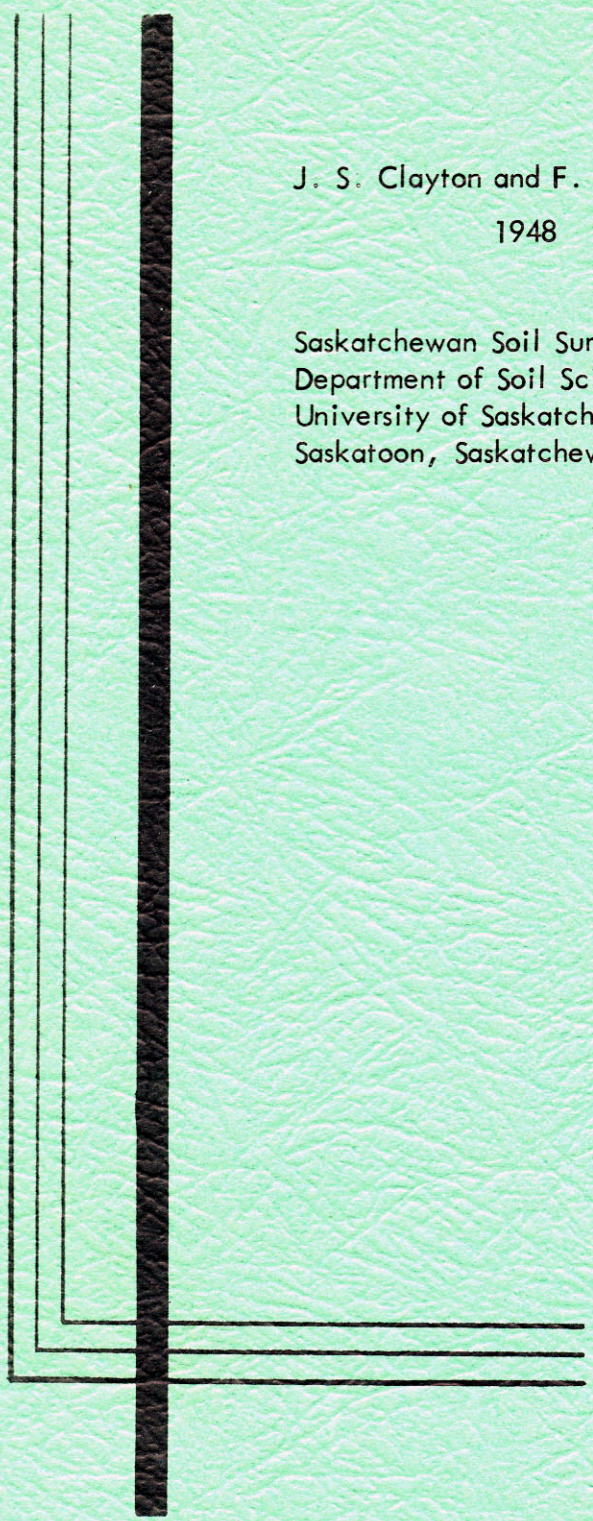
REPORT ON THE SOIL SURVEY OF THE DOMINION EXPERIMENTAL STATION AT SCOTT, SASKATCHEWAN



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Saskatchewan Soil Survey[2].

INTRODUCTION

Detailed soil surveys of Dominion Experimental Stations in Saskatchewan have been undertaken by the Saskatchewan Soil Survey at the request of the Experimental Farm Service, Ottawa. The third of these surveys completed in 1948 covers the Scott Farm.

Every courtesy and facility was placed at the disposal of the surveyors by the Superintendent, Mr. G.D. Matthews, and his staff, particularly Messrs. Van Nice, Kusch, Maas and Nadon whose co-operation and assistance was greatly appreciated during the survey.

SOIL MAP

The contoured base maps on scales of 400' and 100' to an inch which were available for the plotting of soil information on the main Farm areas greatly aided the work. The area surrounding Scott has been covered by aerial photography, and contact and enlarged prints covering the Farm were supplied through the Central Experimental Farm. These latter were of great assistance in the survey, and gave the Soils staff an excellent opportunity of determining the use of aerial photographs in detailed work. The contact prints were used for stereoscopic study of relief,

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1. Soil Specialists, Division of Field Husbandry and Soils, Dominion Experimental Farm Service.
2. Messrs. Rennie, Ballantyne and Dawson, Student Assistants, assisted in the Field Surveys.

while the enlarged photos were used directly in the field where the variations in tone, texture, shadow and outline of areas distinguishable on the aerial pattern were compared and correlated with differences in soils.

In many cases, very close correlation was discovered, inasmuch as soil areas could be outlined from the photo, but experience showed that such correlations without careful field inspection might lead to erroneous interpretation. The combination of large-scaled contoured base maps with aerial photographs was, however, very satisfactory, and aided greatly in the making of a detailed survey. The map accompanying this report has been prepared on a scale of 400' to an inch, and should be used in conjunction with this report.

DESCRIPTION OF FARM

Early History and Development

The original area incorporated in the Experimental Farm lies immediately south and west of the town of Scott, and comprised the N.E. 1/4 of 17, and that portion of the S.E. 1/4 of 20 lying south of the main line of the G.T.P. railway (now C.N.R.) in Township 39, Range 20, West of the 3rd Principal Meridian.

This site was selected by Mr. Duncan Anderson, and was subsequently visited and approved by the Director of the Central Experimental Farm, Wm. Saunders, and other officials. It was purchased by the Dominion Government in the spring of 1910. Mr. Anderson supervised the breaking and preparation of the land and prepared and planned the erection of buildings.

It is interesting to read the following extract of Mr.

Anderson's report to the Director, as included in the Experimental Farm Report, March 31st, 1911.

"The Farm"

"The Farm consists of 198 1/2 acres, and is bounded on the east by the main travelled road leading into the well settled Tramping Lake district, on the north by the railway, and on the south and west by the division line. The surface of the Farm is undulating, open prairie, unbroken by either bush or sloughs. One or two small pot-holes, and here and there a few stones can be seen.

"The Soil"

The soil is a chocolate coloured clay loam of very uniform quality from twelve to fifteen inches deep, underlain with a clay subsoil. With the exception of an acre in the N.E. corner, which had been ploughed by a homesteader, the Farm was in a primitive condition."

Farming began on May 16th, 1910, when drilling for a well was started. Water was obtained at a depth of 65 feet with a flow of 5 barrels per hour. 105 acres were broken that year. It is interesting also to record the cost of this breaking as summarized in the report.

Cost of getting land into cultivation:

Breaking, $3.75 an acre
Packing, $0.25 an acre
Backsetting, $3.75 an acre
Single Discing, $0.50 an acre
Double Harrowing, $0.50 an acre

Total cost -- $8.75 an acre.

On March 1st, 1911, Mr. R. Everest, a graduate of Guelph,

was appointed as first superintendent, and cultural investigations were begun in that same year. The first crop was largely destroyed by a wind, rain and hail storm, and subsequent frost damage. Marquis wheat yielded 4 bushels per acre.

Since that time, the area of the Farm has been enlarged, both by purchase and lease until approximately 1600 acres are now managed directly from the Station. The activities of the staff are not confined to the Farm, but are extended through a large territory in north-western Saskatchewan and eastern Alberta by means of illustration and substations and other extension services. Thus from modest beginnings, the Scott Experimental Station has become a permanent and important link in the chain of agricultural services in the Prairie Provinces.

Location and Extent

The Farm, including both purchased and leased land, comprises a little less than eleven quarter sections of land (1602 1/2 acres) and includes the following parcels:

Purchased Land

a. N.E. 1/4 of 17 and 32 1/2 acres of the S.E. 1/4 of 20 - Twp. 39, Rg. 20, W.3rd Mer. This was the original Farm, purchased in 1910.

b. S. 1/2 of 17-39-20-W.3rd M. was purchased in 1914.

Leased Land

c. S.W. 1/4 of 20-39-20-W.3rd M., leased since 1922.

d. N.W. 1/4 of 21-39-20-W.3rd M., leased since 1925.

e. Sec. 19-39-20-W.3rd M. (614 acres), leased since 1935.

f. N.E. 8-39-20-W.3rd M., leased since 1937.

Section 19 was leased under the initiative of P.F.R.A., for drought and drifting studies. The N.E. of 8 is leased for grazing purposes.

The Farm is conveniently situated adjacent to the town of Scott, and is well serviced by road and rail. The area served by the Farm staff includes all agricultural land in Saskatchewan, north of the South Saskatchewan River and west of Rg. 5, W. of the 3rd Mer. In addition, a small area of east central Alberta has been included as Scott territory.

The following list of illustration and substations are at present directed from Scott.

Substations

Conquest, Kindersley, Loverna, Rosetown

Illustration Stations

Glaslyn, Glenbush, Loon Lake, North Makwa, and Marsden.

PHYSIOGRAPHY

(Relief, Land Form, Topography and Drainage)

Recently the Saskatchewan Soil Survey has been making preliminary studies of the elements of land form in relationship to the topography and nature of the parent materials of the soils of Saskatchewan. The detailed survey of this Experimental Farm has enabled a study to be made of the minor components making up the major land forms in this area. While this type of analysis has not yet been fully developed, it has already proved very valuable in this and other detailed surveys of the experimental farms, particularly in conjunction with aerial photographic interpretations.

In this report and accompanying map, an attempt has been made to correlate land form with the soil described.

Relief

The Scott Farm lies within that portion of the glaciated Canadian section of the Great Plains Region of North America known as the Third Prairie Steppe, lying west of the escarpment of the Missouri Coteau. The main Farm area lies at an elevation of between 2140' and 2210' above sea level, but is divided by the deep but narrow valley of the Eagle Hill Creek, the bottom of which is at 2030' elevation and lies about 100' below the level of the surrounding countryside.

Land Form

The upland area forms part of a shallow (marginal) lake plain which has been partially modified by erosion due to its proximity to the edge of the glacial valley (spillway) of the afore mentioned Eagle Hill Creek. This area forms a part of a much larger area of marginal lake plain that extends roughly from the towns of Unity and Vera south-eastward to Palo and Oban, west to Handel, and Kelfield and from there north-westward bordering the western margins of the Tramping Lake, Eagle Hill Creek valley to the Muddy Lake depression and Unity. This area is indicated on the reconnaissance soil map of Saskatchewan by the areas of Elstow and mixed Elstow and Weyburn soils shown in these vicinities, and is approximately 60 miles from north-west to south-east, and 30 miles north and south.

This lake was likely formed by a temporary flooding during a rapid retreat of the ice from the Bear Hills to the Eagle Hills moraine, and at a time when the Eagle Hill, Tramping Lake channel

was blocked at its southern end. This lake which was presumably fairly shallow, appears to have drained through a number of south-easterly courses, but mainly through the Whiteshore and Richmond Lakes and thus to Lake Saskatoon.

