, poplar, willow, some maple and alder.

#### *St. Léonard de Port Maurice Area*

In the county of Hochelaga, the St. Léonard de Port Maurice area was surveyed. This forms a long stretched-out band. It is only about 25 to 50 yards wide in the narrowest places and about half a mile at the widest point. Its entire length is about 8 miles. From all appearances this has been an old water channel.

The southern edge of this muck area just reaches the Foucher Boulevard; it crosses the Papineau, Montée St. Michel and Pie IX boulevards and Côte St. Michel north-east of the village of St. Léonard de Port Maurice. The entire area comprises 900 to 1,000 acres.

The elevation of this area is less than 125 feet above mean sea level.

The muck is underlain by bluish-grey clay at the southern end. Further north, near Montée St. Michel, the subsoil is more sandy and gravelly, while north of Pie IX boulevard it varies from sandy loam to clay loam. The surrounding mineral soil varies from sandy to clay loam, and is notably rich in lime. Some ridges, near Montée St. Michel and on the northern edge of the area, contain numerous limestone rocks and boulders. There is a limestone quarry near Montée St. Michel, about one-quarter mile distant up the slope from the muck area.

The muck in this area as a whole is in a reasonably well decomposed condition. The surface 1 to 2 feet of soil is very well decomposed, except at the

extreme south-east corner where a small area (about 50 acres) of raw peat was found. The muck subsoil south of Pie IX boulevard is reasonably well decomposed, with some carex and wood remains present. Northeast from that road the subsoil is not so well decomposed and there are moss remains as well as carex and wood. The reaction of the soil south of the Pie IX boulevard is about neutral, while north of that point it varies from slightly acid to very acid (pH value 4·0 to 6·0). The drainage is not very good and certain sections are subjected to flooding; this is especially true of the northern section. The depth of the muck varies considerably. In a section on both sides of the Montée St. Michel boulevard and in another north of Côte St. Michel, the muck has a depth of 4 to 8 feet. In most other places, however, the depth varies between 2 feet and 4 feet. The muck on the narrow connecting strips is very shallow (1 foot to 2 feet) and in some cases is mixed with the underlying subsoil.

TABLE XVIII  
 CHEMICAL ANALYSIS OF MUCK SOIL SAMPLES FROM MONTREAL DISTRICT  
 Oven Dry Basis—A = Surface 12" of soil; B = Subsoil 12"-24" deep  
 ST. LÉONARD DE PORT MAURICE

| Sample No. | Hygroscopic moisture | pH value | Lime requirement<br>lb. CaO per acre | Total ash | CaO  | MgO   | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes   |
|------------|----------------------|----------|--------------------------------------|-----------|------|-------|--------------------------------|------------------|-------------------------------|-----------------|----------------|---|
|            | %                    |          |                                      | %         | %    | %     | %                              | %                | %                             | %               | %              |   |
| 72 A       | 15.24                | 6.42     | 792                                  | 22.90     | 7.26 | 0.115 | trace                          | 0.097            | 0.428                         | 1.505           | 2.18           | Woods (red maple, elm, basswood). Decomposition good. Earthworms present.                       |
| B          | 15.06                | 6.38     | 1,370                                | 13.78     | 6.66 | 0.077 | trace                          | 0.072            | 0.322                         | 2.26            | 2.27           | Decomposition good. Wood remains. Depth 4-5'.   |
| 73 A       | 16.38                | 6.34     | 1,550                                | 14.85     | 8.34 | 0.076 | trace                          | 0.046            | 0.611                         | 1.50            | 1.98           | Small bush (willow, red maple, elm, basswood, cedar). Decomposition good. Muck brown.           |
| B          | 14.77                | 6.53     | 1,840                                | 13.54     | 7.06 | 0.107 | trace                          | 0.034            | 0.262                         | 2.08            | 2.17           | Decomposition good. Depth 2'. Underlain by blue clay.   |
| 74 A       | 17.18                | 6.72     | 1,070                                | 15.99     | 9.22 | 0.147 | 0.029                          | 0.047            | 0.267                         | 1.36            | 1.97           | Bush (poplar, elm, ash, basswood, willow, choke-cherry, sumach, red maple). Decomposition good. |
| B          | 16.02                | 6.75     | 1,370                                | 12.19     | 8.71 | 0.125 | 0.014                          | 0.019            | 0.455                         | 1.61            | 1.69           | Decomposition good. Depth over 3'.  |

Approximately one-quarter of this area is under cultivation, while the remainder of the land is in bush. The bush consists chiefly of cut-over willow and alder bushes, red maple, swamp ash, elm, swamp cedar, yellow birch, poplar and chokecherry. White birch is, in general, absent. The vegetation indicates swamp conditions. Most of the uncleared areas are very poorly drained and the muck in them is almost invariably shallow. The cultivated land represents the best muck soil present in this area. It is, perhaps, more intensively farmed than any other area that was encountered during the survey. Highly specialized market garden crops are mainly grown.

#### *Other areas in the vicinity of Montreal*

A number of other smaller areas are included in the Montreal district. These isolated areas are scattered in the counties of Hochelaga, Jacques Cartier and Laval. Besides the areas surveyed, some others were found, but these were too small to be of any great importance and were, therefore, not surveyed.

In Jacques Cartier county two areas were surveyed, the Côte St. François and Côte St. Rémi areas. The first one of these is the more important and it comprises from 500 to 600 acres. It runs parallel to Côte Vertu and Côte St. François and is about  $3\frac{1}{2}$  miles long. In many places it is quite narrow (200 to 300 yards wide) and reaches one-half mile in width at the widest points. Similarly to the St. Léonard area, it is situated along an old water channel.

The drainage of this area is not very good. The land is subject to periodical flooding and the heavily wooded areas remain wet for a considerable time after each flooding. Only at the places where the muck is widest a better run-off is provided.

The underlying and surrounding mineral soil varies from sandy to sandy clay loam.

The muck is very well decomposed and black in the surface layers, and only a few undecomposed tree remains are left in the soil. It varies from slightly acid to neutral in reaction. The depth varies considerably. In most places it is quite shallow (1 foot to 3 feet deep); only south of the St. François road, where the muck area is at its widest, the depth extends from 5 to 10 feet. Below 3 feet deep, undecomposed carex and moss remains are abundant here.

Approximately 100 to 125 acres of this area are under cultivation. The remainder is in woods or swamp meadow. The woods consist chiefly of red maple, elm, ash, yellow birch, swamp cedar and some white birch. Some of these trees reach enormous size and the muck in these places is usually quite shallow. Where the heavy timber has been cut down, willow bushes and swamp grasses are the dominant vegetation.

Only a small section, approximately 30 acres, of the cultivated land is devoted to intensive market gardening, while the remainder of the cultivated muck soil is under hay and grain crops. This area is within 8 miles of the Montreal city limits.

The Côte St. Rémi area is situated along Côte St. Rémi, half way between Strathmore and Saraguayville. The size of this area is only about 80 acres, most of which is in woods or swamp meadow.

The drainage is poor and the muck is underlain by sandy clay loam. The muck is fairly well decomposed but shallow and acid in reaction (pH value 5.0 to 6.0). It has not been used for market gardening purposes, probably due to the poor drainage and the slight depth.

In Laval county the following areas were surveyed: St. Martin, Petite Côte Ste. Rose, Ste. Rose, Ste. Dorothée and Le Cap. The St. Martin area is largest in size (400 to 500 acres) and the most important. It is situated about 1 mile north of the village of St. Martin and extends about 2 miles east from the Curé Labelle highway.

This area is surrounded by ridges which are rich in limestone and calcareous sandstone. The underlying mineral soil varies from sandy loam to sandy clay loam. Toward the eastern end shell marl was found in several places.

The muck is very well decomposed, black, and slightly acid to neutral in reaction. It varies in depth from 4 feet to 5 feet or more at the wider western end to 1 foot to 2 feet at the eastern end.

