Copy N° 3.

Agric. Dept.

15

COPY
in HO
ACI WI
D2

Davies (R. O.)

Soil survey of Clarach Valley

M.Sc. Thesis

Univ. of Wales

1922

SOIL SURVEY OF CLARACH VALLEY

WITH SPECIAL REFERENCE TO

THE COLLEGE FARM - NANTCELLAN FAWR.

by

R. O. DAVIES.

SOIL SURVEY OF CLARACH VALLEY - WITH SPECIAL REFERENCE TO THE COLLEGE FARM - NANTCELLAN FAWR.

TABLE OF CONTENTS.

INTRODUCTORY.

OBJECT OF WORK.

These investigations were commenced at the time of taking over Nantcellan Fawr for experimental purposes by the Agricultural Department of the University College of Wales, Aberystwyth. It was considered to be an opportune moment for studying the soil both at the College Farm, and in Clarach Valley where the farm is situated, owing to the desirability of obtaining information regarding the characteristics of the soil at the commencement of the experimental period.

LAND INCLUDED IN SURVEY.

A soil survey of all the arable and grass land on the College Farm (approximately 142 acres) was first carried out. The work was then extended to the east and to the west of the farm so as to include a variety of soils from Clarach Valley. Special attention was paid to those portions of the valley which presented features of interest, and could be usefully compared and contrasted with the land on the College Farm.

SAMPLING PROCEDURE AT THE COLLEGE FARM.

In sampling at Nantcellan attention was first paid to those sections of the land which on account of their uniformity were best adapted for division into experimental plots. The rest of the farm was then divided for sampling purposes into small portions which, from a preliminary survey, could be seen to show variations from one another. These variations were apparent either from the general lie of the land, the appearance of the soil, or peculiarities in the vegetation.

CHAPTER 1.

GENERAL CHARACTERISTICS OF NANTCELLAN SOILS.

SITUATION, ASPECT AND ALTITUDE OF FARM LAND.

The College Farm is situated at a distance of 3 miles to the north east of Aberystwyth. Most of the land possesses a southern aspect, while the altitude varies from a few feet to about 400 ~~yards~~ feet. The farm is well sheltered from the north and north east, but is exposed to the south, south west, and westerly winds which are the prevailing winds of the district. As it is only at a distance of a mile from the shore it is highly probable that the sea air has a decided influence upon its soil and vegetation.

RAINFALL AT NANTCELLAN.

As the meteorogical records have only been recently commenced, no information is as yet available regarding the actual average rainfall at the College farm. The rainfall, however, is not likely to differ appreciably from that at Aberystwyth; and the monthly and yearly rainfall at Aberystwyth for the last ten years is given in Table 1.* An indication is obtained from the mean monthly figures of how the average yearly rainfall is distributed.

---

* These figures were obtained through the courtesy of Dr. Abraham Thomas, Aberystwyth.

Table 1.

Rainfall at Aberystwyth during 1912-1921.

(Garden rain gauge records.)

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	Mean.
Jan.	2.10	5.07	2.12	4.49	1.96	1.81	2.51	3.89	3.53	4.72	3.22
Feb.	2.10	1.28	3.62	4.76	3.37	1.59	2.83	1.73	2.25	0.33	2.39
March.	6.56	4.84	4.25	1.55	2.22	1.77	2.33	6.25	6.51	3.42	3.97
April.	0.48	4.86	0.48	1.87	2.30	2.25	1.16	2.23	5.38	1.50	2.25
May.	0.98	3.70	2.14	2.62	4.57	2.68	4.19	1.12	4.25	1.89	2.81
June.	4.60	3.71	1.83	1.29	2.00	2.61	1.49	3.35	3.32	0.60	2.48
July.	3.61	2.02	4.05	2.82	0.95	2.04	3.72	1.72	5.82	1.69	2.84
Aug.	6.34	2.06	3.25	1.62	1.71	9.45	2.24	3.66	2.42	5.67	3.84
Sept.	0.39	3.95	2.08	1.44	3.82	3.25	8.66	2.92	5.36	1.83	3.37
Oct.	4.65	3.62	1.29	2.45	6.55	6.02	3.89	2.67	3.34	2.58	3.71
Nov.	4.19	4.65	3.65	3.02	2.01	3.18	2.89	1.79	1.78	2.40	2.96
Dec.	4.90	2.08	7.36	6.21	3.25	1.78	5.22	6.07	2.62	3.38	4.29
Total	40.90	41.84	36.12	34.14	34.71	38.41	41.13	37.40	46.28	30.01	38.1

From Table 1. it is seen that the average yearly rainfall at Aberystwyth for the last ten years amounts to 38", and that this rainfall is fairly uniformly distributed throughout the year.