The contoured base map of the Scott Farm enables us to obtain some local evidence as to the depth of the lake. No evidence of lacustrine material is seen on the Farm above 2190' elevation, which height is roughly confirmed by other similar evidence obtained from a study of the reconnaissance map and the contoured Tramping Lake sectional sheet. In addition, where erosion of the lake deposition towards the valley edge has occurred, eroded glacial till is exposed at about 2145-50'. The average depth of lacustrine deposition on the Farm is less than 5 feet except for a few pot-hole and depression areas, and this deposition has only partially obliterated the original ground moraine relief. Therefore, it may be assumed that the depth of water in this lake did not exceed 50' and the amount of sediments deposited would indicate a fairly short period of lake conditions, preceded by conditions of rapidly moving water with deposition of sand and gravel which is found in a thin layer at the contact of the lacustrine material and the glacial till. Subsequently the drainage of this lake was captured by the Eagle Hill Creek which eroded down in a narrow channel to about 100' below the level of the lake plain. This Creek not only completely drained the lake, but eroded away a considerable amount of the shallow lacustrine deposition, thus exposing ground moraine till. Later erosion and surface drainage has tended to increase this removal and has also resulted in the formation of shallow runways with alluvial deposition which now drain the surface run-off into the valley.

Table 1

Land Forms with Associated Topographic Classes and Soils

Land Forms		Topography		Soils	
Major Land Forms	Land Form Components	Symbols	Descriptions	Associated Soils	Symbols
1. Glacial Lacustrine Plains (shallow marginal lake plain)	a. nearly level plain	A_1, A_2, B_2	level - very gently sloping to undulating.	Scott and Elstow	Stt E
	b. till knolls and ridges (above lake level)	B_3, B_4, B_5	gently to roughly undulating. gently to moderately rolling.	Weyburn	W
	c. low knolls and minor ridges (below lake level)	B_2, B_3 occasional B_4-$_5$	hummocky - roughly undulating. occasional gently to moderately rolling.	Weyburn (calcareous earth)	W(a)
	d. shallow glacial pot-holes and depression areas modified by lacustrine deposition.	A_0	smooth depressional	Slough bottoms	Sb
	e. slight depressional drainage channels.	A_2, A_3, A_5	very gently sloping to moderately and steeply sloping.	Elstow(deep phase). Scott(deep phase) Weyburn(eroded phase)	E(c) Stt(c) W(er)
2. Glacial Stream-eroded Till Plain	f. sloping plain, occasional mounds, low ridges, and shallow depressions.	A_2, A_3, B_3, B_4	very gently to gently sloping. gently undulating to rolling.	Weyburn Weyburn(eroded phase)	W W(er)
3. Glacial Valley Spillway	g. cut banks and eroded valley slopes.	A_6	steeply sloping.	Eroded soils	Er
	h. alluvial fans.	A_3, A_4	gently to moderately sloping.	Alluvium	Av
	i. flood plain	A_1	level	Alluvium saline phase	Av(sa)

This brief hypothesis of the factors influencing the laying down and removal of the sediments in this area is largely borne out by the elements of land form found in this area. These are shown in Table 1 with their associated topographic classes and soils, and illustrated diagrammatically in Figure 1. The associated soils are listed in this table for reference but are not described in this section of the report. Thus in the upland area, we find the following components of a shallow marginal lake plain.

(a) Nearly level to very gently undulating and sloping land, (A_1, A_2, B_2), formed by lake deposition over ground moraine. This type of topography and land form constitutes the major areas of the Farm north of the valley. Smooth, very low knolls and very slight depressions are occasionally found in this lake deposition.

(b) Low knolls and narrow ridges of gently to roughly undulating (B_3) or gently to moderately rolling (B_4, B_5) topography, according to degree of slope, where the original ground moraine relief is exposed above the lacustrine sediments. Two elongated till knolls on the N.E. 19-39-20 which rise to an elevation of 2200 feet, are free from lacustrine sediments above 2195', and appear to be the exposed tops of kame ridges or drumlins. Another higher area in the N.E. 1/4 of 17 above 2160' elevation may be a similar type of formation, but the top of this has been partially modified by lacustrine wash and sediment.

(c) Low knolls and minor ridges with shallow lacustrine sediment or exposures of washed or eroded glacial till occur plentifully through the main area outlined as shallow lake deposition. These appear to have been exposed by post-glacial erosion of the

lacustrine sediments in areas where the original ground moraine topography had been only partially modified. They occur most frequently adjacent to the edges of shallow surface drainage ways where the accumulation of run-off water has caused increased erosion and washing.

(d) Conversely to the relief outlined in Section C, are a few pot-hole and depression areas occurring on the Farm, which presumably were glacial kettles which were not completely filled up by lacustrine sediment. These are indicated as depressional topography (Ao) being mostly shallow undrained or partially drained slough bottoms.

(e) Slightly eroded runways, frequently with alluvial deposition along their courses, also occur. These concentrate the main surface drainage of the Farm towards the Eagle Hill Valley. These runways have very slight slopes for most of their courses across the Farm, and may be classified as very gently sloping topography (A_2) but nearer to the valley edge, they have cut deeper, giving gentle to steeply sloping topography (A_3 to A_5). These merge into the eroded coulees tributary to the glacial valley, where their land form is associated with the latter feature rather than with that of marginal lake.

(f) Another land form feature of the upland area of the Farm occurs adjacent to the abrupt valley edge, but does not of itself constitute part of the valley features. It is the area where lacustrine sediments have been almost completely eroded, giving exposures of eroded till plain. This area varies from relatively smooth, gently and very gently sloping (A_2, A_3) to steeper and more complex, gently undulating (B_3) and rolling (B_4) topography. This

type of feature occurs fairly continuously between the 2150' contour and the northern edge of the valley which slopes sharply at about 2145' elevation. The entire area south of the valley may be considered as part of a glacial stream-eroded till plain with occasional mounds or low ridges and shallow depressions.

The Eagle Hill Creek or Tramping Lake Valley represents the other major land form in this area. It is typical of a glacial valley spillway, and exhibits a number of the characteristic component land forms of such features. The valley is much broader and deeper than would be expected from the working of the small and intermittent stream which now occupies its course. Thus it is evident that at one time a considerable body of water flowed in this channel.

In the section of this valley cutting through the Scott Farm, the following elements of glacial valley drainage channels may be observed:

(g) Cut-banks and eroded valley slopes.

The valley cuts down abruptly from the upland area with two small tributary coulees entering from the north side. These collect the run-off from the Farm. The valley sides are steeply sloping (A_6), ranging between 15% and 30% and frequently exhibit the characteristic "cat steps" of eroded slopes.

(h) Alluvial fans.

Small, gently to moderately sloping (A_3, A_4) alluvial fans occur at the bases of the slopes, particularly at the entrances of the tributary coulees.

(i) Flood plain.

The bottom of the valley is typically flood plain topography, being nearly level (A_1) and averages between 200 and 300 yards in width. In time of spring floods, the whole valley bottom may be flooded, but throughout most of the year, the water is confined to a small and shallow stream channel that has not entrenched itself to any extent. The presence of alkali salts throughout the valley bottom is another indication of this flood plain condition.

Topography

From the discussion on the elements of land form given above, we can summarize their influence on topography and list the topographic separations significant to the Farm area.

The major portion of the Farm, lying in the marginal lake plain is of very gently sloping to gently undulating topography, this being broken by a few ridges of exposed or partially exposed glacial till, some of which may be classed as gently or moderately rolling, and by the occasional pot-hole and depressional area. A few shallow drainage ways with gently sloping sides cross the Farm and cut down into the valley.

The valley area would be classified as eroded topography on reconnaissance survey, but in this more detailed map, has been separated into steep and very steep slopes on the valley sides, and gently sloping to level and depressional topography in the valley bottom.

Drainage

The drainage of the Farm which is determined mostly by the topography and relief, but also partly by the nature of the soils

and parent material is generally good. The very gently sloping and undulating topography has a general slope towards the Eagle Hill Creek, descending from an average elevation of over 2180' on the north side of Section 19 to 2145' at the valley edge in S.E. of 17. This drop of 35' occurs in a distance of about 2 miles. These long slopes have a tendency to concentrate surface run-off into shallow drainage-ways which deepen rapidly near the valley edge. This tendency is partially offset by the medium texture and good structure of the surface soil over most of the Farm, which increases percolation. A few undrained pot-holes and sloughs occur. These were wet at the time of survey. In the N.W. 1/4 of 21, a quarter used as pasture, there is one fairly extensive, poorly drained area which had water lying in it in late June following the exceptionally heavy run-off condition of the 1948 spring.

The tendency to accumulate run-off due to the long slopes has resulted in some slight water erosion of the cultivated land and the roadways, particularly where the soil has been left bare of vegetation. This is particularly evident where the continued one-way cultivation of permanent blocks and plots has resulted in open furrows running parallel with the general slopes.

The steeply sloping eroded sides of the valley and the tributary coulees cause excessive run-off as is evidenced by the eroded nature of the slopes. The construction of several dams in the main side coulee on the S. 1/2 of 17 has tended to check this rapid run-off, but during the spring thaw of 1948, these washed out under the excessive flood conditions. The level flood plain of the valley is frequently poorly drained as evidenced by the alkali

accumulation through the area, the Eagle Hill Creek usually overflowing during heavy spring run-off.

It can be seen, therefore, that the upland areas, with a few exceptions, tend to be well to somewhat excessively drained due to the general sloping condition of the topography, this condition being partially offset by the fairly open nature of the soil structure.

CLIMATE

The climate of the Scott area is characteristic of that portion of the north-western section of the Dark Brown Soil Zone of Saskatchewan which has been classified as Zone 2D of the Cereal Variety Climatic Zones*. It is differentiated from the main climatic zone of chestnut soils because of its higher elevation and distinctly shorter frost-free period. It is a subhumid to semi-arid northern continental climate, characterized by wide extremes of temperature and relatively low precipitation.

Table 2 shows the average monthly and annual figures for precipitation, temperature, evaporation and frost-free period as compiled to 1947.

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* Guide to Farm Practice in Saskatchewan, 1948 edition.

Table 2

Meteorological Records at the Scott Experimental Station

Compiled to 1947

Month	Mean Monthly Temperature in °F. 1911-1947	Mean Monthly Precipitation In Inches 1911-1947	Mean Monthly Evaporation In Inches 1923-1947
January	0.31	0.66	
February	5.44	0.59	
March	16.57	0.60	
April	37.62	0.84	
May	49.74	1.48	4.01
June	57.33	2.26	3.57
July	61.88	2.18	4.58
August	59.19	1.79	3.81
September	48.95	1.33	2.45
October	37.75	0.73	
November	20.00	0.64	
December	6.88	0.67	
Annual Mean	33.47	13.80	

Average precipitation, April to October inclusive, 10.61"

Average frost-free period 32°F (1911-1947), 88.8 days. In only 10 out of 36 years has the frost-free period exceeded 100 days.