The western end seems to be quite well drained, while the eastern end is poorly drained and subjected to flooding. Approximately 150 acres of the muck in this area is intensively cultivated, while the remainder is in woods. The cultivated land is found mainly at the western and northern sides and is the best drained land in the area.

The Petite Côte Ste. Rose area lies about 1 mile north of the St. Martin muck area. It comprises about 250 acres. None of the land in this area is intensively cultivated. It consists mainly of permanent pastures, swamp meadows and willow scrub bush. The underlying mineral soil is very similar to that of the St. Martin area. The muck is well decomposed but very shallow. In most places the depth varies from 1 foot to 2 feet and only towards the eastern end the muck reaches a depth of 3 feet.

The drainage in this area is poor and the land is subjected to flooding during wet periods of the year.

The Ste. Rose area comprises only about 150 acres. It is situated about 2 miles south of the village of Ste. Rose.

The muck here is well decomposed but shallow (2 to 3 feet deep). It is slightly acid in reaction and consists of well decomposed wood and carex remains. Approximately 50 acres of this area is under cultivation, half of which is devoted to garden crops and the other half to hay and grain crops. The remainder of the land is still in woods (red maple, ash, cedar, willow) and is poorly drained.

The Ste. Dorothée area lies on both sides of No. 8 highway between Ste. Dorothée and Plage Laval. It consists only of about 80 acres, all of which is wooded. The muck here is fairly well decomposed, slightly acid in reaction, and 4 to 5 feet deep.

The farmers use the muck from this area as a top-dressing on their mineral soils for the growing of market garden crops and have used it so extensively that in many cases the mineral soils have become black in appearance.

TABLE XIX  
CHEMICAL ANALYSIS OF MUCK SOIL SAMPLES FROM MONTREAL DISTRICT  
Oven Dry Basis—A = Surface 12" of soil; B = Subsoil 12"-24" deep  
ST. MARTIN DE CO. LAVAL

| Sample No. | Hygroscopic moisture | pH value | Lime requirement lb. CaO per acre | Total ash | CaO  | MgO   | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> | Field notes   |
|------------|----------------------|----------|-----------------------------------|-----------|------|-------|--------------------------------|------------------|-------------------------------|-----------------|----------------|---|
| 75 A       | %                    | 6.1      | 2,310                             | 13.90     | 6.03 | 0.132 | 0.013                          | 0.074            | 0.148                         | 1.26            | 1.72           | Woods (red maple, ash, cedar, elm, yellow birch). Decomposition good. Muck black. |
| B          | 15.64                | 6.07     | 2,160                             | 11.39     | 6.58 | 0.147 | 0.007                          | 0.026            | 0.296                         | 1.26            | 1.87           | Decomposition good. Tree remains. Depth over 4.5'. Drainage not very good.        |
| 76 A       | 17.73                | 6.4      | 2,160                             | 15.23     | 8.42 | 0.104 | 0.038                          | 0.143            | 0.296                         | 1.48            | 1.86           | Bush (conifers, maple, elm, basswood, etc.) Decomposition good. No earthworms.    |
| B          | 16.65                | 6.44     | 2,140                             | 13.78     | 7.90 | 0.122 | trace                          | 0.082            | 0.580                         | 3.29            | 1.91           | Decomposition good. Water table 2'. Depth 3'. Marl found $\frac{1}{4}$ mile away. |
| 77 A       | 16.43                | 6.04     | 3,940                             | 14.45     | 5.72 | 0.075 | 0.077                          | 0.131            | 0.260                         | 1.66            | 2.06           | Bush (white birch, balsam, maple, elm, etc.). Decomposition good.                 |
| B          | 15.11                | 6.09     | 2,130                             | 10.97     | 6.41 | 0.150 | 0.026                          | 0.052            | 0.116                         | 1.99            | 2.22           | Decomposition good. Wood remains. Depth 3.6'.                                     |

| ST. FRANÇOIS DE CO. JACQUES CARTIER |       |      |       |       |       |       |       |       |       |      |      |  |
|-------------------------------------|-------|------|-------|-------|-------|-------|-------|-------|-------|------|------|--|
| 83 A                                | 15.44 | 6.63 | 1,690 | 17.01 | 7.17  | 0.145 | 0.032 | 0.253 | 0.333 | 1.88 | 2.40 | Bush (red maple, elm, ash, swamp cedars). Decomposition good. Muck black.        |
| B                                   | 14.82 | 6.72 | 1,585 | 13.66 | 6.52  | 0.146 | 0.035 | 0.131 | 0.333 | 2.31 | 2.34 | Decomposition good. Wood remains. Muck brown. Depth 3-4'. Subject to flooding.   |
| 84 A                                | 17.49 | 6.31 | 2,620 | 13.76 | 8.00  | 0.102 | 0.035 | 0.252 | 0.373 | 1.06 | 1.98 | Bush (red maple, ash, elm, willow, white birch). Decomposition good. Muck black. |
| B                                   | 17.86 | 6.15 | 2,160 | 11.22 | 8.21  | 0.180 | 0.005 | 0.063 | 0.144 | 1.17 | 1.67 | Decomposition good. Wood remains. Muck brown. Depth 3-4'. Drainage poor.         |
| 85 A                                | 17.66 | 6.93 | 1,800 | 17.54 | 10.65 | 0.201 | 0.005 | 0.183 | 0.277 | 1.42 | 1.84 | Cleared uncultivated field. Decomposition good.                                  |
| B                                   | 16.51 | 6.6  | 1,115 | 13.17 | 10.10 | 0.171 | 0.005 | 0.102 | 0.168 | 3.17 | 2.00 | Decomposition good to 3'. Below carex and moss remains. Depth over 8'.           |

The Le Cap and Canton Bélanger areas are situated along No. 11 highway. Le Cap is no more than 50 acres in extent while the Canton Bélanger area is about 100 acres. Both of them are ill-drained.

The first of these areas consists chiefly of swamp meadows, while the other is completely covered with woods. The muck in these two areas is medium well decomposed and very shallow, hardly ever exceeding 3 feet in depth. The Canton Bélanger is the better. At present neither of these areas is fit for cultivation.

#### DISCUSSION OF MUCK AREAS IN THE VICINITY OF MONTREAL

The muck in the St. Hubert area is on the whole very acid. In this muck occurrence the highest pH value of 6.03, was found in a sample of shallow muck soil underlain by heavy clay. The lime requirement varies with the pH value. The pH value of the cultivated and heavily fertilized celery soil is of about the same order as that of the uncultivated muck soil.

From the total ash content it is seen that some mineral soil has been mixed with the muck in the subsoil of sample No. 68 and the subsoil of sample No. 69 consists largely of clay. In the deeper soils the total ash content of the subsoils is low due to poor decomposition.

The lime content of the uncultivated soils is low and has been considerably raised on the cultivated celery soil.

The manganese, magnesium and potash contents are low in the samples from this area, although the latter has been slightly increased on the cultivated soil.

The uncultivated soils are comparatively low in phosphoric acid content, while it has been greatly increased in the intensively cultivated soil.

More sulphur was found to be present in the cultivated soil than in the uncultivated soils.

The nitrogen content of these soils varies between 1.6 per cent and 2.1 per cent.

The muck soil in the St. Léonard area is from slightly acid to neutral in reaction, and the lime requirement is comparatively low. The total ash content varies from 14 per cent to 26 per cent and indicates good decomposition in all cases and, comparatively, freedom from mineral matter. The lime content is very high in all the samples from this area. There is no apparent difference between the intensively cultivated and uncultivated soils in their pH values, lime requirement, total ash and lime contents.

The percentages of MgO, K<sub>2</sub>O and especially of P<sub>2</sub>O<sub>5</sub> have been considerably increased in the cultivated and heavily fertilized soils. The potash, however, is still very deficient in the heavily fertilized soil.

The sulphur in the fertilized soil is slightly higher than in the unfertilized soil but probably not significantly so.

The total nitrogen content is very similar in the cultivated and uncultivated soils and varies between 1.8 per cent and 2.4 per cent.