GENERAL DISTRIBUTION OF SOILS.

The lower reaches of the College farm, skirting the Clarach stream, consist of a flat surfaced pasture of alluvial origin, which merges somewhat indefinitely into a light glacial drift on a slightly higher level. This drift evidently runs in a zig zag manner, with occasional interuptions, throughout the lower portion of Clarach valley; and its path can be roughly traced during a period of prolonged drpught, as the effect of the drought on the colour of the vegetation here is to be seen earlier than in the declivities, where a greater depth of soil is found. From this light drift

one ascends a gradual slope of heavier soil culminating in a narrow strip of boulder clay, while the more abrupt slopes on a still higher level constitute the typical sedentary soil of the district.

CHARACTERISTICS OF SOILS FROM FIELD TO FIELD. (see Soil map of Nantcellan. page 22)

1. CAE'R EFAIL.

Approximately 15 acres of this field consist of alluvial soil, while the narrow portion of about 4 acres on the slightly higher ground bordering both the Borth and Bow Street roads is made up of glacial drift. The alluvial soil in this field is at such a low level that the question of draining it is very difficult to solve, and during past years the state of the drainage has been very unsatisfactory. At times of flood the overflow from the river into the fields of the adjoining farms Tyn-yr-abbey and Nantsiriol is diverted on account of the natural lie of the land into Cae'r Efail, and remains stagnant in the low lying section for a considerable period. For these reasons there has been an abnormal accumulation of organic matter in this part of the field (see Table 111, sample 3 page 13) and the pasture suffers considerable from the acid nature of the soil. The vegetation is characterised by an abundance of rushes, and during recent years the area involved in this type of vegetation has extended at the expense of the area under the superior type typical of the glacial drift portion of the field. Such a high proportion of clay and fine silt is present in this soil (see Table 111 sample 3 page 13) as to render it very heavy in spite of the large amount of organic matter.

The narrow strip of glacial drift is entirely different from the above as the high percentage of the coarser particles contained in it render the soil of a light open nature (see Table 111 sample 13). Like the alluvial portion,

however, it has been under permanent pasture, and has accumulated a good store of organic matter, though naturally at a much slower rate than the low lying alluvial soil.

2,3. GAT GOCH AND ARDD FAWR.

Both these fields have been continuously under the plough, apart from occasional rests in grass of from 2 - 3 years, and the soil as a consequence contains an abnormally low amount of organic matter. (see Table III. sample 1,2.) This probably largly accounts for the fact that Ardd Fawr was found to be exceptionally liable to suffer from the drought of 1921, the root crop suffering to a marked extent.

Of the 10½ acres in Gat Goch, 9¼ acres are made up of the lightest type of soil on the College farm (see Table III, sample 1.) This soil, which is 9" deep, lies on a gravelly substratum having a depth exceeding 20 ft. A shaft was sunk through the latter some years ago, and the reports from those who observed this substratum indicate that the gravel gets continuously of a coarser nature until its lower boundary is reached. Below this layer of gravel, a pan of about 2 ft. in thickness appears to have been formed. The north eastern corner of Gat Goch contains an acre of decidedly heavy soil, and suffers from the drainage water that lodges in it from an adjoining field. The depression which commences near the Borth Road is also found to differ from the bulk of the field, the soil being deeper, (this deeper soil is coloured so as to differentiate it from other drift in the soil map on page 22) and containing a lower proportion of stones. (see Table II. page 11 and compare samples 1 and 2.) This depression, which only includes about ¼ of an acre of Gat Goch, continues throughout the length of Ardd Fawr, and widens towards the south western section of the field. The 8½ acres from Ardd Fawr covered by it are distinctly heavy to work. The remaining 6 acres of soil in this field are very similar in texture to the major portion of Gat Goch, but past experience seems to indicate that it is liable to greater seasonal variations.

4,5. ANGRY HALL AND CAE DAN TY.