A comparison of the meteorological figures for Scott and the other experimental stations in Saskatchewan is shown in Table 3, based on figures compiled to 1943. It includes a calculation of moisture efficiency based on the Millsap formula as used in the Saskatchewan Soil Survey Report No. 12.

Table 3

Comparison of Meteorological Records and Moisture Efficiency of Experimental Stations in Saskatchewan

Station	Cereal Variety Climatic Zone*	Annual Temp. °F	Annual Ppt. in Inches	Average period between killing frost in days	Soil Zone Climatic Index**
Swift Current	1A Brown soils subject to frequent droughts	38.7	14.95	Over 120	30
Saskatoon	2B Dark brown soils slightly cooler than 2A	35.1	13.83	Over 120	37.6
Scott	2D Dark brown soils, higher elevation and distinctly shorter frost-free season than 2B	33.4	13.71	105	44.0
Indian Head	3C Black soils, better moisture conditions than 2B	34.7	17.46	110-115	49.4
Melfort	3D Deep black soils	32.8	15.44	110-115	52.6

* Guide To Farm Practice in Saskatchewan, 1948 edition

** Soil Zone Climatic Index $C = \frac{2000\ P}{T\ (1.38T - 27.4)}$

It can be seen from the above data that precipitation alone does not give a reliable measurement of moisture efficiency and that an expression including the effects of temperature, evaporation, length of season and other pertinent factors is necessary to give

a more accurate designation of climate as expressed by the development of native vegetation, zonal soils, and agronomic differences between stations. Thus the lower rainfalls recorded at Scott and Saskatoon are compensated for, by lower annual and summer temperatures with consequent lower evaporation rates, giving a higher moisture efficiency than at Swift Current, in the Brown Soil Zone, but lower than either Indian Head and Melfort in the Black and Deep Black Zones respectively. The Scott Farm is important from the climatic standpoint in comparison to other established stations, in that its crops are developed on a lower average rainfall, and shorter season, than any of the experimental farms established in Saskatchewan. Only Manyberries and Fort Vermilion in Alberta have lower precipitation records than Scott, and only Melfort and Fort Vermilion have lower annual temperatures.

SOILS

Classification of Soils

The soils on the Farm have been classified according to the system adopted by the Saskatchewan Soil Survey, as outlined in Soils Report No. 12, in which the Soil Association, comprising a local group or association of related soil profiles, is used as the main unit of separation.

The term "related" is used to define the essential character of the association, namely that all profiles of a given soil association must belong to the same soil zone and must occur on a similar type of parent material. The important soil groups and member profiles of Saskatchewan are listed and broadly described in Tables 7 and 8, Soil Survey Report No. 12, and need not be

further described here.

Table 4 lists the associations and member profiles together with the textural classes and soil phases mapped and recognized in this survey.

Zonal Soils

The Scott Farm lies within the north-western section of the Dark Brown Soil Zone in Saskatchewan, being located about 24 to 30 miles north of the Brown Zone and 18 miles south of the Black Zone Chernozem-like soils.

The natural vegetation of the region is designated as mixed prairie, which includes both short and medium-tall grasses, plus a number of shrub plants, willows and small aspens, these latter types being usually found around sloughs or poorly drained pot-holes. In early settlement days, the area was described as treeless prairie, but with protection from fire, an advance of the aspens and willows from the Black Soil Zone or parkland prairie has modified this landscape.

The soils of the Dark Brown Zone are mainly chestnut soils, characterized by medium to dark brown or dark greyish-brown colors. Surface colors of cultivated, well-drained soils at Scott vary from dark grey through greyish and dark greyish-brown to brown. Color values of 10 YR 4/1, 4/2, 5/2, 5/3 have been recorded on the Munsell standard soil color chart. In local areas of low and relatively moist positions, deeper and darker soils occur, ranging from dark grey to very dark or dark greyish-brown. The Munsell values are 10 YR 3/2 - 4/1 - 4/2. On eroded knolls and in areas where wind and water erosion has exposed subsurface soil, lighter

Table 4

Classification of Soils on Scott Experimental Farm With List of Soil Symbols Used in Mapping

Soil Zone	Parent Material Separations	Soil Association	Member Profiles Recognized	Mapping Symbol	Textural Class
Dark Brown Soils	1. Glacial Till a. Undifferentiated	Weyburn	1. hard columnar profiles	W	Loam
			2. calcareous earth profiles	W	"
			3. shallow knoll profiles of 1 and 2	W(a)	Loam - clay loam
	b. Stream eroded till	Weyburn	1. hard columnar	W(Er)	Loam
	2. Silty Lacustrine a. Deep deposits generally over 28" usually with varving in C horizon	Elstow	1. hard columnar	E	Loam and clay loam
			2. regrading solod		"
			3. profiles of 1 and 2 with deeper than average development and slightly darker surface horizons	E(c)	
			4. High lime profiles	E(ca)	"
	b. Shallow silty deposits usually less than 28" depth with a sandy gravelly layer overlying contact with the glacial till.	Scott May be regarded as a shallow Elstow profile in surface horizons	1. hard columnar	Stt	Loam
			2. regrading solod		
			3. profiles of 1 and 2 with deeper than average development and slightly darker surface horizons	Stt(c)	"
Miscellaneous Soils (feebly developed Zonal characteristics)	3. Alluvial Deposits a. deposits in valley bottom	Alluvium	1. Solonchak (saline profiles)	Av.	Clay
	b. recent shallow alluvial depositions	listed under Scott or Elstow Associations	1. columnar	Stt(c)	Loam
			2. slough bottom or meadow profiles	E(c) Sb	
	c. Eroded till on valley slopes	Eroded	Truncated profiles	Er.	

Phases - Soil phases mapped include stony, gravelly, sandy, wind and water eroded phases.

colors such as greyish-brown and light brownish-grey, 10 YR 5/2 and 6/2 may be found. Many of the areas of lighter and darker soils are distinguishable on the aerial photographs.

Parent Materials

The soils on the Scott Farm are influenced very greatly by the nature and mode of deposition of their parent materials. This factor has been partially discussed under the sections on relief and land form with which it is closely associated, but further discussion is necessary to relate the parent material directly to the soil.

As previously noted, the Scott area is part of the glaciated section of the Great Plains, and the parent material of the soils is all of glacial origin, although much of this has been modified by post glacial sorting and deposition.

The area is underlain by glacial till, presumably undulating ground moraine with a few knolls, kame ridges and shallow kettles or pot-holes. This till was flooded during the ice retreat, at which time a thin deposition of sandy and gravelly outwash varying from a few inches to over a foot in thickness was laid down, followed by a period of lacustrine deposition in which from 2 to 5 feet of silty material was laid down. Evidence of varving at the base of this deposit may be seen where the deposit is deep enough to go below the zone of soil weathering. This depth of deposition was not enough to completely obliterate the former ground moraine relief, and did not extend to the highest elevations on the Farm, where unmodified glacial till is exposed.

Following drainage of this lake area and the cutting of

the Eagle Hill Creek Valley, erosion took place, removing some of the lacustrine deposits, particularly off the knolls and ridges. Adjacent to the valley sides, it removed all of the lacustrine material and some of the underlying till, leaving an exposure of stony and bouldery eroded till.

Minor post-glacial drainage has only slightly modified these conditions, but has resulted in a weakly developed drainage pattern across the area. This has caused further erosion from the sides of knolls and steeper slopes, and deposition of surface soil material in shallow runways and slight depressional areas.

In the Eagle Hill valley, deep erosion has taken place, causing exposures of slightly weathered till on the slopes, and alluvial deposition on the valley floor.

Summarizing the results of these conditions of land formation, we can list the following types of parent materials that may be found on the Farm.

1 a. Undifferentiated glacial till.

b. Stream eroded glacial till exposed by removal of surface deposits.

2. Silty lacustrine deposits, fairly shallow in depth and underlain by a sandy gravelly layer at the contact of the deposition and the till.

3 a. Alluvial and some colluvial deposits in the Eagle Hill Valley.

3 b. Recent alluvial deposits of surface soil material in shallow depressions and runways.

3 c. Eroded exposures of till on the valley sides.

Glacial Till Undifferentiated

This is found on the highest elevations on the Farm, presumably above the levels of the marginal lake. One such area on the N.E. 1/4 of 19 lying above the 2190' elevation is most typical of this condition and represents the summits of kames or drumlin knolls which were not flooded. Another such area is located on the ornamental gardens and building area of the Farm, but it is difficult to be sure if this area was not partially modified by water action. In the N.W. 1/4 of 21, there is a fairly extensive area of undulating glacial till.

No attempts have been made to separate or distinguish the till in this area from the undifferentiated glacial till generally mapped in Saskatchewan. It appears to be very similar to that underlying most of the Weyburn and Oxbow soils, being a moderately to highly calcareous and stony clay loam. This glacial till is the parent material of the Weyburn soils mapped on the Farm.

Glacial Till (Stream Eroded)

This parent material which is a modification of the undifferentiated glacial till, is found at the lower elevations of the upland area, adjacent to the valley edges, and is generally located below the 2145' - 2150' contours. It represents areas from which erosion has removed all lacustrine deposition and some of the till, leaving a relatively stony surface, on which large boulders and occasional pockets of gravelly outwash may be found. The soils developed on this parent material are classified as Weyburn (eroded phase) being generally more stony and frequently more shallow than the average profile of the Weyburn soil.

The eroded valley sides, where till is exposed, may also be classed with this parent material. However, the truncated soils formed here are placed in the category of miscellaneous soils and classified with eroded lands.

Silty Lacustrine Deposits

The deposits were laid down in the shallow marginal lake and consist of silty clay material ranging in thickness from 1' to 5', generally underlain by a gravelly sandy layer usually less than 1 foot in thickness. The deeper deposits of this material show varving below the horizon of lime accumulation. Occasional lenses of sand may occur within the deposit, but these are local in extent. One such area occurs on the S.E. 1/4 of 19 and various other small areas were observed in excavations made during the survey.

The silty deposit is the parent material of the Elstow Association as described in Soils Report No. 12. However, in the classification of the soils on the Farm, a modification of this has been made to meet a peculiar local condition. Over the greater portion of the Farm, the silty lacustrine deposit is so shallow that soil profile development has extended below the silty deposit, through the sandy contact and into the underlying till. This situation has resulted in a soil profile sufficiently different from the Elstow soil to warrant their separation, particularly on the detailed scale of mapping and survey used on an experimental farm.

Accordingly, these soils of mixed parent material have been separated from the Elstow, and have been given a new name, at least for the purposes of this survey. They have been called

the Scott soils, and will be described later in the report. No work has yet been done to determine the extent of these soils in the district at large, although it is probable that a considerable acreage of them occurs. Until such time, no attempt will be made to establish a soil association of this name, and the Scott soil may be regarded as a type of the Elstow Association.

In addition to the areas mapped as Scott soils, there is a fairly large acreage on the Farm, where the deposition is thick enough to include all or most of the soil profile development. In these cases, normal Elstow soils have been mapped.