The St. Martin de Co. Laval and St. François de Jacques Cartier areas are similar to the St. Léonard area in many respects. The soil is slightly acid in these two areas (pH value 6.0 to 6.9) and the lime requirement is comparatively low. The total ash is very much alike in the samples from both areas, in the intensively cultivated as well as in the uncultivated soil, which indicates fairly good decomposition. The CaO content is high in all samples taken in these two areas. It is somewhat higher in the St. François than in the St. Martin area. The magnesium, manganese and potash are low in all samples analysed; however, the potash and magnesia contents in the fertilized soil in the St. Martin area are somewhat greater than in the unfertilized soil. The phosphorus content of the cultivated soils has been very greatly increased by fertilization, while the sulphur and nitrogen content is about the same in the fertilized as in the unfertilized soil.

## GENERAL SUMMARY

The organic soils—peats and mucks—in the southwestern region of Quebec province have been classified, mapped and analysed. This region is bounded on the south by the United States, on the east by the Richelieu river, on the north by the St. Lawrence and Ottawa rivers, and on the west by the St. Lawrence river.

Within any one of the areas discussed in this report there is to be found wide variation in the peat—in its origin, its chemical composition and its existing degree of decomposition. The conditions of drainage, of the extent and severity of top-burning and of present utilization of the soils differ widely.

Not all of the maps that have been prepared are published here, but eight of the main areas are portrayed, with a total acreage in excess of 50,000. Chemical analyses are given of samples from several hundred representative soils, many of which are located clearly on the published maps.

The effect of the mineral soils surrounding and underlying the organic soils is obviously great, and the high lime content of the mucks and peats closely reflects the ease with which lime washes from the higher lands around the organic deposits. The kind of vegetation native to these organic soils appears to be closely related to the soil condition.

The methods of evaluation of muck and peat soils are stated and full discussion is offered. Appendices are added showing the methods followed in field and laboratory and one is given presenting the analysis of a number of organic soils on which celery is grown in the vicinity of Montreal.

About 80% of the muck and peat soils in this region of Quebec are grouped in the southern section of this district, within a circle the radius of which does not exceed 15 miles.

A new sub-station was started in 1935 by the Dominion Experimental Farms on the muck soil of the Sherrington-Ste. Clothilde area near the village of Ste. Clothilde, in Chateauguay county.

## APPENDIX I

### FIELD METHODS USED IN SOIL SURVEY

The muck and peat areas surveyed were isolated occurrences and the procedure used in the field, therefore, varied somewhat from the methods employed in usual survey work, as practised, for example, by the United States Department of Agriculture, where all the soil in a definite political unit (generally a county) is surveyed.

When starting work in a new peat area the first step is the locating of some definite point on or near the organic soil boundary. Beginning from this point the boundary around the muck or peat area is determined. A sighting compass and a Jacob's staff are used. Another arbitrary point is selected on or near the muck or peat soil boundary and the angle which the line between the two points forms with the magnetic north is recorded in a surveyor's field note book. The distance between the two points is paced and the deviations of the muck or peat boundary from a straight line are traced in the note book. With experience, measurement by pacing proves very satisfactory. While one man is handling the compass and pacing the distance between the stations, another man locates the boundaries and indicates what points to select for stations, i.e., points on which to align the compass sights. In order to locate closely the exact boundaries, holes have to be dug quite frequently. Only soils in which the organic deposit is at least  $1\frac{1}{2}$  feet deep are mapped, except in special cases shallower muck soils are mapped as "shallow phase muck."

While the boundaries around the muck and peat areas are being traced, notes are taken describing the nature of the surrounding mineral soil. Special attention is paid to their acidity or alkalinity, to the presence of limestone and calcareous sandstone, and to the texture and slope of the surrounding and underlying mineral soil. After the outside boundary of an area is completely mapped, traverses are made at frequent intervals, crosswise through the area, to study the conditions throughout. During this survey the land under cultivation is marked on the map. Notes on the condition of the crops and the kinds of crops grown are taken.

The type of natural vegetation on the uncultivated land is noted. Holes are dug frequently to examine the state of decomposition of the soils in the organic deposits, the plant origin of the organic matter, whether trees, sedges, sphagnum moss, etc., the occurrence of different well-marked layers in the soil, and the acidity of each of these layers. Spades are used for this work throughout. Extension augers can be used only to measure the depth in case of very deep organic soils and to study the underlying mineral soil. Drainage conditions are observed and the water courses and canals are mapped.

In many cases the well-decomposed muck has been burned off on the surface, leaving some undecomposed peat, with a layer of ash, exposed, or else large deep holes have been burned in the muck. These burned areas are marked on the maps.

The field notes are transferred to maps every evening. In this way the field notes are permanently recorded while all details are fresh in mind. The scale of the maps prepared is four inches to one mile. During this survey military maps, issued by the Department of National Defence, have been freely used to confirm the survey work and these have proved to be valuable. When doubt arises concerning any point, this is checked up before the area is left.

During this survey it has been possible to classify the organic soils into three groups:—

1. The black muck soils.
2. Medium decomposed muck.
3. Raw peat.

(1) The black muck soils consist of friable, well-decomposed organic matter. Wood remains and sedge grasses are the main sources of the organic materials of mucks. Numerous semi-decomposed stumps and roots of coniferous and deciduous trees are invariably found in the black mucks. The depth of the well decomposed layer varies from 1 foot to 3 feet. As a rule they are slightly acid in reaction and are the most productive of the organic soils. Under virgin conditions, red maple, poplar and swamp alder are the dominant tree vegetation.

(2) In the medium decomposed muck and peat, the organic material in a shallow surface layer is in a fairly well decomposed condition. This is not true in the deeper layers of such soils. Sedge grasses, wood remains and sphagnum moss are the sources of the organic matter. When well drained, such soils produce very good crops of potatoes. Under virgin conditions, they are covered with mixed vegetation consisting of white birch, poplar, swamp cedar, black spruce, tamarack, willow, swamp alder and red maple.

(3) The raw peats consist of "raw" undecomposed or poorly decomposed organic matter. Sphagnum moss, cottongrass and some sedges form this peat and but few remains of trees are found to be present. As a rule the peats are very acid and poorly drained and have a covering of sphagnum moss, cottongrass, cranberry, blueberry, Labrador tea, stunted black spruce, etc. None of the really raw peat in the areas surveyed was found to be under cultivation.

#### SAMPLING

Samples for chemical analysis were taken, after completion of survey work, from representative soils throughout the areas. The samples were not taken according to the profile changes, because high water tables often interfered with the sampling process. They were, therefore, taken at standard depths, 0 to 12 inches, and 12 inches to 24 inches. Six holes were dug and about equal amounts of soil from each hole were mixed on a rubber sheet, and from this well-mixed composite sample a representative portion was taken and sent to the laboratory in a two-quart glass sealer.

#### APPENDIX II

#### METHODS OF ANALYSIS OF MUCK AND PEAT SOILS USED BY THE QUEBEC SOIL SURVEY 1934-1935-1936

In the analysis of mucks and peats the ordinary methods of analysis used with mineral soils cannot be employed without modification. As is done in most soils laboratories in North America, fusion methods are used here in determination of total amounts of soil constituents. The great cost of platinum crucibles and dishes, which are necessary in sodium carbonate fusions, apparently still limits the use of fusion methods in some laboratories. The neatness and reproducibility of results that are possible when platinum ware is used make the fusion methods of analysis essential in modern soil survey chemistry laboratories.

Certain features of organic soils render necessary the use of quite different quantities of such soils for analysis than are used in the case of ordinary mineral soils. For example, organic soils are almost always much richer in nitrogen than mineral soils and a smaller-sized sample should be used. On the other hand,

mucks and peats are nearly always very low in their potassium content, so as large-sized samples as possible must be used in analyzing for this element.

Wherever possible, information is given which may be useful to the analyst. This is not intended to be a complete list of methods that can be applied in the analysis of mucks and peats. It includes, however, methods for most of the elements in these soils, of which a knowledge of the amounts present will be useful to the soil surveyor in reaching conclusions as to the relative value or condition of fertility of a muck or peat soil.