The soil in these fields is of a tenacious nature (see Table III, samples 15,20) excepting 1½ acres of light drift at the bottom of Cae Dan Ty, and 2 acres of similar drift at the summit of the slope in Angry Hall (see Table III, sample 16). There is also a tendency for the soil to get lighter than in the main portions of the fields at the eastern corner of Angry Hall adjoining Gat Goch. On account of its tenacious character, the bottom portion of Angry Hall readily gets water logged and as a consequence the herbage suffers markedly in this part, containing but little clover, while moss makes its appearance particularly during the winter months. The soil on the sloping portion of Angry Hall does not possess this disadvantage, as it gradually gets lighter, while excellent drainage is afforded. Can Dan Ty, although the soil here also is heavy, has always been regarded as a good field, especially suitable for meadow hay.

6,7. CAE LLOI AND CAE POND.

The above fields have soil very similar in nature to the heavy type in Angry Hall (compare samples 6,7, with sample 20. Table III.) These areas have practically always been left in grass.

8. CAE CHWAREL.

This field contains soil of a sedentary character (see Table III. samples 8,9.). There is a tendency towards water logging during wet weather on the 2½ acres nearest Cae Lloi, and this part of the field has been generally considered less suitable for arable purposes than the remaining portion.

9. CAE BRYN POETH.

The slope on the hillock is made up of light sedentary soil. The soil on the abrupt slope being shallow and having a south-westerly aspect is very liable to suffer from drought. The remaining 3 acres of this field consist of the heavy drift that composes such a large proportion of the farm land.

10. CAE MAWR.

The narrow strip of 4 acres fringing Cribin-llwyd trees (see soil map page 22) is made up of light sedentary soil. (see Table lll. sample 18.) The remaining 20 acres contain heavy land, being more markedly so at the northern section, where a strip of boulder clay is encountered. (see Table lll. samples 11,17.) This field has been occasionally ploughed, but of recent years it has been left under grass.

11. GILWERN.

A rectangular area of 4 acres running alongside the trees in Gilwern is also a typical boulder clay, and the mechanical analysis of the soil from this area shows it to be the heaviest soil on the farm. (see Table lll. sample 5.) This small section of heavy land is, however, not uniform, the heaviest clay being found near the road, and a slight tendency towards a lighter soil being noticable at the higher end of the rectangle. The soil in the remaining 5 acres of Gilwern, excepting a small plot at the north eastern corner which is exceptionally stiff, consists of lighter material (see Table lll, sample 21.), which still, however, is of a decidedly heavy nature.

The indications obtained from the analytical results regarding the exceptionally heavy nature of much of the soil in Gilwern are in close harmony with experience and practice in this field. We have found from previous occupiers that it was extraordinarily difficult to carry on the ordinary operations of cultivation, because when the weather was even only slightly wet, the soil was particularly liable to become puddled when cultivated, whereas a comparatively short period of dry weather would render the soil so hard as to make cultivation impossible. For this reason, previous occupiers have been compelled to leave the field down to bare fallow when they had attempted to prepare it for a root crop.

12. BANK.

With the exception of 3 acres at the bottom, which is a heavy drift, all the soil in this field is of a sedehtary character. This land has been found to be the healthiest on the farm for sheep grazing, and as a rule the crops grown here have been eaten off by sheep. Although the mechanical analysis of this soil shows it to contain a good proportion of clay and fine silt (see Table 111, samples 4,14.), yet the soil is of a light nature in the field, because it contains a high percentage of stones, while a very high percentage of stones is present in the subsoil. (see Table 11. sample 4, page 11). With the exception of wheat, good results are obtained in Bank with all arable land crops. Although highly situated, the highest reaches exceeding an altitude of 400 ft., the soil is not particularly liable to suffer from drought. This is because the land here, unlike the bulk of the farm, possesses a north western aspect.

13. JERICHO.

Here the soil is of a light sedentary nature similar to that in Bank. (see Table 111, sample 10 page 13 and Table 11 sample 10 page 11). Seventeen years ago this field ran wild under gorse, but was at that time cleared and put under the plough. It has, however, only been sparingly cultivated since, and has naturally not received as much attention as the more accessible land on the farm.

CHAPTER II.

MECHANICAL ANALYSIS OF SOILS AT NANTCELLAN.

DETERMINATION OF PERCENTAGE STONES AND GRAVEL.

Exceptionally large samples of the soils were retained in order to arrive at an indication of the variations in the proportion of stones and coarse gravel present. This was considered necessary because of the wide fluctuations apparent in this respect, which would have a pronounced effect on the soil conditions, and would considerably modify any deductions made from an analysis of the fine earth. Table II shows how the typical soils vary in this respect.