Alluvial and Colluvial Deposits

These deposits are confined to the valley bottom of the Eagle Hill Creek, and have not been studied in any great detail in this report. They appear to be clay and heavy clay deposits. Colluvial deposits occur to a minor extent at the mouths of eroded gullies and bases of valley slopes. The soils on these materials have been classified as undifferentiated saline and alluvial soils.

Recent Alluvial Depositions

This type of sediment should not properly be considered as parent material, but has influenced some phases of the Scott and Elstow soils on the Farm. It consists of fairly recent deposits of surface soil material that has been accumulated by washing into shallow depressions and along drainage runways. It does not constitute the parent material of any soil type, but has resulted in the formation of deeper A horizons than would normally be expected. One such area occurs along the west side of the S.E. 1/4 of 20 and the N.E. 1/4 of 17, at the head and along the upper

reaches of a shallow draw that extends southward to the valley. The soils in these areas are generally a little deeper and darker in depth and surface color than the average of the soils, but have been described with their respective associations.

Soil Associations

The soils recognized and mapped on the Scott Station are listed in Table 4, and are described in the following sections under their respective associations. Virgin profiles of each soil were examined and sampled wherever possible, and these descriptions supplemented by observations of the cultivated soils in the field. The areas of soil considered significant were delineated, and representative samples of most areas were taken for analysis. The analyses are discussed in a later section. The locations of most of the soil examination sites are shown on the map, and are numbered corresponding to the descriptions in the report.

Weyburn Soils

The Weyburn soils consist of medium-textured chestnut soils developed on glacial till. Three profiles have been recognized in this survey, the hard columnar, calcareous earth, and shallow knoll members. Where these three members are found in close association, the relationship and sequence is generally topographic, that is, the shallow knoll, calcareous earth, and hard columnar profiles occur in that order proceeding from the upper knoll to the lower positions down the slope. Hard columnar profiles occupy the areas of greatest water penetration. Shallow knoll profiles dominate most of the tops of knolls and upper slopes.

The Weyburn soils occur in a scattered pattern across the

entire Farm in small areas of higher relief; but along the east side of Section 17, in the N.W. 1/4 of 21 and south of the valley in the N.E. 1/4 of 8, considerable acreages of Weyburn soil have been mapped. These Weyburn soils are mainly found as areas of till knobs and ridges above the lake level, areas of undulating resorted or lake wash till, or as glacial stream eroded till plain. The knolls and ridges vary from gently and roughly undulating to gently and moderately rolling according to degree of slope, and consist mainly of shallow knoll profiles with hard columnar types occurring towards the base of the slopes.

Throughout the gently sloping and undulating areas of lacustrine deposition, many very low knolls of partially washed glacial till occur. These areas have developed shallow calcareous knoll profiles. Most of them have such slight relief that they do not constitute a break in the topography from the gently sloping class.

The areas of stream-eroded till plain vary from gently and very gently sloping to gently undulating and rolling topography, and the soil consists mainly of stony phases of the hard columnar type.

Surface drainage on the Weyburn soils varies from good to excessive. The excessive drainage occurs mainly on the slopes of knolls and ridges, and has accentuated erosion and the formation of shallow knoll and thin eroded profiles. On areas of moderate surface drainage, columnar profiles have developed. Internal drainage of the till soils is fair to good, the depth to lime carbonate horizon varying from 13 to 23 inches below the surface, this being generally shallower than for the Scott and Elstow soils.

Little evidence of poor drainage has been observed on these soils.

The surface texture of most of the Weyburn soils is a loam, but some clay loam may be found, particularly where erosion has exposed subsurface material in the cultivated layer. Local gravelly and sandy textures may be found, but these are not of widespread occurrence.

The major areas of Weyburn soils are in native or cultivated pasture, but where cultivated the surface soil is of a good cloddy structure which crushes to medium sized granules.

The glacial till on this area is moderately stony; the stones, ranging in size from small cobble to large boulders, are of mixed origins. The Weyburn soils vary from moderately to very stony, the latter phase occurring most frequently on the eroded till areas where considerable quantities of finer materials have been removed by washing. Surface cobbly stone is present on the very shallow knoll profiles, and on the sloping sides of shallow drainage courses where the till is exposed or comes close to the surface of the lacustrine areas.

Some stone has been removed from the plots and other cultivated areas, but occasionally large boulders may be found partially hidden in the soil. A number of these, where located, have been shown on the map.

The hard columnar soil is not readily distinguished from the other soils on the Farm in surface color, but is generally distinguished by the occurrence of stones, which are generally absent from the Elstow and Scott Associations. The shallow knoll soils, and calcareous earth types which are widespread across the

Farm are readily distinguishable in the cultivated field because of their light brownish-grey to pale brown color which is contrasted with the dark greyish-brown to greyish-brown color of the other soils. They are also characterized by many small surface stones and frequent variation in density and color of crop from the surrounding areas. When tested with hydrochloric acid, they generally show effervescence, indicating the presence of lime carbonate in the surface soil.

Profile examinations were made of typical sites for the Weyburn Association. A typical Weyburn columnar profile was examined, sampled and photographed at Site 4 on the road cut along the east side of the N.E. 1/4 of 17, adjacent to the ornamental garden, and is described as follows:

Site 4. Weyburn Hard Columnar Member

A_{oo}	0-2"	dust mulch, dark greyish-brown color (10 YR 4/2).
A_1	2-4"	dark greyish-brown (10 YR 4/2), cloddy crushing to granular loam.
B_1	4-11"	yellowish-brown (5/4) columnar, gritty clay.
B_2	11-13"	similar to B_1 but slightly lighter in color.
B(ca)	13-30"	light brownish-grey (2.5 Y 6/2) massive, crushing to granular calcareous gritty clay.
C	30-40"	light brownish-grey massive gritty clay, less calcareous than B(ca). The profile was stony throughout.

Another site examined was located at the southwest end of the pasture on the N.W. 1/4 of 9 and represents a deeper example of the columnar soil with the lime concentration layer below 23".

Site 21

A_{oo}	0-2"	dust mulch, dark brown to brown (10 YR 4/3 - 5/3).
A_1	2-6"	very dark brown, moist color (10 YR 2/2), medium cloddy crushing to fine granular.
B_1	6-14"	dark yellowish-brown, spike columnar structure.
B_2	14-21"	yellowish-brown (5/6)(moist) faintly columnar breaking to cloddy and crushing to granular structure.
B(ca)	23"	pale brown (6/3) calcareous granular clay loam, small stones throughout profile.

Other field examinations of Weyburn columnar soil showed on the average 4-5" of brown A_1, over 8-9" of dark yellowish-brown columnar B_1, and a lime concentration layer occurring at depths from 13 to 23" below the surface.

A calcareous earth profile was examined in the field at Site 10 on the S.E. 1/4 of Section 19. This was located on a low ridge of Weyburn loam with a greyish-brown surface color, and was calcareous and stony at the surface.

Site 10

A	0-4"	loam, moderately calcareous
B_1	4-20"	heavy clay loam, moderately calcareous with faint structure.
B(ca)	20^+	strongly calcareous clay.

Examinations of shallow knoll profiles in the cultivated fields showed a slightly to moderately calcareous cultivated A horizon ranging from greyish-brown to light brownish-grey and pale brown gritty loam overlying a B(ca) horizon, varying from 6-14"

below the surface. Examination of knoll positions in undisturbed sod occasionally shows shallow columnar B_1 horizons, but under cultivation, these become mixed with the surface cultivated layers.

Elstow Soils

The Elstow soils consist of medium to moderately heavy textured soils developed on silty lacustrine deposits. As discussed in the section on parent materials, only those soils in which the profiles to below the lime carbonate horizons have developed in the silty deposit are designated as the Elstow Association. Shallower lacustrine soils in which profile development extends into the glacial till below are described under the Scott soils.

It must be recognized that it is difficult to separate soils such as the Scott and Elstow types, differing mainly in subsoil characteristics, without a considerable amount of digging, and then the boundaries must perforce be arbitrarily projected. However, the average of the range in surface color of the Elstow soil is a little darker than that found on the shallow Scott type and serves as a guide in recognition of these types.

Three Elstow profile types have been recognized and mapped in this survey. These include hard columnar and solodized members of average profile development, similar members with deeper than average development and with darker A_1 horizons due to topographic position, and high lime, calcareous profiles which occur in a few local patches within the main belt of Elstow soils.

The Elstow soils are not found in a widespread pattern across the Farm, but occur in local, fairly well defined areas. The largest area of Elstow soils occurs along the west and northwest

side of Section 19 west of a dividing height of land. This Elstow area extends west of the Farm into Section 18, and is characterized by local patches of calcareous soils which show very distinctly on the aerial photographs. The second largest area of Elstow soils occurs in an area centering on the C.N.R. railway line and includes portions of the S.W. and S.E. 1/4 of 20. Other smaller local areas of Elstow soil occur on the N.E. 1/4 of 17 east of the Farm buildings, in the S.W. 1/4 of 17 in Plot 4, Rotation J, and in the S.E. 1/4 of 17.

The Elstow areas, being those of deepest lacustrine deposition on the Farm, are generally of smooth, very gently to gently sloping topography, broken by a few shallow knolls and ridges, and slight depressional hollows and runways. These breaks in the sloping topography are not as numerous in the Elstow as they are in the Scott areas where the deposition is thinner.

Surface drainage is fair to good on the Elstow soils, depending on topography. The slight depressional areas collect some surface water, but only two poorly drained depressions occur. Internal drainage is generally good, allowing good percolation as evidenced by the leaching of the A horizons and the depth to lime carbonate which is generally found between 18" and 25" below the surface. An exception to this situation may occur on the calcareous patches of Elstow soil found on the west side of Section 19. Here, subsoil examinations showed moist conditions as compared to the dry subsoils of the columnar and solodized types, and it is possible that these calcareous patches, which usually are only a few yards in extent, may be due to upward movement of water at these localities.

The surface textures of the Elstow soils range from loam to clay loam; the subsoils are generally heavier, the B horizons averaging a silty clay. A few soil examinations indicated the presence of sandy lenses, but no areas of these were mapped. Stones are generally absent from the Elstow areas, excepting where a shallow till knoll is exposed at or near the surface. These knolls are infrequent in the Elstow areas.

The color of the surface soil in the Elstow areas corresponds very closely to the expected color range of chestnut or dark brown soils in this area. A range from dark greyish-brown to greyish-brown (10 YR 4/2 - 5/2) is most common. The areas of Elstow with slightly deeper and darker A horizons found in lower positions range from dark grey to dark greyish-brown (10 YR 4/1 - 4/2). The small patches of calcareous Elstow soil are usually lighter in color, averaging greyish-brown 2.5 Y (5/2).