Of low specific gravity compared with mineral soils, mucks and peats present interesting water absorption relationships. When thoroughly air-dried they are difficult to wet with water, but the addition of a little alcohol is very effective in increasing their wettability.

In soil survey work, the methods of analysis employed should be those in common use in many laboratories. They should give the total amounts present of the elements under study; they should be known to all workers who may at any time make use of the chemical data obtained as a part of the survey work.

#### PREPARATION OF SAMPLE

The soil samples taken in the field are spread out to dry until the moisture of the sample is in equilibrium with that of the air. The air-dried sample is ground in a Wiley laboratory mill and thoroughly mixed. A representative portion of this sample is then ground in an iron mortar with an iron pestle until it passes through a 50-mesh sieve, and weighed small quantities of this sieved material, after thorough mixing, are analyzed for the total amounts present of  $N_2$ ,  $P_2O_5$ ,  $K_2O$ ,  $CaO$ ,  $MgO$ ,  $SO_3$ ,  $Mn_3O_4$ , for total ash and the hygroscopic moisture. The pH value is determined either on the moist sample direct from the field or on the ground air-dried samples. The "lime requirement" value is determined on the ground air-dried samples.

#### HYGROSCOPIC MOISTURE

Two grams of prepared sample are weighed in duplicate weighed porcelain crucibles. The crucibles with contents are placed in an electric oven, at 100 degrees C., for 24 hours. Constant weight is reached during this time. The dried samples with the crucibles are cooled and weighed. The loss of weight is reported as the percentage of hygroscopic moisture in the air-dried soil. The soil in the crucibles is saved for determination of total ash.

#### TOTAL ASH

The samples in the crucibles are ignited in an electric muffle furnace, slowly at first to drive off fumes and smoke. They are then ignited at 550 to 600 degrees C. until the organic matter is destroyed. Three to four hours or less at 600 degrees C. is usually sufficient to ash the sample completely. Cool and weigh. Report the weight of ash as percentage of total ash on the basis of oven-dried soil.

*Reference:* A.O.A.C. Methods of Analysis, 3rd Edition, 1930, XXVII, 8, p. 278.

#### JONES LIME REQUIREMENT METHOD

The method is based on the assumption that the soil hydrogen ions will be displaced by the cations of a neutral salt. The acids formed may then be titrated against standard alkali solution of suitable strength.

*Determination.*—To 5·6 grams of air-dried soil, add 0·5 grams of recrystallized calcium acetate, mix well with pestle in mortar and add enough water to make a stiff paste. Pestle well, add 30 cc. of distilled water and mix again for

30 seconds. Avoid spattering. Wash into a 200 cc. volumetric flask keeping the volume down to about 160 cc. Let stand 15 minutes, shaking 20 times every 2 minutes.

Make the volume up to 200 cc., shake to mix thoroughly, and filter into 250 cc. beakers or Erlenmeyers, using dry No. 4 Whatman filters. If the first 50 cc. or so of filtrate is cloudy, discard it.

Titrate with N/10 NaOH 50 cc. of clear filtrate, using 2 drops phenolphthalein as indicator.

Multiply the titration result in cc. (corrected for normality) by 4, which gives the number of cc. of 0·1 alkali needed to neutralize the entire 200 cc. This result times the arbitrary factor, 0·9 times 1000, equals the pounds of CaO needed per 1,000,000 pounds of soil.

A calcium acetate blank should always be run. The correction needed for the blank should not exceed 0·2 cc. of 0·1 N. NaOH.

Due to the low specific gravity of muck soils, 1,000,000 pounds is considered as an acre foot of soil, while in mineral soils 2,000,000 pounds is considered as the weight of an acre of soil to plough depth in the calculation of the lime requirement. The factor 0·9 instead of 1·8 is, therefore, used in the calculations.

*Reagents:* Standard N/10 NaOH solution. Recrystallized calcium acetate—[Ca(CH<sub>3</sub>COO)<sub>2</sub>.2H<sub>2</sub>O].

*References:* Jones, C. H., 1913, "Amer. Fertilizer" 39, No. 11, p. 28.  
Carleton, E. A., 1923, "Soil Science," 16, 79-90.

#### CALCIUM (CaO)

Two grams of air-dried material are weighed into a porcelain crucible and ashed as described under total ash. The ash is then fused in platinum crucibles with from 5 to 10 times its weight of anhydrous sodium carbonate. Place the charge in a 30 cc. platinum crucible and heat gently at first. Gradually increase the heat until the bottom of the crucible reaches a bright red, almost white, heat. Fuse until the charge becomes completely fluid. While hot pour the fused charge into a platinum dish which is floating in cold water. Use platinum tipped tongs only to handle the hot platinum crucible. After cooling, place fused mass from dish, the crucible and the cover in a covered 250 cc. beaker, moisten and dissolve in 10 cc. of 1 to 1 HC1. When dissolved, rinse and remove crucible and cover and transfer contents quantitatively to a 100 cc. volumetric flask and make up to volume with distilled water. The sample is mixed and filtered through an acid-washed ashless filter paper (Schleicher and Schull No. 589). A 25 cc. aliquot is pipetted out of the clear solution into a 50 cc. Pyrex centrifuge tube which tapers to a point. Ten drops of a 0·04 per cent solution of dibromocresol purple indicator are added, followed by 10 cc. of a saturated ammonium oxalate solution. The solution is made alkaline with concentrated NH<sub>4</sub>OH and then slightly acid with 1 N. HC1. It is then heated on a steam bath for a few minutes, cooled and the pH value adjusted to 5·8 (light grey colour) with dilute NH<sub>4</sub>OH and HC1 if necessary. The precipitate is allowed to stand overnight or digested on the steam bath for two hours. It is then made up to 40 cc. volume with distilled water and centrifuged at 1,300 r.p.m. for 10 minutes.

The supernatant liquid is saved for the magnesium determination by carefully decanting it off into a 250 cc. beaker. The calcium tube is inverted above the beaker and allowed to drain for about 10 minutes. After draining, any liquid remaining around the edge of the tube is wiped off with a clean dry towel. The precipitate is stirred up with a stream of dilute ammonia water from a wash bottle (2:98) using 40 cc. The tubes with their contents are centrifuged again,

the wash solution decanted off and discarded, and the tubes drained by inverting on filter paper for 10 minutes. After draining, any liquid remaining around the edge of the tube is wiped off as before. The calcium oxalate precipitate is then dissolved by adding 10 cc. of 1 N.  $H_2SO_4$  and heating in boiling water. The titration is carried to the first faint pink colour lasting for 1 minute, with 0.05 N potassium permanganate.

**Calculation:** cc. of  $KMnO_4 \times$  Normality of  $KMnO_4 \times 28$  (as 1 cc. of N  $KMnO_4 = 28$  mg. CaO)  $\times 4$  (for aliquot)  $\times 100$   
divided by weight in milligrams of sample  
= per cent CaO in sample.

This result should be corrected for the hygroscopic moisture content of the air-dried sample.

**Reference:** Morris, Nelson, and Palmer. Industrial and Engineering Chemistry, Analytical Edition, vol. 3, No. 2, April 15, 1931.

**Reagents:**

- Anhydrous sodium carbonate.
- 0.04 per cent bromocresol purple indicator.
- Saturated ammonium oxalate solution.
- 1 N. HCl.
- 1 N.  $H_2SO_4$ .
- HCl conc.
- $NH_4OH$  conc.
- 0.05 N.  $KMnO_4$ .
- $NH_4OH$  2:98.

### MAGNESIUM (MgO)

To the supernatant liquid from the calcium determination add 40 cc. of conc.  $HNO_3$  and evaporate to dryness on steam bath to decompose  $NH_4$  salts. Take up with HCl (1+4) and make to a volume of about 100 cc. with distilled water. Add 5 cc. of a 10 per cent Na-citrate solution and 10 cc. of a 10 per cent  $Na_2HPO_4$  solution or enough to precipitate all the magnesium. Add  $NH_4OH$  (1+4), with constant stirring and allow to stand in a cool place overnight. Filter (Whatman paper No. 42) and wash with  $NH_4OH$  (1+9). Dissolve the precipitate on the filter paper in the same beaker with HCl (1+4) and reprecipitate as before. Allow to stand several hours, or overnight, if possible, in a cool place. Filter, wash free of chlorides with  $NH_4OH$  (1+9), ignite the filter paper, and weigh as  $Mg_2P_2O_7$ . Calculate and report the result as MgO. Duplicates are run on each sample. A blank determination should be run.