Table II.

Stones and Coarse Gravel in various Types of Soil.

Type of Soil.	Reference Number of Sample.	SOIL.			SUBSOIL.		
		% Stones above 1 cm. diam.	% Coarse Gravel 3 m.m.- 1 cm. diam.	Total	% Stones above 1 cm. diam.	% Coarse Gravel 3 m.m.- 1 cm. diam.	Total.
Alluvial	3 (Cae'r Efail).	3.0	79.2	82.2	1.5	40.3	41.8
Lighter Drift	1 (Gat Goch).	29.3	30.9	60.2	112.0	66.0	178.0
Lighter Drift	2 (Ardd Fawr).	13.0	27.5	40.5	18.6	60.0	78.6
Heavier Drift	11 (Cae Mawr).	10.4	40.0	50.4	0.5	50.0	50.5
Heavier Drift	6. (Cae Lloi).	40.0	72.0	112.0	2.2	57.4	59.4
Heavier Drift	5 (Gilwern).	6.5	3.0	9.5	16.0	15.7	31.7
Sedentary	4 (Bank).	73.5	85.0	158.5	112.0	98.0	210.0
Sedentary	8 (Cae Chwarel)	30.0	56.3	86.3	128.0	72.0	200.0
Sedentary	10 (Jericho)	41.0	60.0	101.0	120.0	70.0	190.0

The above percentages have been calculated on the amount of air dried soil passing through a 3 m.m. sieve.

DUCTIONS FROM TABLE II.

1. STONES AND COARSE GRAVEL IN ALLUVIAL SOIL.

While the total quantity of stones and coarse gravel in the alluvial soil (sample 3) is high, the alluvial subsoil contains a smaller total than any other soil excepting the boulder clay (sample 5).

2. STONES AND COARSE GRAVEL IN LIGHTER DRIFTS.

The percentage of coarse gravel is practically identical in the samples from the lighter drifts (samples 1,2.), but there is a marked difference in the percentage of stones. This difference is much greater between the subsoils than between the soils, a fact of some significance seeing that the subsoil is reached at a depth of 9" in the case of Gat Goch, while it is only reached at a depth of $2\frac{1}{2}$' in Ardd Fawr. The open subsoil being so near the surface in Gat Goch renders the field light in behaviour, while the less open subsoil in Ardd Fawr being at the same time so much further from the surface plays no such prominent a part in the aeration and drainage of the soil. As a consequence, while no marked difference is apparent in the mechanical analysis of these two portions (see Table III, samples 1,2 page 13), and they are therefore classified under the same type of drift, the Ardd Fawr soil is much heavier in the field than the Gat Goch soil.

3. STONES AND COARSE GRAVEL IN HEAVIER DRIFTS.

A very wide variation is found in the proportion of stones present in the soils of the heavier drift type (samples 5,6,11.). The heaviest soil amongst these (sample 5) contains a relatively small percentage, but a much larger proportion is present in those of a lighter nature. In all the samples from this type of drift, however, only a comparatively low percentage of stones and coarse gravel is to be found in the subsoils.

4. STONES IN THE SEDENTARY SOILS.

A high proportion of stones is found in the sedentary soils (samples 4,8,10) and especially so in the subsoils. Thus for every ton of fine earth in the sedentary subsoil about 2 tons of stones and coarse gravel are present. The high proportion of stones is the main factor contributing towards the light character of these soils.

MECHANICAL ANALYSIS.

The following table indicates the results of the mechanical analysis of the soils at Nantcellan (Table III). In some instances where the results were practically identical, the average analysis from two samples is given, and in those cases the numbers of both samples are inserted above the analysis.

TABLE III.

MECHANICAL ANALYSIS OF NANTCELLAN SOILS.