Both hard columnar and solodized members have been mentioned as occurring in the Elstow Association, but it is doubtful if these two types can be separated on the Farm. Profile studies show a fairly uniform type of horizon development with characteristics common to both columnar and solodized soils, but not completely representing the full expression of development of either one. It may be possible that we have a type of profile development here that has not been heretofore recognized; or to enter into the realm of speculation, it may be that this is a soil that has gone through a stage of solodization and has now regraded and established characteristic colors and structures of the zonal columnar type of development. Specifically, these soils are distinguished by a

cloddy A_1 which is common to the region, underlain by a lighter colored A_2 horizon which shows a structure similar to but not as intense as that found in solodized profiles. This includes horizontal cleavage of the columns with light and dark interfaces and a generally porous condition. The B_1 and B_2 horizons, however, are not markedly solonetzic in structure. Normal lime carbonate horizons occur below, usually followed by signs of varving in the slightly weathered C horizons. Although chemical analyses of these profiles will be discussed in a later section of the report, it may be stated here that pH values for the A_2 and B_1 horizons of these soils are definitely more acid than is usually encountered in columnar dark brown soils.

Specific soil descriptions of located sites are given below:

Site 1

This profile was located on the S.E. 1/4 of 20, in the road cut on the east side of the Farm, directly opposite the lawn and ornamental garden. The topography was very gently sloping, and the profile site well drained. The site appeared to be on undisturbed sod.

A_{oo} 1" of dust mulch, presumably from road.

A_1 0-4" very dark to dark greyish-brown (10 YR 3/2 - 4/2) loam, soft cloddy structure breaking to fine granules.

A_2 4-9" brown (5/3) silty clay loam medium sized, distinct columnar structure breaking to medium flat horizontal segments or plates with light and dark faces.

B_1 9-14" yellowish to light yellowish-brown (10 YR 5/4 - 6/4) silty clay, hard columnar structure breaking to nutty

(nuciform) fragments. Columns show faint solonetzic characteristics, i.e. glossy coated with rootlets clinging to surfaces rather than penetrating the aggregates.

B_2 14-21" light yellowish-brown (6/4) (silty clay) narrow hard columns breaking to flat clods which crush to hard nuciform and powdery structure.

B(ca) 21-25" light brownish-grey (2.5 Y 6/2) silty clay, massive to faintly cloddy structure crushing to fine granules, strongly calcareous.

C 25-37" massive faintly columnar silty clay breaking to fine granules, strongly calcareous.

Alternate light and dark varves including 4 dark varves averaging 1/2" in thickness.

Light varves were light brownish-grey (2.5 Y 6/2).

Dark varves were grey in color (10 YR 5/1).

The lacustrine deposition ended at 37" where contact with the sandy overwash underlain by till was found.

D_1 (sandy) 37-42" a sandy layer, light grey in color (10 YR 7/1) with a distinctly pinkish-grey (7.5 Y 7/2) sandy layer about 3/4" thick.

D_2 42"+ glacial till, small stones, massive structure crushing to granular color, light brownish-grey (10 YR 6/2).

One Elstow profile was examined on the same road cut, but south of Site 1, being located 15 yards north of the pin marking the N.E. corner of Section 17. This profile was very similar to that of Site 1, but differed from it because of the presence of a

sandy lens in the lower horizons. As this sandy layer was underlain by silty lacustrine deposit, it was considered as an Elstow rather than a Scott type. The A_2 horizon appeared lighter in color and more deeply leached than in Site 1.

Site 39

A_{oo} 0-2" dust mulch.

A_1 2-7" dark greyish-brown (10 YR 4/2) clay loam, faintly columnar to cloddy structure.

A_2 7-13" yellowish-brown (10 YR 5/4) clay loam, large columns breaking to flat segments.

B_1 13-17" light yellowish-brown (10 YR 6/4) hard columnar breaking to solonetz-like nutty aggregates.

B_2 17-21" massive to faintly columnar structure.

D_1 (ca) 21-29" pale brown (6/3) sandy clay loam moderately to strongly calcareous.

D_1 29-33" pale brown sandy clay loam, slightly calcareous.

D_2 33-44" pale yellow (5 Y 7/3) silty clay, massive to slightly laminated structure, highly calcareous.

Site 38

This profile was located on the road allowance along the west side of Section 19, 126 yards south of the N.W. corner of the section, and on prairie sod. The topography was very gently sloping and the drainage good. The lacustrine deposition in this location is generally deeper than the average on the Farm.

A_1 0-5" very dark greyish-brown (10 YR 3/2) loam, soft cloddy structure.

A_2 5-7" dark brown (10 YR 4/3) clay loam columnar structure.

A_3 7-16" dark yellowish-brown (10 YR 4/4) silty clay loam, long columnar breaking to hard flat-topped segments.

B_1 16-22" yellowish-brown (10 YR 5/4) silty clay, medium columnar breaking to large nutty aggregates.

B_2 22-27" pale brown (10 YR 6/3) silty clay massive structure breaking to large clods.

B(ca) 27"+ light brownish-grey (2.5 Y 6/2) silty clay, massive structure, moderately calcareous.

C 42-46" light brownish-grey silty clay massive structure.

Other field examinations of the Elstow columnar and solodized type show the following features: A_1 horizons of about 4-5" dark greyish-brown loam on clay loam with A_2 horizons of 4-7" lighter in color and showing platy structure, A_3 horizons occasionally found, usually when the profile exhibits some solonetzic characteristics. The B_1 and B_2 horizons are generally silty clay in texture and vary in depth from 10 to 18". The lime carbonate horizon occurs from 18"-25" below the surface.

The Elstow soils with deeper than average development and darker A_1 are not extensively developed on the Farm, but occur in locally lower areas and along drainage-ways where deposition of surface soil material has occurred. This type of soil is found more frequently with the Scott soils. One small area occurs on the N.W. 1/4 of 19 near the north end of the Farm and has a very dark-grey surface color (10 YR 3/1). The lowest positions in this area show some signs of poor drainage. Another such area located in a shallow swale or drainage-way (Site 11, on the S.W. 1/4 of 19) showed a dark grey 10 YR 4/1 color with an A_1 horizon 6 1/2" thick.

In a drainage-way which crosses the east side of the Farm, two sites were examined where deposition material occurred. Site 7 indicated about 7" of dark, freshly deposited material over an old A horizon of 11". Farther down the same drainage-way at Site 20, evidence of a gley B_2 was found at 11-20" below the surface. The surface soil in this area was very dark grey in color.

It was not possible to obtain a virgin sod site for an examination of the calcareous (high lime) Elstow member, but a location in the N.W. 1/4 of 19 where this soil type crossed a grassed-in roadway between plots was examined. These areas consist of lighter colored irregular patches of slightly elevated relief which are calcareous at the surface, and vary in size from a few yards to over 30 yards in diameter.

Site 45

Very gently undulating position, occupying a very slightly elevated area about 20-30 yards wide.

A_1 (ca) 0-7" dark greyish-brown (10 YR 4/2) clay loam, cloddy structure, slightly calcareous, cultivated horizon.

A_2 7-12" greyish-brown (10 YR 5/2) light clay, faintly columnar breaking to fine cloddy structure, very slightly calcareous.

B(ca) 12-36" greyish-brown (2.5 Y 5/2) silty clay; massive breaking to medium cloddy, moderately strongly calcareous.

C 36"+ pale olive (5 Y 6/3) very fine sandy and silty clay, strongly calcareous and quite moist.

The surface cultivated soil was greyish-brown (2.5 Y 5/2) in color and moderately calcareous.

The moist condition of the subsoil in this location, contrasted to the dry nature of other subsoils examined, suggests the possibility of the rise of capillary or ground water at this and other similar sites.

Scott Soils

In the discussion of the silty lacustrine sediments in this area, it was stated that because of the shallow nature of much of this deposit, soil profile development had extended below the silty deposits and into the underlying sandy layer and glacial till. This situation resulted in soil profiles sufficiently different from the Elstow soils to warrant their separation. Where this has been done, the soils have been tentatively named the Scott soils, and described as such. As might be expected, the Scott soils have surface features very similar to those of the Elstow, and differ mainly in the subsoil characteristics.

Morphologically, the Scott soil has been separated from Elstow when the lime carbonate horizon occurs below the silty deposit. Because of the porous nature of the sandy layer which generally marks the juncture of the lacustrine till materials, the lime carbonate is found concentrated at the top of the till, and the sandy material is usually lime free. This sandy layer varies from a few inches to 20 inches in depth, but averages from 4-6", and may occur at from 14-27" below the surface. The total depth of lacustrine and sandy deposit, of course, determines the depth to the glacial till which in the Scott soil examined varied from 13-30" below the surface. When the silty lacustrine sediments were deeper than about 28", the B(ca) horizon was usually well within the silty

sediment and in these cases the soils were regarded as true Elstow types.

Essentially the same genetic profiles occur in the Scott as in the Elstow soils, with the variation in subsoil conditions referred to above.

Two main Scott profiles have been mapped and separated on the Farm, the columnar solodized member, as described in the Elstow soils, and similar soil profiles with deeper and darker than average A horizons due to topographic position or deposition of surface materials.

The Scott soils occupy the largest area of any of the soils mapped on the Farm, north of the Eagle Hill valley, and therefore no specific references to local areas need be made. The topography of the Scott areas varies from gently sloping (A_2) and very gently undulating (B_{2-1}) to gently sloping A_3, broken by very low knolls and ridges occupied by shallow knoll Weyburn soils, and slight depressional hollows and runways with deeper Scott soils. Compared to the Elstow, the Scott areas are usually a little rougher in topography. This would be expected because of the shallow lacustrine deposition which only partially modifies the morainic relief. They also have a greater proportion of sloping land which has accentuated erosion on this soil.

Surface drainage is generally good on the Scott soils and may tend to be somewhat excessive on the longer slopes. The internal drainage is probably more pronounced than on the Elstow soil since the sandy subsoil layer is closer to the surface, allowing for greater moisture drainage. It is likely that the moisture-holding

capacity of this soil is also inferior to the Elstow, particularly under drought conditions.

The surface texture of the Scott soils is loam, and of the B_1 horizons, silty clay. The sandy layers vary in texture from gravelly and sandy clay loams to gravelly or sandy loams. The glacial till subsoil horizons are usually clay loam to clay in texture.

Stones are infrequent on the Scott soil, but more plentiful than on the Elstow areas. Occasional big boulders may be found, and smaller stones are fairly numerous adjacent to shallow till knolls which are plentifully exposed within the Scott areas. Some stony and gravelly phases of the Scott soil have been textured and mapped out. In these areas the lacustrine deposits are usually very shallow with the gravelly lenses or glacial till occurring near the surface.

The color of the surface Scott soil is dominantly dark greyish-brown (10 YR 4/2) but variations from greyish-brown to brown (10 YR 5/2, 4/3, 5/3) occur.

In the darker Scott soils, Stt(C), the surface color ranges from very dark grey, dark grey, dark greyish-brown to very dark greyish-brown (10 YR 3/1, 4/1, 4/2, 3/2).