**Reagents:** 10 per cent Na-citrate. 10 per cent  $Na_2HPO_4$ .  
 $HNO_3$ . HCl (1+4).  
 $NH_4OH$  (1+4).  $NH_4OH$  (1+9).

**Reference:** A.O.A.C. 3rd Edition, 1930, XII, 13, p. 106.

### POTASSIUM

Mix thoroughly by grinding with an agate pestle in an agate mortar the ash from 4 grams of muck soil ashed at low red heat in a muffle furnace, approximately 1 gram of  $NH_4Cl$  and 10 grams of  $CaCO_3$ . Cover the bottom of a 30 cc. platinum crucible with  $CaCO_3$ , place the charge in the crucible and cover it with  $CaCO_3$ . The charged crucible is then placed over a low flame and heated moderately until the  $NH_4Cl$  is decomposed. (Heat moderately until no odour of  $NH_3$  is detectable). Now increase the flame and heat until the lower part of the crucible is a bright red or almost white, taking care to keep the upper part and cover as cool as possible, never allowing it to reach more than a dull red colour. By using a holed asbestos board to hold the platinum crucible this

is possible. Fuse over the hot flame for 40 minutes. Allow to cool and transfer to a 250 cc. Pyrex beaker by slaking the contents of the crucible with hot water, stirring with a policeman and washing out into the beaker with a stream of boiling water. Allow the fusion to settle in the beaker, decant the supernatant liquid through a filter and work the fusion in the beaker with a policeman until all grit is gone. Transfer the pulverized material to the filter and wash to about 400 millilitres with hot distilled water, or until there is given only a slight test for Cl ion in the filtrate.

Run the filtrate and washings to dryness on the steam bath, take up with hot water and again filter and wash. Evaporate the filtrate to dryness, take up just enough to dissolve with 1:1 HCl, and precipitate the potash from this solution by adding 1 cc. of  $H_2PtCl_6$ . Evaporate to a sirupy consistency, cool and take up with 80 per cent alcohol. When all but the  $K_2PtCl_6$  has gone into solution transfer to a Gooch crucible. Wash thoroughly with 80 per cent alcohol, then wash three times with the  $NH_4Cl$  solution and finally several times again with 80 per cent alcohol, or until all Cl is removed. Dry the crucible and its contents in an electric oven at 100°C. and record the weight of the  $K_2PtCl_6$  precipitate. Report as percentage of  $K_2O$ . Duplicate samples should be run. A blank determination must be run on the reagents used, at the same time as the soil samples.

*Reference:* This is an adaptation of the J. Lawrence Smith method from Bul. 105, Bureau of Chemistry and Soils, U.S.D.A., Washington, D.C.

#### Reagents:

5 per cent Platinic chloride solution.

80 per cent alcohol;  $C_2H_5OH$  sp. gr. 0.864 at 15°C.

Lindo-Gladding wash: Dissolve 100 grams  $NH_4Cl$  in distilled water, make up to 500 cc. and saturate with  $K_2PtCl_6$  by shaking thoroughly. (A few grains of  $K_2PtCl_6$  are enough to saturate the solution.)

#### SULPHUR

Moisten 1 gram of the soil sample with a little ethyl alcohol in a porcelain dish and add 15 cc. of magnesium nitrate solution. Mix sample and  $Mg(NO_3)_2$  solution well; evaporate to dryness and char on an electric hot plate until no further action takes place. Place a watch glass over the dish just as charring commences. Ignite in an electric muffle furnace until the charge is thoroughly oxidized. No black particles should remain. Add enough water to moisten. Add 10 cc. of concentrated HCl and evaporate to dryness. Moisten with water and add 10 cc. concentrated HCl; heat to boiling, filter and wash on a Buchner funnel into a filter flask, using medium suction (No. 3 Whatman filter), transferring the filtrate into a 250 cc. beaker. Heat the filtrate to the boiling point; add drop by drop, 5 cc. of a 10 per cent solution of  $BaCl_2$ . Digest one to two hours on a low heat hot plate, allow to stand over-night or an equivalent length of time. Filter through a No. 42 Whatman filter paper, dry in an electric oven at 100°C., ignite at 600°, and weigh as  $BaSO_4$ . Blank determinations must be made on all reagents used.

Keep the filtrate for the phosphorus determination.

*Reference:* Swanson, C. O., & Latshaw, W.L., Soil Sci. XIV, No. 6, 1922.

*Reagents:*  $Mg(NO_3)_2$ . Dissolve 320 grams of c.p. (low sulphur) calcined magnesia ( $MgO$  "Light," of highest purity) in 1:1 nitric acid. The magnesia ( $MgO$ ) must be in excess. Boil, filter and dilute to 2,000 cc.

Ten per cent  $BaCl_2$  solution.

## PHOSPHORUS

Phosphorus is determined on the filtrate from the sulphur determination. Neutralize the filtrate with  $\text{NH}_4\text{OH}$ ; acidify slightly with  $\text{HNO}_3$ . Evaporate to about 75 cc. Add 5 grams of  $\text{NH}_4\text{NO}_3$ . Raise the temperature to about 55 degrees C. and precipitate the phosphorus with ammonium molybdate solution by adding 20 cc. of this solution with constant stirring until the precipitate begins to form. Digest on a waterbath for 2 hours, stirring several times during this period.

Filter with moderate suction through a No. 2 Whatman filter paper.

Wash the beaker and filter paper very thoroughly with cold distilled water. Now transfer the precipitate (on the filter paper) back to the beaker, wash the funnel over the beaker to remove any traces of yellow precipitate, and add 10-15 cc. of distilled water to the beaker.

Now add enough standard  $\text{NaOH}$  solution to the beaker to dissolve all the precipitate, and then about 5 cc. in excess. Add 4 drops of phenolphthalein indicator and titrate with the standard acid until the last trace of pink colour just disappears.

Record the number of cc. of alkali and acid used. Subtract the cc. of acid from the cc. of alkali used and calculate the per cent phosphorus in the sample as  $\text{P}_2\text{O}_5$  or as P.

*Reference:* Swanson, C.O., and Latshaw, W. L., Soil Sci. XIV, No. 6, 1922.

### Reagents:

#### $\text{NH}_4\text{NO}_3$ crystals.

Ammonium molybdate solution: Dissolve 100 gr. of molybdic acid ( $\text{MoO}_3$ ) in a mixture of 144 cc. of  $\text{NH}_4\text{OH}$  and 271 cc. of  $\text{H}_2\text{O}$ . Pour this solution slowly and with constant stirring into a mixture of 489 cc. of  $\text{HNO}_3$  and 1148 cc. of  $\text{H}_2\text{O}$ . Keep the final mixture in a warm place for several days or until a portion heated to 40 degrees deposits no yellow precipitate of  $\text{NH}_4\text{-phosphomolybdate}$ . Decant the solution from any sediment and preserve in glass-stoppered vessels.

Standard  $\text{NaOH}$ : 0.3238 N. Dilute 323.81 cc. of N. alkali free from carbonates to 1 liter; 100 cc. of this solution should neutralize 32.38 cc. of N. acid. 1 cc. = 1 mg. of  $\text{P}_2\text{O}_5$ .

Standard acid: 0.3238 N. Prepare a solution of  $\text{HCl}$  corresponding in strength to the  $\text{NaOH}$  solution.