Type of Soil	Alluvial	LIGHTER DRIFT				HEAVIER			
Sample	3. Cae'r Efail.	13. Cae'r Efail.	1. Gat Goch	2. Ardd Fawr	16. Angry Hall. high portion	15. Cae Dan Ty	21. 'Gilwern' lighter portion	11. Cae Mawr' southern end.	6,7. Cae Lloi
Fine Gravel.	1.3	15.3	19.8	17.8	11.1	6.2	5.4	3.2	1.4
Coarse Sand.	1.3	11.4	9.5	12.2	6.2	6.4	2.1	2.8	1.6
Fine Sand.	3.9	10.1	11.0	8.9	14.4	15.1	12.3	13.6	11.0
Silt.	12.5	15.3	11.5	8.9	15.7	15.5	16.4	15.4	17.0
Fine Silt.	33.3	29.0	26.9	31.0	29.5	32.7	37.5	34.9	33.2
Clay.	21.5	7.1	9.1	10.6	11.8	10.8	11.4	13.8	15.0
Moisture.	6.5	2.8	4.7	3.0	1.0	1.7	2.0	3.4	4.8
Loss on Ignition.	22.9	11.4	9.2	7.3	9.2	10.0	11.0	11.7	12.0
Calcium Carbonate.	Nil.	0.01	0.03	Nil.	Nil.	Nil.	Nil.	0.01	Nil.
Subsoil.									
Fine Gravel.	0.0	22.9	33.2	33.6	29.5	9.3	7.4	3.1	0.6
Coarse Sand.	0.6	14.6	13.7	16.8	11.6	12.4	4.0	3.9	3.0
Fine Sand.	13.5	9.8	10.8	8.6	14.0	16.2	19.7	11.8	13.7
Silt.	12.8	11.7	8.7	6.7	12.8	14.6	18.3	20.0	17.6
Fine Silt.	34.7	24.8	18.0	16.4	18.3	25.8	30.2	32.2	31.2
Clay.	21.3	7.1	9.2	10.0	6.2	12.3	12.0	14.5	21.0
Moisture.	3.7	2.3	2.4	2.2	1.1	1.0	1.9	2.5	2.4
Loss on Ignition.	11.1	8.5	5.7	6.2	6.1	6.7	3.0	8.3	7.1
Calcium Carbonate.	--	--	--	--	--	--	--	--	--

analysis of the soils at Nantcellan (Table III). In some instances where the results were practically identical, the average analysis from two samples is given, and in those cases the numbers of both samples are inserted above the analysis.

TABLE III.

MECHANICAL ANALYSIS OF NANTCELLAN SOILS.

Type of Soil	Alluvial	L I G H T E R DRIFT				HEAVIER				DRIFT.			S E D E N T A R Y.					
Sample	3. Cae'r Efail.	13. Cae'r Efail.	1. Gat Goch	2. Ardd Fawr	16. Angry Hall. high portion	15. Cae Dan Ty	21. Gilwern lighter portion	11. Cae Mawr southern end.	6,7. Cae Lloi.	20. Angry Hall. bottom	17. Cae Mawr Northern end.	5. Gilwern heavier portion	10. Jericho	18. Cae Mawr	8,9. Cae Chwarel	14. Bank. higher portion.	4. Bank. lower portion.	12. Waste Land.
Fine Gravel.	1.3	15.3	19.8	17.8	11.1	6.2	5.4	3.2	1.4	3.3	1.0	1.6	17.2	12.4	13.9	13.9	15.9	13.4
Coarse Sand.	1.3	11.4	9.5	12.2	6.2	6.4	2.1	2.8	1.6	4.2	2.2	3.0	5.3	7.6	7.7	4.1	8.5	7.4
Fine Sand.	3.9	10.1	11.0	8.9	14.4	15.1	12.3	13.6	11.0	16.0	12.8	8.0	7.0	16.9	16.1	9.1	6.7	7.2
Silt.	12.5	15.3	11.5	8.9	15.7	15.5	16.4	15.4	17.0	15.5	14.4	14.6	10.2	12.2	12.7	12.7	13.1	14.2
Fine Silt.	33.3	29.0	26.9	31.0	29.5	32.7	37.5	34.9	33.2	34.4	35.7	36.2	27.4	24.0	25.0	31.0	25.9	27.3
Clay.	21.5	7.1	9.1	10.6	11.8	10.8	11.4	13.8	15.0	15.3	15.4	19.6	10.8	11.0	11.2	11.4	13.4	14.8
Moisture.	6.5	2.8	4.7	3.0	1.0	1.7	2.0	3.4	4.8	1.6	2.5	4.0	4.3	2.3	3.0	2.5	3.4	3.1
Loss on Ignition.	22.9	11.4	9.2	7.3	9.2	10.0	11.0	11.7	12.0	9.5	14.7	11.4	15.8	13.1	10.7	14.0	12.1	15.0
Calcium Carbonate.	Nil.	0.01	0.03	Nil.	Nil.	Nil.	Nil.	0.01	Nil.	0.01	--	--	--	--	--	--	0.01	--
Subsoil.																		
Fine Gravel.	0.0	22.9	33.2	33.6	29.5	9.3	7.4	3.1	0.6	1.6	0.0	2.8	19.3	14.4	17.7	20.4	18.5	18.8
Coarse Sand.	0.6	14.6	13.7	16.8	11.6	12.4	4.0	3.9	3.0	2.3	0.3	3.3	5.8	7.8	8.2	8.0	10.8	8.0
Fine Sand.	13.5	9.8	10.8	8.6	14.0	16.2	19.7	11.8	13.7	18.0	9.2	10.3	4.5	17.1	14.3	12.0	10.5	5.5
Silt.	12.8	11.7	8.7	6.7	12.8	14.6	18.3	20.0	17.6	17.2	15.3	13.1	12.6	10.6	13.0	16.3	12.9	12.4
Fine Silt.	34.7	24.8	18.0	16.4	18.3	25.8	30.2	32.2	31.2	34.2	35.5	31.5	23.1	26.9	24.3	26.4	24.2	28.2
Clay.	21.3	7.1	9.2	10.0	6.2	12.3	12.0	14.5	21.0	19.2	28.2	29.8	10.6	10.9	11.6	8.0	13.1	14.4
Moisture.	3.7	2.3	2.4	2.2	1.1	1.0	1.9	2.5	2.4	1.0	1.6	3.2	3.5	1.7	2.3	1.4	2.3	3.0
Loss on Ignition.	11.1	8.5	5.7	6.2	6.1	6.7	3.0	8.3	7.1	5.0	9.8	6.6	13.4	8.9	8.0	7.7	7.6	12.2
Calcium Carbonate.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