Specific soil descriptions on located sites are given below:

Site 37

Scott type, columnar-solodized member, north side of road allowance, 40 yards west of the gate in the middle of the north side of 19. The vegetation at this site was prairie grass and sage, the topography very gently sloping, and the drainage good.

A_1	0-4"	very dark greyish-brown (10 YR 3/2) loam, medium soft cloddy crushing to fine granules. This horizon may include some dust mulch.
A_2	4-6"	dark greyish-brown to brown (10 YR 4/2-3) medium hard columnar breaking to platy structure and crushing to structureless or very fine granular loam.
B_1	6-14"	yellowish-brown (10 YR 5/4) silty clay, large columns cleaving to narrow spike columns.
B_2	14-18"	yellowish-brown (5/4) large segmented columns breaking to medium granular. An occasional smooth pebble was found in this horizon.
D(sandy)	18-23"	light brownish-grey (2.5 Y 6/2) sandy loam, large cloddy breaking to structureless and powdery conditions. Stones embedded in horizon.
D(till)	23-27"	light brownish-grey (10 YR 6/2). Large cloddy breaking to fine granular, not calcareous.
D(ca)	27"+	light brownish-grey mottled with white concretions, cloddy to granular structure, moderately to highly calcareous.

Site 3

Scott type, columnar solodized member. Location, N.E. 1/4 of 17, 10 yards south of section pin; very gently sloping land with good drainage.

A_{oo}	0-2"	dust mulch.
A_1	2-6"	very dark greyish-brown (10 YR 3/2) loam, cloddy structure.
A_2	6-13"	dark yellowish-brown (10 YR 4/4) clay loam, large columns breaking into horizontal segments.

B_1	13-19"	yellowish-brown (10 YR 5/4) silty clay, fine columns breaking to nutty structure.
D(sandy)	19-25"	gravelly clay loam, pale olive (5 Y 6/3) color. Massive gritty structure, not calcareous.
D(ca)	25-33"	gravelly clay loam, pale olive (5 Y 6/3) with white concretions, moderately calcareous.
D(till)	33"+	light brownish-grey (10 YR 6/2) stony calcareous glacial till.

Other field examinations of this soil showed a cultivated A horizon of from 3-8", and an average of 5" thick. The B horizon ranges from 8-16" depending on the depth to the sandy gravelly layer. The gravel layer varied from less than 2" to over 20" but averaged 4-6". The lime free layer varied from 13-30" depending on the depth to till.

Examination of areas that had suffered from erosion indicated removal of portions of the A_1 horizon and incorporation of B_1 material in the cultivated layer. The darker phases of Scott soil, where examined, showed A horizons of from 8-14" and ranged in color from very dark grey to dark greyish-brown. The lime layer was generally found below 22" in these areas. Few of these darker soil areas appeared to be poorly drained.

Alluvium

The soils classified as occurring on alluvial deposits may be divided into two classes on the Experimental Farm, the saline alluvium found in the bottom of the Eagle Hill Creek valley, and the slough bottom and meadow soils occurring on recent alluvial

deposits in the upland area. Neither of these types has been studied in detail on the Farm, as they are largely non-arable.

The saline (solonchak) soils of the valley bottom are of heavy texture, and immature profile development. Salts are present throughout the solum. They support a vegetation of sedges, wild barley and other saline-tolerant grass vegetation.

The recent alluvial, slough-bottom soils were generally wet at the time of survey. One large slough area occurs on the N.W. 1/4 of 21. This area has a vegetation of sedge, aspens and willows.

Slough Bottom Soils

A few small sloughs occur on Section 19. These are semi-permanently wet and have a vegetation of aspen, willows and sedge. Adjacent to these slough bottom areas, soils of the Scott Association exhibit signs of poor drainage.

Eroded Soils

No soil descriptions have been taken on the eroded valley sides of the Eagle Hill Creek. The soils are composed of immaturely developed and truncated profiles on erosional debris from glacial till.

CHEMICAL AND PHYSICAL COMPOSITION OF SOILS

Approximately 125 soil samples were taken on the Farm, and these were analysed in the laboratory for hygroscopic moisture, pH, nitrogen, phosphorus and carbonate effervescence. The Munsell color values and the soil textures were also confirmed in the laboratory, and mechanical analyses were made on selected samples. Seven complete profiles were sampled according to horizons. These

represent the main soil types identified on the Farm, and correspond to specific sites described for each association. A number of composite cultivated samples were taken, representing all major soil separations and areas. In addition, certain plots where fertilizer practices had been followed were sampled to ascertain if any significant differences in nutrient content could be measured.

Chemical Composition

The analyses of surface cultivated composites of the various soils mapped show little variation within one type, but the differences between soils are well defined, and illustrate very well the characteristics of each soil, which would be expected from field observations. The averages of these analyses are shown in Table 5.

Table 5 Laboratory Analyses of Surface Cultivated Soil Types. Scott Experimental Station Average pH, Nitrogen and Phosphorus Values.

Soil Type	No. of Composite Samples	pH	%N	%P
Weyburn (W)	2	6.5	0.275	0.070
Weyburn W(a) (shallow knoll)	3	7.9	0.206	0.062
Elstow (E) (columnar solodized)	4	5.6	0.358	0.075
Elstow E(ca) (calcareous)	1	8.0	0.255	0.068
Scott (Stt) (columnar solodized)	10	5.5	.276	.062
Scott (deep phase) Stt(c)	4	5.6	0.401	0.074

Nitrogen values for the cultivated soils correspond very well to averages for the Dark Brown Soil Zone. Thus the nitrogen values for the Weyburn columnar and Scott columnar soils are 0.275 and 0.276% N. which correspond very closely to the average figures recorded for Weyburn Loam and Elstow Silt Loam in Soil Survey Report No. 12, Table 12, p. 187. The figures for Elstow soil, however,

appear to be somewhat higher, 0.358, but this may be partially accounted for by the heavier texture of the Elstow than the Scott. The lower nitrogen values for the shallow knoll compared to the columnar Weyburn soils confirm the profile and surface color differences recorded for these soils. Similarly, with the calcareous and columnar Elstow soils, the lower nitrogen values correspond to difference in color of the surface horizon. The differences between the columnar Scott and the deep phase, darker colored Scott soil found in hollows and depressional runways is well brought out by the nitrogen values. The latter type has over one and one half times the nitrogen of the columnar, well drained type; 0.401% as compared to 0.276% N.

The phosphorus content of all cultivated soils is quite uniform within and between the various soils. These values which range from 0.05% to 0.08% represent an average phosphorus content for chernozem and chestnut soils on glacial parent materials in Saskatchewan. For two sample sites in which signs of erosion were observed, the phosphorus values fell slightly below the average.

The pH values of the cultivated soils are very interesting. The Weyburn columnar type with an average pH value of 6.5 is close to normal for such soils. Likewise, the higher values, 7.9 - 8.0 for the shallow knoll type of Weyburn and the calcareous Elstow are to be expected in soils which have free carbonates in the surface cultivated horizons. The unusual and significant fact, however, is the low pH values for the columnar solodized, Elstow and Scott soils. These values are uniformly low in the cultivated layer, ranging from 5.2 to 5.8 with an average of 5.5 to 5.6 for both associations.

These values are among the most highly acid of any cultivated grassland soils analysed in Saskatchewan, despite the fact that the calcareous lime layer is found at shallow depths of from 12-30" over the entire Farm. There is apparently no significant difference in acidity between either the Elstow and the columnar Scott soil, or the deep phase Scott type. This fact may be correlated with the evidence found by pedological study of these soils; that the Scott and Elstow members exhibit morphological features common to solodized or regrading solodized soils, namely; a light colored platy A_2 horizon overlying a heavier illuviated B horizon.

Other grassland soil associations mapped in Saskatchewan on which fairly acid pH values are found include the Echo, Robsart, Trossachs, Estevan, Lloydminster, Waseca and Onion Lake soils, and these all include solodized members. It should be mentioned that samples of Elstow soils taken in other areas have occasionally shown pH values below 6, but in general the Elstow soils are more nearly neutral in reaction. pH values from 5.0 to 5.5 are considered as indicating a moderately acid soil, and the values obtained on the Elstow and Scott soils on this Farm raise the possibility that the acidity of these soils may be enough to affect plant growth, at least in the early stages. An interesting observation in this regard was made of growth conditions on Plot 1, Rotation J, the soil of which is mainly Scott Loam with a few areas of shallow calcareous Weyburn soil. This plot was sown to a crested wheat - alfalfa mixture, and it was noted that in certain patches the alfalfa was considerably taller and more vigorous than on the area as a whole. More detailed observation established the

point that this vigorous growth was generally confined to the calcareous Weyburn soil. Results of analyses from closely sampled areas, as in the sampling of fertilizer plots, show that the pH values are very sensitive in recording soil changes on this Farm. As an example, samples were taken across a series of plots in which various applications of manure were applied in a 3-year rotation. A small calcareous Weyburn area happened to lie across these series of plots which were dominantly Scott soil. The pH values recorded from each plot in succession across the block are shown as follows: 5.6, 6.0, 6.1, 6.6, 7.7, 7.6, 7.4, 6.0, 5.9, 5.8, 5.8, 5.6, 5.5, 5.5, 5.6, 5.6, 5.8, 6.0, 5.8. The samples with a pH value of 7.7, 7.6, 7.4, lay within the area of the calcareous Weyburn soil.

From a study of the analyses for the cultivated soils on the Farm, the following points appear worthy of consideration from the standpoint of the agronomists and soil specialists:

1. The Scott columnar type of soil which is dominant on the Farm appears to be fairly uniform in pH, nitrogen and phosphorus values. It is significantly more acid than the general type of dark brown soil found in Saskatchewan.

2. The deep Scott type, Stt(c) and the Weyburn calcareous soil W(a) which occur in scattered fashion throughout the areas of Scott soils are distinctly different from the dominant type, the former by reason of its higher nitrogen content and the latter by its higher pH. Therefore in the laying out, or interpretation of experiments, cognizance should be taken of these soil variabilities where they occur on a set of plots or treatments.

The effects of cultivation and cropping on the original

nutrient content of the soils are shown in Table 6 which gives the nitrogen and phosphorus content of paired samples of virgin and cultivated soils. It was difficult to obtain reliable virgin samples on the Farm, and the figures for nitrogen on these sod samples appear rather high. The figures for cultivated soils are average for the zone.

Table 6 Nitrogen and Phosphorus Content of Paired Virgin and Cultivated Soil

Soil Type		% N	% P	
Scott	sod	0.431	.071	
	cultivated	0.292	.060	Average loss of Nitrogen 37.9%
Scott	sod	0.391	.072	
	cultivated	0.291	.068	
Elstow	sod	0.642	0.082	
	cultivated	0.327	0.062	Average loss of Phosphorus 26.4%

The comparisons between sod and cultivated show a loss of potential fertility under cultivation of 38% nitrogen and 26% phosphorus. These losses are somewhat higher than average for dark brown or chestnut soils. Figures reported from other areas indicate approximately 23% loss of nitrogen on Elstow and 18% on Weyburn soils.