## TOTAL NITROGEN

Transfer 2 grams of air dry muck soil into a 500 cc. Kjeldahl flask without letting any adhere to the neck. Add to the sample 5 grams of a mixture of 95 per cent  $\text{K}_2\text{SO}_4$  and 5 per cent  $\text{CuSO}_4$  and mix with the soil. Then add 25 cc. of concentrated  $\text{H}_2\text{SO}_4$  flowing it down the neck of the flask to wash down any adhering dust. Heat the mixture gently until frothing ceases; then boil briskly and continue the digestion for a time after the mixture is colourless or nearly so, or until oxidation is complete. Cool the flask completely and add to its contents 150 cc. of water and shake up. Add a few pieces of granulated zinc to prevent bumping. Add 75 cc. or more concentrated  $\text{NaOH}$  and make sure the contents of the flask are strongly alkaline. Do not shake the flask until connected to the condenser of the distilling apparatus. Distil the ammonia into a 500 cc. Erlenmeyer flask which contains an exactly measured amount (30 cc.) of standard 0.1 N.  $\text{HCl}$ . The end of the distillation tube must extend down into the standard  $\text{HCl}$  solution. When all the  $\text{NH}_3$  has distilled over (the first 125 cc. of the distillate will generally contain all the  $\text{NH}_3$ ), remove the receiving flask and titrate the distillate with standard 0.1 N.  $\text{NaOH}$  solution, using methyl red indicator.

Calculate the percentage of nitrogen in the soil. Run duplicate determinations and also a blank on all reagents used.

Reference: A.O.A.C. 3rd Edition, 1930, II, 24.

*Reagents:*

$H_2SO_4$  concentrated.

$K_2SO_4$  (95 per cent) +  $Cu SO_4$  (5 per cent), fine ground and mixed.  
Granulated zinc.

$NaOH$  concentrated. Dissolve 1000 grams of crude  $NaOH$  in 1000 cc. of water. Cool and pour off supernatant liquid.

Standard  $NaOH$ : 0·1 N.

Standard  $HCl$ : 0·1 N.

NOTE: This Kjeldahl method, while it accounts for a definite fraction of the soil nitrogen and gives reproducible results, does not permit the determination of the nitrogen in such ring structures as pyridine and quinoline, nor that of the N:N linkage. The Dumas complete combustion method may be used to determine total soil nitrogen.

MANGANESE

Ash two grams of soil and mix with approximately 6 grams of anhydrous  $Na_2CO_3$ . Place the mixture in a 30 cc. platinum crucible and heat gently at first. Gradually increase heat until the bottom of the crucible reaches a bright red, almost white, heat. Fuse until the charge becomes completely fluid. While hot, pour the fused charge into a platinum dish which is floating in cold water. Use platinum tipped tongs to handle the hot Pt crucible. Place fused mass from dish, crucible and cover in a covered 250 cc. beaker containing 75 cc. of 1:3  $HNO_3$  (sp. gr. 1·13); heat to aid solution, if necessary, but do not evaporate much of the acid. Cool, add about 0·25 grams of sodium bismuthate and stir. After 10 minutes add 50 cc. of  $HNO_3$  (sp. gr. 1·015) and filter the whole through a Gooch asbestos filter, using suction. Wash beaker and filter with 50 cc. of the same acid.

Titrate the filtrate with standard ferrous ammonium sulphate solution and add an excess. Titrate the excess to a faint pink colour with standard potassium permanganate solution. Run blank determinations on all reagents used. The difference between the total amount of ferrous ammonium sulphate solution added, and the amount of potassium permanganate solution used, expressed in terms of the ferrous ammonium sulphate solution, is equivalent to the manganese in the soil sample. Calculate and report as  $Mn_3O_4$ .

Reference: "Quantitative Agricultural Analysis"; Mahin, E. G., and Carr, R. N., 1923, p. 261.

*Reagents.*— $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$  solution, containing 50 cc. of  $H_2SO_4$  in each 1,000 cc., 1 cc. of which is equivalent to 0·00015 g. of  $Mn_3O_4$ .

Standard  $KMnO_4$  solution, the concentration to be about one-tenth that of the ferrous ammonium sulphate solution.

Nitric acid, specific gravity 1·13. Dilute one volume of concentrated acid with 3 volumes of water.

Nitric acid, specific gravity 1·015. Dilute three volumes of concentrated acid with 100 volumes of water.

Sodium bismuthate c.p. quality.

PH VALUE

The hydrogen ion concentration is determined electrometrically, using platinum-blacked spiral platinum wire electrodes.

Two grams of the prepared air dried sample, or 3·5 grams of the moist sample, are placed in a one inch diameter glass tube, which serves as the elec-

trode vessel, and are thoroughly shaken up with 25 cc. of distilled water. Washed hydrogen gas is led into the tube through a fine glass tube and bubbled through the soil suspension, to keep the soil-water mass in motion and saturated with hydrogen. The titration is continued until a potentiometer reading is obtained which will stay constant for at least two minutes. A Leeds & Northrup Type K potentiometer is used, with Eppley standard cell. A saturated KCl calomel/mercury half cell is used as the pole of known potential.

### APPENDIX III

#### REPORT ON CELERY SOILS IN THE MONTREAL DISTRICT

At a meeting of the Quebec Refrigeration and Cold Storage committee held in June, 1934, under the chairmanship of Mr. J. H. Lavoie, a resolution was passed requesting that certain soils in the immediate vicinity of Montreal, on which celery is grown, should be surveyed. The names of the celery growers were furnished by Mr. J. H. Lavoie to the Soil Survey committee. In accordance with this request these soils in which celery was actually growing were examined in detail and samples were taken for analysis.

In this appendix the soils are described, chemical analysis are presented, and there is given a detailed discussion of the characteristics of these soils.

#### DESCRIPTION OF CELERY SOILS

*Depth.*—The depth of the organic soils on which celery is grown and from which the samples were taken varies considerably.

The first sample of muck was taken on Julien Guinois' farm at a point where the depth of the organic soil was about four feet.

The second sample was taken on the same farm from a location where the organic soil varied from  $1\frac{1}{2}$  to 3 feet deep and was underlain by mixed sand and heavy clay.

The depth of the muck on Pierre Guinois' farm varies from 2 to 12 feet. Sample No. 3 was taken where the depth of the muck was greater than 4 feet.

The depth of the muck on André Lafitte's farm where sample No. 4 was taken was at least 4 feet.

On Eugène and Antoine Guinois' farm, where sample No. 5 was taken, the organic soil was about 7 to 8 feet deep.

Sample No. 6 was taken from André Mathiez' farm where the depth of the muck was 8 to 15 feet.

The depth of the muck where sample No. 7 was taken, on Abandonnato's farm, was only from 2 to 3 feet.

*Degree of Decomposition and Source of Organic Matter.*—The muck on the farm of Julien Guinois is very well decomposed in the surface and subsoil. This soil has been formed from the remains of pine, spruce, tamarack, white birch and sedges.

On Pierre Guinois' farm the muck is very well decomposed at a depth of 4 feet or more. Tamaracks, cedars, elms, swamp maples and sedges are the source of this organic soil.

The muck soil on A. Lafitte's farm is very similar to that of Pierre Guinois' in degree of decomposition and has been formed from remains of the same plant species.

The degree of decomposition of the muck on E. and A. Guinois' farm is rather poor. Tree remains similar to those on P. Guinois' farm were found. Carex and moss remains are dominant in the subsoil.

The muck soil on A. Mathiez' farm is well decomposed in the surface layer. In the subsoil the decomposition is not so good. Deciduous and coniferous tree remains, sedges and moss were found to be present in the subsoil.

The surface soil on Abandonnato's farm was very well decomposed, but the decomposition in the subsoil was poor. Sedge grass remains are the main source of organic matter in this soil.

### FARM PRACTICES

*Julien Guinois*.—The land has been under cultivation for at least 18 years. Celery has been grown continuously in the same soil for the last five years. He has applied 35 tons of barnyard manure per acre for 18 years. No commercial fertilizer has been used.

*Pierre Guinois*.—Celery has been grown for 27 years. During the first 15 years limestone mixed in with barnyard manure was applied in very liberal dressings, but for the last 12 years the limestone has been omitted. He used 7-7-7 chemical fertilizer mixture for several years, but discontinued this, because no apparent beneficial results were obtained from the fertilizer treatment.