EFFECT OF HIGH CONTENT OF FINE SILT AND CLAY ON SOILS.

It is seen from Table III that with the exception of the lighter drifts all the soils at Nantcellan are characterised by a high clay content, together with a high proportion of fine silt. Excluding the lighter drifts, the remaining soils have a mean clay content of 14%, while the average percentage of fine silt reaches 31%. The soils in Cae'r Efail, Cae Mawr (drift portion), Cae Lloi, Angry Hall (bottom portion) and Gilwern(heavier portion) contain an exceptionally high percentage of fine silt (33 - 36%), accompanied by a very high proportion of clay (14 - 22%). Apart from Gilwern all these soils have been left as permanent pastures in recent times; while the cultivation of the heavier portion in Gilwern was latterly abandoned owing to the extreme difficulty of obtaining a satisfactory tilth.

EFFECT OF FINE SILT AND CLAY DIMINISHED BY A HIGH PROPORTION OF STONES.

Table III shows that the sedentary soils at Nantcellan are characterised by a high proportion of clay and fine silt to such an extent that having regard to the analysis of the fine earth alone they would be considered of a heavy nature. But these soils as indicated in Table II (page 11) contain a very high percentage of stones, which greatly modify the effect of the fine silt and clay in the field. This modification is so profound that the sedentary soils in the field have all the characteristics of light soils in spite of the mechanical composition of the fine earth.

LOSS ON IGNITION OF NANTCELLAN SOILS.

The highest loss on ignition by far is obtained in the case of the alluvial soil (see Table III, sample 3). Owing to the low situation of the field and the absence of an efficient drainage system, the high percentage of organic matter by no means obliterated the harmful effect of the fine silt and clay on the texture of the soil at the time of sampling. The drains and outlet were in such a faulty condition that the drainage water was found to be within 10" of the surface, although the sampling was done in comparatively dry weather.

The amount of organic matter present in the soils from Jericho (Table III, sample 10), the northern end of Cae Mawr (Table III, sample 17) and the higher portion of Bank (Table III, sample14) is also high compared with that in the other soils on the farm. While the mechanical composition of the mineral portion of the soil in Cae Mawr is such as to indicate quite a stiff clay, the presence of the high amount of organic matter tends to counterbalance this, so as to make the soil comparatively lighter than a similar soil in Gilwern (Table III, sample 5.) The minimum percentage of organic matter found in these soils is met with in Ardd Fawr (Table III, sample 2), and this is probably the field which has been most frequently cultivated.

A COMPARISON BETWEEN THE MECHANICAL STRUCTURE OF SOILS AND THAT OF SUBSOILS.