The analyses of seven profiles sampled according to horizons, are reported in Table 7. These profiles identified by site number correspond to typical site examinations described under their respective soil association.

Table 7 -- Laboratory Analyses of Representative Soil Profiles, Scott Exp. Station

Soil Type	Site No.* Sample No.	Horizon and depth in inches	Hyg. Moist.	%N.	%P.	pH	Efferves-cence (CO_3)	Color	Texture
Weyburn (columnar)	Site 4								
	No. 37	A_{o-1} 0-6	2.81	0.600	0.088	7.1	0	2.5 Y 3/2	L
	38	B_1 4-11	1.77	0.122	0.048	6.2	0	10 YR 5/4	C
	39	B(ca) 13-30	1.23	0.066	0.044	8.1	very strong	2.5 Y 6/2	C
	40	C 30+	1.07	0.043	0.044	8.1	strong	10 YR 6/2	
Elstow	Site 1								
	No. 17	A_1 0-4	2.65	0.434	0.078	7.3	0	10 YR 4/2	HvL
	18	A_2 4-9.5	1.88	0.153	0.035	6.8	0	" 4/4	CL(Si)
	19	B_1 9.5-14	2.30	0.116	0.050	7.2	0	" 5/4	SiC
	20	B_2 14-21	2.56	0.092	0.052	7.9	0	" 6/4	SiC
	21	B(ca) 21-25.5	2.29	0.082	0.057	8.4	strong	" 6/3	SiC
	22	light varves C-25-37	2.54	0.072	0.044	8.5	very strong	2.5 Y 6/2	SiC
	23	dark varves	3.84	0.114	0.053	8.0	moderate	10 YR 5/1	
	24	D_1	0.39	0.020	0.046	8.6	moderate	" 7/1	
		D_1 37-42							
	25	D_{1A}	0.18	0.013	0.013	8.6	moderate	7.5 YR 7/2	
	26	D_2 42+	1.24	0.030	0.052	8.4	strong	10 YR 6/3	
Elstow	Site 38								
	No. 9	A_1 0-5	2.99	0.642	0.082	6.1	0	10 YR 3/2	L
	10	A_2 5.5-7.5	2.02	0.286	0.069	5.6	0	" 4/3	CL
	11	A_3 7.5-16	1.56	0.120	0.045	6.1	0	" 4/4	SiC
	12	B_1 16-22.5	2.12	0.087	0.052	6.4	0	" 5/4	SiC
	13	B_2 22.5-27	2.50	0.097	0.049	7.3	0	" 6/3	
	14	B(ca) 27+	1.88	0.054	0.053	8.2	very strong	2.5 Y 6/2	SiC
	15	C 42-46	2.12	0.041	0.052	8.5	strong	6/2	SiC
	16	cultivated composite 0-6	2.24	0.327	0.062	6.0	0	10 YR 4/2	CL
Elstow (sandy sub-soil layer)	Site 39								
	No. 27	A_1 2-7	1.97	0.238		7.2	0	10 YR 4/2	CL
	28	A_2 7-13	1.67	0.137	0.049	7.4	0	" 5/4	CL
	29	B_1 13.5-17.5	1.92	0.110	0.051	7.3	0	" 6/4	C(Si)
	30	D(ca) sandy 21-29	0.77	0.050	0.039	8.2	strong	" 6/3	SCL
	31	D(ca) silty 33-44	1.76	0.046	0.066	8.5	strong	5 Y 7/3	SiC

* Site No. The field description of these profiles is discussed in the section on Soil Association and Descriptions.

(continued) Table 7 -- Laboratory Analyses of Representative Soil Profiles, Scott Exp. Station

Soil Type	Site No. Sample No.	Horizon and depth in inches	Hyg. Moist.	%N.	%P.	pH	Efferves-cence (CO_3)	Color	Texture
Elstow (calcareous)	Site 45								
	No. 41	A_1 0-7.5	2.25	0.246	0.051	7.8	slight	10 YR 4/2	CL
	42	A_2 7.5-12.5	2.09	0.153	0.055	8.0	slight	" 5/2	C
	43	B(ca)12.5-36	1.98	0.148	0.042	8.1	strong	2.5 Y 5/2	C(Si)
	44	C 36+	1.68	0.064	0.052	8.4	strong	5 Y 6/3	
	45	cultivated composite 0-6	2.06	0.255	0.068	8.0	moderate	2.5 Y 5/2	C
Scott	Site 37								
	No. 1	A_1 0-4	2.24	0.508	0.071	6.4	0	10 YR 3/2	L
	2	A_2 4-6	1.51	0.277	0.069	6.3	0	" 4/2	L
	3	B_1 6-14	1.71	0.125	0.068	6.2	0	" 5/4	CL
	4	B_2 14-18	1.68	0.092	0.054	6.2	0	" 5/4	CL(Si)
	5	D(sandy) 18-23	0.37	0.020	0.027	6.5	0	2.5 Y 6/2	SCL
	6	D(till) 23-27.5	0.97	0.028	0.051	7.7	moderate	" 6/2	SC
	7	D(ca)	0.92	0.038	0.042	8.3	strong	" 6/2	C
	8	cultivated composite 0-6	1.84	0.292	0.060	5.4	0	10 YR 3/2	L
Scott	Site 3								
	No. 32	A_1 2-6	2.31	0.380	0.085	7.0	0	10 YR 3/2	L
	33	A_2 6-13	1.51	0.150	0.055	6.4	0	" 4/4	CL
	34	B_1 13-19	1.86	0.125	0.055	6.3	0	" 5/4	SiC
	35	D(sandy) 19-33	0.70	0.060	0.036	7.0	0	5 Y 6/3	CL
	36	D(till) 33+	0.96	0.064	0.038	8.1	very strong	2.5 Y 6/2	

In general, the results confirm the morphological and pedogenic interpretation of these soils. Unfortunately, profiles from sites 1, 3, 4 and 39 were of necessity taken along the edge of the highway on the east side of the Farm, and high pH values (7 or higher) obtained suggest some contamination from outside causes in the surface horizon. However, sites 37 and 38 were taken in areas removed from highway dust contamination, and here the pH values correspond more closely to those obtained in the cultivated soil, showing well defined acid A_2 horizons.

The A_1 horizons of all samples excepting sites 39 and 45 on the Elstow and site 3 on the Scott show higher nitrogen values in the A_1 than are usually reported in this zone. No definite explanation of this can be made, but it may be due to high organic matter accumulation in the shallow dust mulch incorporated into the A_1 horizons. The separation of A_1 and A_2 horizons in the Elstow and Scott solodized soils is well confirmed by the analysis, showing a considerable decrease of nitrogen, slight decrease of phosphorus, and differing Munsell color values in the A_2 horizons.

The Weyburn soils show no comparable separation of A_1 and A_2 horizons. The calcareous Elstow profile shows low nitrogen values in the surface horizon, and the high pH values confirm the carbonate effervescence found in the field examinations. Another interesting feature of this profile is the change in Munsell color values from the 10 YR to the 2.5 Y and 5Y charts, in the lower horizons. Although insufficient data has been obtained to date, it appears that soil horizons exhibiting characteristics of hydromorphic or poor drainage conditions frequently have colors which

compare more closely to the 2.5 Y and 5 Y charts which tend to yellow and olive values, whereas well drained soils in Saskatchewan may be best compared with the 10 YR chart. Horizons of calcium carbonate accumulation frequently may be best compared closely to the 2.5 Y chart. The moist conditions of the subsoil horizons in this calcareous Elstow soil were noted in the field examinations.

The horizon of calcium carbonate accumulations, B(ca), are distinguished by pH values of 8.0 or over. It may be noted in the Scott soils that this change coincides with the sandy contact between the lacustrine and till materials, while in the deeper Elstow soils as in site 1, the B(ca) occurs within the lacustrine material. From the Elstow profile (site 1) separate samples of the light and dark colored varves in the lacustrine parent material were analysed. The dark varves appear slightly heavier in texture and higher in nitrogen and phosphorus than the light colored, more silty varves, but these latter have a higher pH value than the dark, heavier deposit.

Physical Composition

Mechanical analyses by the pipette method were performed on three composite samples from cultivated areas, and are shown in Table 8.

Table 8

Mechanical Composition of Surface Cultivated Soils

Scott Experimental Farm

Soil Type	Sample No.	Percentage of Soil Separates (calculated to 100% mineral matter) Sand over .05 mm.	Silt .05-.002 mm.	Clay below .002 mm.
Elstow clay loam	SH 16	25.6	48.1	26.3
Scott loam	SH 62	33.0	42.3	24.7
Scott loam	SH 53	42.8	36.2	21.0

The Elstow Clay Loam is quite high in silt content and might be regarded as very close to a silty clay loam. Sample 62 from a Scott area is just below the tentative limits for a clay loam, and may be considered as a heavy loam texture. Sample 53 may be regarded as an average loam soil.

Analyses of Samples from Manure and Fertilizer Treatments

Three experimental rotations were sampled during the survey of the Farm, two including various rotation treatments with barnyard manure and the third with artificial fertilizer. No attempt has been made to treat these results statistically, and only general observations can be made on the results.

1. Manure on wheat, F 501-rotation, 3-year rotation, fallow-wheat-wheat, sampling 0-6" depth; A composite sample of 5 sites equally spaced through the centre line of each plot. All sampling was done in the fallow plots. It was noted that wheat on manured plots showed greener and taller than on check strips. This rotation has been running since 1935, thus completing 5 cycles and entering the first year of the 6th cycle.

Three rates of application of manure: 6, 12 and 18 tons have been used, and two differing times of application, i.e. manure applied before ploughing in the fallow year, and secondly, manure applied before seeding on the stubble crop. The average nitrogen and phosphorus values are shown in Table 9 which is arranged to correspond to the sequence of treatments in the rotation.

Study of the figures in Table 9 illustrate the difficulty of evaluating such results with regard to residual effect, where soil variabilities in the experiments have to be taken into account.

Assuming that 5 applications of manure at 20 tons per acre have been applied, and also assuming a fertilizer composition for manure of 0.5 - 0.25 - 0.5, the latter highly theoretical, then with no losses of nutrient added by cropping, leaching etc. and no additions of nitrogen by increased organism activity, one could expect a maximum gain in nitrogen of about .005% and of phosphorus of approximately .001% in residual effects.