*André Lafitte*.—He has used 8-8-8 fertilizer mixture for several years, as well as barnyard manure. He has not used commercial fertilizer this year (1934). He attributed cracking of his celery fibres to the nitrogen in the chemical fertilizer he applied.

*Eugène and Antoine Guinois*.—They grow celery year after year on the same place. A 4-8-10 fertilizer mixture at the rate of 400 to 500 pounds per acre has been used for the last 12 years with, also, heavy farmyard manure application.

*André Mathiez*.—The land was cleared of woods about 10 years ago and was in rough pasture for 8 years. Celery has been grown for two years. He used 0-8-10 fertilizer mixture at the rate of 1,000 pounds per acre without farmyard manure.

*Abandonnato*.—He used no chemical fertilizers, but large quantities of farmyard manure, especially pig manure, on celery.

*Acidity Relationships*.—The soils of Pierre Guinois and of André Lafitte are neutral in reaction. They are the least acid of all the soils tested, both under field and laboratory conditions. The large quantities of lime applied for a number of years to the soil of P. Guinois are probably responsible for the high pH value (7.17) of this soil. The soils of Julien Guinois, E. and A. Guinois and Mathiez are slightly acid, varying in their values from pH 6.14 to 6.67. The soil of Mathiez is the most acid of the above three. The soil of Abandonnato is the most acid of those examined under both field and laboratory conditions. The surface soil, by hydrogen electrode potentiometric measurement, has a pH value of 5.7 while the subsoil is very acid, with a pH value of 4.68.

There is a close relationship between the pH values obtained in the laboratory and the relative lime requirements. The surface soils of samples 3 and 4 which are the closest to neutrality have an insignificant lime requirement, while in the subsoils of these two samples it is  $\frac{1}{2}$  ton to 1 ton respectively. The surface samples from the farms of J. Guinois and E. and A. Guinois have a lime requirement or  $\frac{1}{2}$  ton to 1 ton of CaO per acre and the subsoils have a lime requirement of 1 to 2 tons of CaO per acre. The soil of André Mathiez, which is slightly more acid than the soils of the two farms above mentioned, has a lime requirement of 2 tons in the surface layer and a little over 3 tons in the subsoil. The soil of Mr. Abandonnato, which is the most acid according to its pH value, has the greatest lime requirement, namely  $2\frac{1}{2}$  tons in the surface soil, and almost 9 tons in the subsoil as the need of CaO per acre for neutralization.

The total ash in the surface soils varies from 15.5 per cent to 22.9 per cent which is normal for muck soils and indicates that the degree of decomposition is good and that very little mineral soil is mixed into the muck. In the subsoils a wider variation in the total ash content exists, with a range from 6.9 per cent to 20 per cent. The low total ash contents of samples 1B, 5B and 7B are due to poorer decomposition of the organic materials, while the high percentage in sample 2B is due to the fact that the muck soil here is rather shallow, and some sand and clay is mixed into the muck soil.

*Lime Status:* All the soils sampled are very well supplied with lime. The percentages of CaO in these samples considered as a whole are much higher than in the muck soils of the Sherrington-Ste. Clothilde area. The high calcium content may be due to the leachings from surrounding limestone rocks and soils and to the fact that severe burning has modified the surface soils in some cases, and fertilizer and manure applications also have changed the soil. There does not seem to be a close relationship between the total CaO content and the pH value or lime requirement. Samples 1B and 7B that are lowest in total ash are also lowest in their CaO content.

*Magnesium:* The magnesium content of all seven soils is low and this low percentage of magnesium seems to be characteristic of our Quebec mucks. The magnesium, expressed as magnesium oxide, present in these soils varies between 0.25 and 0.78 per cent.

*Manganese:* The percentages of  $Mn_3O_4$  are very low in all the samples except that from the surface soil of A. Lafitte. The reason for this comparatively high figure (0.18) cannot be explained although the analysis has been checked repeatedly.

*Potash:* The potash in all the soils sampled is comparatively low. If a  $K_2O$  content of one per cent is considered as a reasonable supply of potash, all these soils must be considered as extremely deficient in potash. The potash content of all the surface samples, except that from the farm of A. Mathiez, is remarkably constant, varying only from 0.21 per cent to 0.25 per cent. In Mathiez' soil both the surface and subsoil are very deficient in potash, having a  $K_2O$  content of 0.037 per cent and 0.027 per cent respectively. In two cases only (samples No. 2 and No. 7) is the potash content of the subsoil equal to that of the surface soil; in all other cases the subsoils have a considerably lower  $K_2O$  content than the surface soil. Presumably added manure and fertilizers must thus have affected the  $K_2O$  content of the surface soils.

*Phosphorus:* If 0.5 per cent of  $P_2O_5$  is considered as an adequate supply of phosphorus, all these soils may be considered well supplied with this constituent in the surface layers. Samples No. 1 and No. 2 have 0.61 and 0.60 per cent of  $P_2O_5$  in the surface layers respectively, while in the subsoils the  $P_2O_5$  content is 0.39 per cent and 0.46 per cent respectively. Samples Nos. 3, 5 and 7 have over 1 per cent of  $P_2O_5$  in their surface soils, while in their subsoils the amount of this element is considerably lower. The sample from the farm of A. Mathiez has a  $P_2O_5$  content of 0.48 per cent in the surface soil (just below the 0.5 mark) and 0.27 per cent in the subsoil.

In general, all these soils are very much higher in their phosphorus content than the soils of the Sherrington-Ste. Clothilde area. It is likely that the higher potash and especially phosphorus contents in these soils are due to continuous heavy applications of manure and fertilizers. The soil from the farm of A. Mathiez has only been under cultivation for two years and the potash and phosphorus contents are much lower in this soil; in this respect they run more in line with the soils of the Sherrington-Ste. Clothilde area.

*Sulphur:* The sulphur content of all the celery soil samples taken is high, which is characteristic of all Quebec muck soils that have been analyzed in this laboratory. The subsoil from Abandonnato's farm is exceptionally high (4.08 per cent of SO<sub>3</sub>).

*Nitrogen:* The total nitrogen in all the celery soil samples analyzed is high and varies from 1.45 per cent to 2.42 per cent. The forms in which these large quantities of nitrogen exist are unknown. Large quantities of nitrogen are present in organic form and thus mostly unavailable for immediate plant use. The nitrogen available as plant food may vary considerably during the growing season. When conditions are favourable, e.g., during warm weather after a rain, the amount of available nitrogen may increase very rapidly and become excessive. Plant growth at this time may be very rapid as a consequence, and at such times potash deficiency in these soils may become acute.

*Moisture:* The external water relationships of the soils dealt with in this report vary a great deal. It is probable that all of these soils in the springtime are covered by water. At certain dry times during the growing season it is likely that crops on these soils suffer from lack of water. The nature of the material composing these soils must be considered as this gives them some uniformity in water relations. Organic matter can hold from 3 to 4 times its own weight of water. As will be seen from the table showing results of analysis, all these soils, when in equilibrium with dry air in the laboratory, contain around 15 per cent of water that is only removable by heating them in an electric oven at 100 degrees C. The percentage of moisture in freshly taken samples of black muck soils is very much higher than that in fresh samples of mineral soils, in the summer time being usually of the order of 30 to 40 per cent or higher.

We know relatively little of the water movements within muck soils in the field. In spite of the summer rainfall our mucks seem to get steadily drier from the surface downward throughout the growing season. This may indicate that there is not very free movement of water upwards through muck soils to replace the water that evaporates from the surface. The surface layers of these celery soils at times may be lacking in the amount of moisture needed to afford ready passage of water from soil to plants. When the immense capacity of soil organic matter to absorb water is recalled it may be realized that in dry times the plants growing in these black soils may lose in the competition for water. This may have serious effects on the plant, especially on quick-growing, leafy, succulent tissues, and especially where the nitrogen supply in the soils is badly balanced.