1. COMPARISON OF THE ALLUVIAL SOIL AND SUBSOIL.

There is no wide variation between the alluvial soil and subsoil (see Table III, sample 3), except that the subsoil contains more fine sand than the soil. This, however, may only be of slight significance as it is not known to what

extent the amount of this ingredient may vary among the soils themselves of this type.

2. CLOSE SIMILARITY BETWEEN THE SEDENTARY SOILS AND SUBSOILS.

In the sedentary soils of the south eastern counties of England the surface layer is generally coarser in texture than the subsoil, because during the whole process of formation of the soil there has been a washing down and washing away of the finest material leaving the larger and coarser grains on the surface *. In contrast to this a close similarity has been found to exist between the soil and subsoil of the sedentary soils examined at Nantcellan, this being apparent from Table IV which indicates the mean percentage of the various particles in all the sedentary soils and subsoils sampled at the farm.

TABLE IV.

Average Composition of Sedentary Soils and Subsoils at Nantcellan.

	Soil.	Subsoil.
Fine Gravel	14.4	18.2
Coarse Sand	6.8	8.1
Fine Sand	10.5	10.5
Silt	12.5	13.0
Fine Silt	26.8	25.5
Clay	12.1	11.4

3. COMPARISON OF SEDENTARY SOILS AND SUBSOILS AT DIFFERENT LEVELS ON SLOPING FIELD.

A comparison of the following two samples (Table V), one of which was taken immediately above the other on a sloping field shows that no washing of the finer particles from the surface soil of one to the other has occurred.

* Agriculture and Soils of Kent, Surrey and Sussex - Hall & Russell - page 62.

TABLE V.

Comparison of Sedentary Soils and Subsoils at different levels.

	No. 8. Sample A.(Cae Chwarel.) From higher portion of field. (Depth of soil , 9".)		No. 9 Sample B.(Cae Chwarel) From lower portion of field. (Depth of soil - 11".)	
	Soil.	Subsoil.	Soil.	Subsoil.
Fine Gravel.	18.1	19.7	9.8	15.6
Coarse Sand.	6.0	7.8	9.4	8.5
Fine Sand.	14.4	14.1	17.9	14.5
Silt.	12.4	13.4	13.1	12.6
Fine Silt.	25.4	23.5	24.6	25.0
Clay.	11.2	11.9	11.3	11.2.

4. COMPARISON OF SEDENTARY SOIL AND SUBSOIL ON STEEP SLOPE IN CLARACH.

To verify that the phenomenon referred to in the last two paragraphs were general throughout Clarach valley a sample of sedentary soil from an exceptionally steep slope at Nantsiriol farm was analysed. The following results (Table VI.) indicate the close resemblance between the soil and subsoil that still prevails.

TABLE VI.

Mechanical Analysis of Sedentary Soil and Subsoil from Steep Slope behind Nantsiriol (Sample 33). Depth of Soil - 6".

	Soil.	Subsoil.
Fine Gravel.	21.2	23.3
Coarse Sand.	9.1	10.7
Fine Sand.	13.9	11.1
Silt.	12.3	12.5
Fine Silt,	21.5	20.2
Clay.	7.8	7.9
Moisture.	3.3	2.0
Loss on Ignition	10.1	8.2

5. DIFFERENCE BETWEEN SOILS AND SUBSOILS ON LIGHTER DRIFTS.

Although there is a high percentage of fine silt in the lighter drift soils, it is evident from Table III. (page 13) that a much lower percentage of this ingredient is present in the subsoils. This greatly facilitates the drainage, which as a consequence is satisfactory in this type of drift.

6. DIFFERENCE BETWEEN SOILS AND SUBSOILS OF HEAVIER DRIFTS.

The heavier soils of glacial origin are characterised by subsoils containing more clay than the soils, and this divergence between soil and subsoil gets more pronounced as the clay content of the soil increases. Thus in the case of Cae Dan Ty (Table III. sample 15, page 13) where the clay content of the soil is 11 (the lowest amount of clay found among soils of this class) there is not much difference between the respective amounts of clay in the soil and subsoil, while at Gilwern (Table III, sample 5) where the soil contains about 20%, the subsoil contains as much as 30% of clay.

CHAPTER III.

CLASSIFICATION OF SOILS AT NANTCELLAN.

DIVISION OF THE SOILS INTO FOUR GROUPS.

The soils at Nantcellan can be divided, according to their mechanical composition (See Table III, page 13) into four distinct groups; namely, alluvial soil, heavier drift soil, lighter drift soil and sedentary soil.