Table 9

Chemical Composition of Surface Soil from Fallow Plots,

Rotation F.501

Manured Treatments on 3-year Rotation

Sample No.	Rate of Application in tons/acre	Treatment	% N	% P	pH	Soil Type
73	6 tons/acre	Manured	.341	.087	5.6	Stt(c)
74	12 "	in	.234	.078	6.0	Stt(c)
75	18 "	fallow year	.385	.080	6.1	Stt(c)
76	0 "	Check	.278	.061	6.6	W
77	6 "	Manured	.246	.069	7.7	W(a)
78	12 "	before	.247	.077	7.6	W
79	18 "	seeding stubble	.226	.065	7.4	W
80	0 "	Check	.198	.072	6.0	Stt.
81	6 "	Manured	----	.068	5.9	Stt
82	12 "	in	.286	.076	5.8	Stt
83	18 "	fallow year	.307	.077	5.8	Stt
84	0 "	Check	.247	.056	5.6	Stt
85	0 "	Single	.234	.066	5.5	Stt
86	0 "	samples	.234	.064	5.5	Stt
87	0 "	taken across	----	.072	5.6	Stt
88	0 "	1 plot	.273	.076	5.6	Stt
89	6 "	Manured	.239	.066	5.8	Stt
90	12 "	before	.230	.074	6.0	Stt
91	18 "	seeding stubble	.252	.077	5.8	Stt

Looking at the table of results, it can be seen that samples 73, 74, 75, taken on manured plots on Scott(c) soil, have no check plot on the same type of soil. This type has a higher nitrogen or phosphorus

content than all other samples in the experiment. Samples 76, 77, 78, 79 are located on Weyburn soil with a higher pH value than any other soils. Casual observation will show that the check plot on the Weyburn has a higher nitrogen but lower phosphorus value than any of the 3 manure treatments.

Presumably samples 80 to 91, being located on Scott columnar type, may be examined as a unit. Sample 80, being at the juncture of Scott and Weyburn soil and with a low nitrogen content, might possibly be excluded. The other 5 check samples taken across one plot, show a reasonable uniformity in nitrogen value, ranging from .23 to .27% N., and phosphorus value from .056 to .076. pH is very uniform across the plot, and indeed on the whole set of samples from Sample 81 to 91. The figures shown for the treatments are the average of 5 samples from each plot. Comparing the figures on the Scott soil, we can arrange them as shown in Table 8.

Table 10

Analyses of Manured and Untreated Plots on Scott Columnar Soil to Show Variations in Nitrogen and Phosphorus Content

Treatments	% N.	Differ. from check %	% P.	Differ. from check %
Check	.247(± .02)		.067(± .01)	
Manured in stubble crop year				
6 tons/acre	.239	-.008	.068	+.001
12 " "	.230	-.017	.076	+.009
18 " "	.252	+.005	.077	+.010
Manured in fallow year (manured in year of sampling)				
6 tons/acre	----	----	.066	-.001
12 " "	.286	+.039	.074	+.007
18 " "	.307	+.060	.077	+.010

A comparison of these averages indicates little if any residual accumulation of nitrogen as shown in the stubble treatments, but an increase in the plots which have been freshly manured during the sampling season. On the other hand, there appears to be a slight increase in phosphorus content on all the treated plots. However, in all cases, the variations in soil as shown by the analysis of the 5 single check samples are as great as the differences between the average values for the various treatments.

2. Another experiment located on Section 19, on manured and check strips with a two-year rotation fertilized each summerfallow year. The results are shown in Table 11.

Table 11

Comparison of Manured and Check Plots, Section 19; Composite 6" Samples; Scott Soil, 2-Year Rotation, Wheat and Fallow

Treatment	pH	Analysis % N.	% P.
Check, Average of 10 sites	5.4	0.225	0.072
Manured 10 tons per acre, average of 10 sites	5.85	0.306	0.087

The increase in nitrogen and phosphorus content appeared to be more than would be expected by the addition of one year's application of manure.

3. The third set of treatments sampled was one in which various rates of artificial fertilizers had been applied on a 2-year rotation, wheat and fallow. The samples were taken from Range 4 and Range 6, Rotation F(511) and sampled in the summerfallow year. Composites of surface and subsoil were taken in most cases. The

soil on these plots is mainly of the Elstow columnar type with a few stony knolls of Weyburn soil and one or two areas of darker Elstow(c) soil. These latter types were avoided wherever possible. The results of analyses and arrangement of the experiment are shown in Table 12. This experiment has been carried on since 1942 and would therefore include 4 applications of fertilizer. Samples from Range 4, Plots G and I, with high surface pH values would indicate either an area of Weyburn soil or possibly contamination from the roadway.

Table 13

Average Phosphorus Contents of Treated and Untreated Plots on Elstow Loam

Treatment (4 times)	lbs. of phosphorus per acre/foot	Difference from check
Check	2110	0
40 lbs. 11-48-0	2320	+ 210
15 lbs. 11-48-0	2090	- 20
15 lbs. 2-19-0	2165	+ 55
40 lbs. 2-19-0	1770	- 340

The results shown in Table 13 do not appear capable of any clear interpretation as the maximum amount of phosphorus added to the highest rate, i.e. 40 lbs. 11-48-0 4 treatments, would be about 33 lbs.

Table 12

A Comparison of the Analyses of Fertilized and Untreated Plots on Experiment F(511)

Barley 1/4. Scott Farm. 1948.

Sampled in fallow - 2-year rotation since 1942.
i.e. 4 fertilizer applications.

Location of Samples		Treatment	Sample No. and Depth		% N.	% P.	pH	lbs. of P. per acre foot
Range	Plot							
4	G	check	96	0-6"	0.186	0.059	7.7	1910
		guard strip	97	6-12"	0.110	0.047	7.9	
4	1	15 lbs.	98	0-6	0.219	0.073	7.1	2450
		11-48-0	99	6-12	0.165	0.062	7.9	
4	2	20 lbs.	100	0-6	0.257	0.045	6.8	
		11-48-0						
4	3	25 lbs.	101	0-6	0.245	0.062	6.5	
		11-48-0						
4	4	30 lbs.	102	0-6	0.230	0.071	6.1	
		11-48-0						
4	5	35 lbs.	103	0-6	0.278	0.072	5.6	
		11-48-0						
4	6	40 lbs.	104	0-6	0.273	0.077	5.7	2300
		11-48-0	105	6-12	0.137	0.050	6.7	
4	7	check	106	0-6	0.308	0.069	5.5	2200
			107	6-12	0.134	0.052	6.2	
4	8	15 lbs.	108	0-6	0.295	0.082	5.5	2240
		2-19-0	109	6-12	0.128	0.041	6.0	
4	13	40 lbs.	110	0-6	0.216	0.063	5.5	1880
		2-19-0	111	6-12	0.206	0.041	6.0	
4	14	15 lbs.	112	0-6	0.294	0.071	5.3	2090
		11-48-0	113	6-12	0.165	0.044	6.1	
4	19	40 lbs.	114	0-6	0.303	0.078	5.5	2340
		11-48-0	115	6-12	0.157	0.052	5.9	
4	20	check	116	0-6	0.305	0.065	5.8	2020
			117	6-12	0.144	0.046	6.1	
4	21	15 lbs.	118	0-6	0.329	0.066	5.6	2090
		2-19-0	119	6-12	0.206	0.049	6.3	
4	26	40 lbs.	120	0-6	0.236	0.053	5.6	1660
		2-19-0	121	6-12	0.153	0.039	6.5	

Excluding plots 4G and 4.1 where pH values indicate soil variability, the average total phosphorus contents in lbs. per acre/foot are shown in Table 13.

AGRICULTURAL PROBLEMS

In the discussion of the climatic data at Scott, it was stated that the Station is important in comparison to others established on the prairies, in that its crops are developed on a low average rainfall and a short season. In this respect, the conditions at Scott are comparable to a large area of north-west Saskatchewan and east-central Alberta.

The Farm may be considered to represent an average medium-textured chestnut or dark brown loam soil, comparable to the Weyburn and Elstow loam soils west of the Coteau in Saskatchewan and similar to the dark brown glacial till, resorted till and lacustrine alluvial loam soils of Alberta from the Saskatchewan border westward to the Wainwright and Coronation region, but probably not as far west or south as Sullivan Lake or Hanna. In addition, a considerable portion of the shallow black loam soils in Saskatchewan such as the Oxbow, Waseca and Blaine Lake soils, west of the Coteau and south of the North Saskatchewan River, and shallow black soils in Alberta as far north as the Vermilion and west to the Viking area, might be considered as reasonably similar in general agricultural adaptation. Heavier soils in these areas, such as clays and heavy clays, light textured sandy types and those associations with well developed solonetz structures could not be closely compared to the soils at the Scott Station. However, it is no exaggeration to say that the soil conditions at Scott may be compared to as large, if not a larger area than that of any other experimental farm in the prairie region.

The general textural characteristics of the Scott and

Elstow soils on the Farm are similar to other medium-textured soils on similar parent material, the surface texture ranging from loam to clay loam and being underlain by a somewhat heavier B horizon.

As might be expected with a low average rainfall on such soils, factors of drought resistance and moisture-holding capacity are dominant over almost all others in their effect on crop production, and in their influence on crop experimentation. Perusal of the Experimental Station reports for 1931-36 indicates that these factors are most important. Results with rotations, including grasses, various methods of summerfallowing, cover crops, etc. have shown that control of all unnecessary plant growth is essential for maximum grain production. Results have also shown that the three-year rotation with a second crop after fallow has outyielded the two-year alternate grain-fallow system.

Wind erosion, while it has been of serious proportions and consequences to the general area in past years, does not appear to have caused appreciable damage on the Scott Farm. The protection by extensive shelter belts and the system of small plots, with frequent grassed-in roadways characteristic of the Farm layout, tend to minimize soil damage from this source.

Water erosion, while not serious, has caused some damage on the Farm. The characteristic long, uniform, although very gentle slopes on the Farm tend to concentrate the flow of excess water into runways during spring thaws and after heavy rains. That this is not entirely the result of cultural practices is shown by the natural characteristic of the virgin soils, i.e., the shallow calcareous knolls, the areas of deeper dark colored soils lying in

runways and depressions, and the eroded till soils adjacent to the valley edge. However, cultivation does increase run-off and consequent damage to soils. A few acres on the Farm have suffered some sheet erosion, but it is difficult to ascertain the extent of topsoil removal. A few erosion rills were observed, particularly where open furrows concentrated the flow of water down a slope. Also along one or two of the roadways, the concentration of run-off water in ruts has tended to accentuate erosion. Apart from these minor occurrences, no serious erosion damage appears evident on the Farm.

The question of soil fertility has been discussed in the section on chemical composition. Results with the use of artificial fertilizers and barnyard manure have shown steady crop increases when moisture conditions were favourable. However, this statement may be applied to most soils of Saskatchewan.

The question of soil acidity has been discussed at length, and this factor should possibly be investigated further. It must be remembered that the potential acidity is confined largely to the top 20 inches of the soil, and that a plentiful supply of lime may be found at lower depths.

In conclusion, it may be stated that the Scott Experimental Farm is well located to serve a large area of the dark brown and shallow black soils of Saskatchewan and Alberta. Its location with respect to low rainfall and short season gives it decided advantages, from the standpoint of experimentation, with regard to moisture conservation and other problems common to prairie agriculture.

The cropping and cultural methods which have been stressed

on this Station have been well planned with these factors in mind, and it may be expected that the Scott Farm will continue to serve western agriculture with increasing effectiveness.