#### DISCUSSION

The purpose in making this study of celery soils was to differentiate the soil types, if possible, and to establish the distinctive characters of the soils, namely, (1) those characters common to all the celery soils examined, (2) those characters peculiar to individual celery soils. The soils examined were those of the principal celery growers in the Montreal district, from a list furnished by the Quebec Department of Agriculture. All of the soils examined are mucks, and these black lands are the chief celery soils of this region.

The field characteristics of the soils studied and the results of laboratory examination are shown in the text. Certain characters are common to all these soils, while other features are very different from soil to soil.

Two of the mucks are shallow—namely, the second sample taken at Julién Guimois' on Ile Jésus and the soil sampled at Abandonnato's at St. Hubert, Chambly county. The other mucks are quite deep. Because of the relatively limited areas involved, there is more variation in depth than would be the case in a good-sized area.

All the mucks except that of Mathiez, near St. Paul l'Ermite, l'Assomption Co., have been farmed for periods of 10 to 30 years or longer. Mathiez' soil has been under cultivation for only 2 years.

The surface soils at Pierre Guinois' and André Lafitte's places may be described as neutral to alkaline, those of Julien Guinois and of Eug. and Antoine Guinois as slightly acid, and those of Mathiez and Abandonnato as fairly acid. This differentiation is made from observations made with field test kits, from electrometric pH determinations in the laboratory and from lime requirement values determined in the laboratory.

These soils are all very rich in calcium, the surface soils in most cases being richer in lime than the subsoils.

Regardless of the applications of manure and fertilizers that have been made, these soils throughout are very deficient in potassium. This condition of potassium deficiency must be aggravated by the richness of these soils throughout in nitrogen. Especially at favourable times during the warm summer months there must be an excess of available nitrogen in these surface soils. Application of sufficient potassium at one time, at the beginning of the season, may not be feasible and it may fail in its purpose, but by adding of potassium salts as side dressings at intervals during the active growing season of the celery, the deficiency may be met.

The surface soils of Pierre Guinois, André Lafitte, Eug. and Antoine Guinois and of Abandonnato are outstandingly rich in phosphorus, presumably because of the heavy applications of manure and fertilizers. The surface soils of Mathiez and of Julien Guinois are not greatly in need of phosphatic fertilizer.

These soils seem to be very low in percentage of manganese, with the exception of the surface soil of André Lafitte which is relatively rich in that element.

It must be noted that the important factors modifying soil conditions are interlocking. Thus we have here to consider for all soils in this study:—

- (1) Fluctuations during the growing season in the amounts present of available nitrogen. There is a large amount of total nitrogen in all cases.
- (2) General presence of large amounts of soil calcium.
- (3) Fluctuation in soil water content during the season.
- (4) General deficiency of soil potassium in all.

Other factors that are of importance vary from soil to soil. As pointed out:—

- (1) Four out of seven of these soils are very rich in phosphorus.
- (2) Six out of seven appear deficient in manganese.
- (3) Two are neutral to alkaline (around pH 7), three are slightly acid and two are fairly acid—pH 6·0 and below.
- (4) The relations between surface soils and subsoils are not constant in any of the factors considered.

Before drawing conclusions of too decided nature, the effects of any factor upon each other factor must be considered. Points of especial significance in this connection are the following:—

- (1) The very high nitrogen: potash ratio especially at certain times throughout the growing season.
- (2) The low amount of potash relative to phosphorus in several of the soils, and the large quantity of the latter element.
- (3) The very high lime content must have significance, and lime compounds must predominate in these soils.
- (4) The deficiency of water in the surface soils is likely acute at times during what is normally the most active growth period of the celery.

**SUMMARY AND CONCLUSIONS—APPENDIX III**

From the survey made it may be concluded that there are a number of soil factors in the soils studied that must influence celery quality. The four most obvious soils factors are likely not the only ones. These most obvious soils factors are seasonal high available nitrogen percentage, high lime percentage, low potash percentage and seasonal water deficiency. Controlled experimental studies are needed of these and other factors governing celery production in Quebec. Of course, this appendix deals only with the soil studies made in connection with the celery work.

TABLE XX  
CHEMICAL COMPOSITION OF SAMPLES FROM MUCK SOILS WHERE CELERY IS GROWN

| Sample No.  | Hygroscopic moisture % | pH value | Lime requirement<br>lb. CaO per acre | Total ash % | CaO  | MgO  | Mn <sub>3</sub> O <sub>4</sub> | K <sub>2</sub> O | P <sub>2</sub> O <sub>5</sub> | SO <sub>3</sub> | N <sub>2</sub> |
|---|------------------------|----------|--------------------------------------|-------------|------|------|--------------------------------|------------------|-------------------------------|-----------------|----------------|
|   |                        |          |                                      |             | %    | %    | %                              | %                | %                             | %               | %              |
| Expressed on oven-dry basis (dried at 100° C.)            |                        |          |                                      |             |      |      |                                |                  |                               |                 |                |
| 1 A } Julien Guinois, St. Martin, Ile Jésus.....          | 15.7                   | 6.67     | 1170                                 | 17.9        | 7.16 | 0.76 | 0.02                           | 0.22             | 0.61                          | 2.36            | 1.84           |
|   | 14.3                   | 6.07     | 4000                                 | 6.9         | 4.48 | 0.46 | trace                          | 0.038            | 0.39                          | 2.02            | 2.28           |
| 2 A } Julien Guinois, St. Martin, Ile Jésus.....          | 15.8                   | 6.16     | 2490                                 | 18.9        | 7.56 | 0.55 | 0.02                           | 0.21             | 0.60                          | 1.67            | 1.68           |
|   | 14.2                   | 6.46     | 1245                                 | 20.0        | 6.40 | 0.61 | trace                          | 0.23             | 0.46                          | 3.00            | 2.28           |
| 3 A } Pierre Guinois, St. Léonard, Ile Montréal.....      | 15.6                   | 7.17     | 165                                  | 21.16       | 7.48 | 0.78 | 0.06                           | 0.25             | 1.01                          | 2.17            | 1.80           |
|   | 16.1                   | 6.65     | 1060                                 | 17.8        | 8.80 | 0.78 | 0.02                           | 0.11             | 0.54                          | 2.73            | 1.07           |
| 4 A } André Lafitte, St. Léonard, Ile Montréal.....       | 15.4                   | 6.95     | 825                                  | 21.7        | 8.52 | 0.37 | 0.18                           | 0.22             | 0.93                          | 2.53            | 1.97           |
|   | 15.7                   | 6.54     | 2150                                 | 16.1        | 9.04 | 0.41 | 0.018                          | 0.092            | 0.49                          | 2.81            | 1.03           |
| 5 A } Eugène & Antoine Guinois, St. Léonard, Ile Montréal | 14.8                   | 6.24     | 2135                                 | 22.9        | 6.40 | 0.25 | 0.04                           | 0.24             | 1.22                          | 2.36            | 2.42           |
|   | 15.3                   | 6.04     | 4200                                 | 11.2        | 5.88 | 0.38 | trace                          | 0.079            | 0.35                          | 1.73            | 2.07           |
| 6 A } André Mathiez, St. Paul l'Ermite, Co. l'Assomption  | 16.2                   | 6.14     | 4000                                 | 15.5        | 7.12 | 0.51 | 0.02                           | 0.039            | 0.48                          | 1.64            | 1.45           |
|   | 17.2                   | 5.98     | 6500                                 | 14.3        | 8.08 | 0.46 | 0.009                          | 0.027            | 0.27                          | 1.56            | 1.85           |
| 7 A } M. Abandonnato, St. Hubert, Co. Chambly.....        | 13.15                  | 5.70     | 5000                                 | 18.3        | 8.04 | 0.38 | 0.019                          | 0.232            | 1.15                          | 2.34            | 2.00           |
|   | 13.28                  | 4.68     | 17500                                | 9.1         | 4.04 | 0.40 | 0.007                          | 0.238            | 0.63                          | 4.08            | 2.10           |

A = Surface 10" of soil; B = Subsoil between 12" and 24".