DISTINGUISHING FEATURES OF ALLUVIAL SOIL.

The alluvial soil naturally stands in a group by itself, its behaviour being entirely unique owing to its situation, the high percentage of finer ingredients contained in both its soil and subsoil, the effect of which will be modified by the large amount of organic matter present.

DISTINCTION BETWEEN DRIFT SOILS AND SEDENTARY SOILS.

No difficulty is experienced in discriminating between the drift soils and those of a sedentary character; and even at levels where one type might merge into the other the line of demarcation can be definitely established owing to the difference in both the appearance and distribution of the stones.

DISTINCTIONS BETWEEN LIGHTER AND HEAVIER DRIFT SOILS.

1. A HIGHER CLAY CONTENT IN THE HEAVIER DRIFT SOILS.

The lighter drift soils on the average contain much less clay than the heavier drifts, the mean amount of clay in the former being 9.7%, while the mean in the latter is 14.5%. It is true that some of the heaviest soils in the lighter drifts may contain as much clay or even slightly more than the lightest soils in the heavier drifts, and the clay content of the soil alone can not be taken as the final criterion in the classification of these drifts.

2. THE HEAVIER DRIFT SUB-SOILS MORE FINELY GRAINED.

In the lighter drift soils the soil and subsoil either contain the same amount of clay, or else the subsoil contains less clay than the soil. In the heavier drift soils the subsoil contains more clay than the soil.

3. A HIGHER PROPORTION OF FINE GRAVEL IN LIGHTER DRIFT SOILS AND SUB-SOILS.

The lighter drift soils contain a high proportion of fine gravel and a marked increase in the proportion takes place on passing from soil to subsoil. A low proportion of fine gravel is found in the heavier drift soils, and there is but a slight increase, if any, in the proportion of this ingredient on reaching the subsoil.

4. WIDER AND MORE ABRUPT FLUCTUATIONS IN THE MECHANICAL COMPOSITION OF HEAVIER DRIFTS.

The fluctuations which take place from point to point within the heavier drift area are much more marked and sudden than those which occur in the area including the lighter drift soils. The significance of the sudden changes in the heavier drift soils becomes apparent from the following considerations:-

(a)The Fluctuations in the Heavier Drifts affect the Practice on the Farm.

In Gilwern field a portion of the heavier drift soil (see Table III, sample 21, page 13) is suitable for cultivation, while the other part (see Table III, sample 5 page) is much less tractable and is better suited for grass.

(b). These Fluctuations render the Effect of Drought variable from Point to Point.

The cracks which developed on the less tractable part of Gilwern during the drought of 1921 ranged from small shallow fissures to scars 3 inches wide, exceeding a foot in depth, and several yards in length. Certain portions of the soil in the same area remained free from cracks after prolonged

drought, and these contained better vegetation, notably a higher percentage of clover. No relationship could be found between the moisture content of the soil sections and the dimensions of the cracks, but after many weeks of dry weather the cracked portions gave a mean moisture content of 21.4%, while the small intervening portions containing plenty of clover and immune from cracks contained an average moisture of 23.4%

(c). The Fluctuations in the Heavier Drifts may affect the Distribution of the Vegetation.

In a field (Cae Lloi) of the heavier drift type a plant of the carex species grew only in certain well defined sections, while no traces could be found in adjacent areas. Two samples of soil were analysed, one sample representing the portions of the field on which the plant grew, and the other being representative of the soil immediately adjacent from which the plant was absent. The analyses of these samples are given in Table VII.

TABLE VII.

Analysis of Heavier Drift Soils taken from adjacent Plots showing a marked difference in the natural Vegetation.

Sample A. - Soil on which no plant of Carex species grew.

Sample B. - Soil where plant of carex species thrived.

Sample A.(No. 6. Cae Lloi.)			Sample B. (No. 7. Cae Lloi.	
Mechanical Analysis.	Soil.	Subsoil.	Soil.	Subsoil.
Fine Gravel.	1.7	0.7	0.9	4.4
Coarse Sand.	2.9	2.3	1.1	3.9
Fine Sand.	10.3	11.3	11.3	14.9
Silt.	18.1	19.1	16.9	17.9
Fine Silt.	32.6	32.4	35.0	29.2
Clay.	17.0	23.4	14.0	19.0
Moisture.	4.8	2.4	3.9	2.3
Loss on Ignition.	12.0	6.8	12.3	7.4
Chemical Analysis.				
Nitrogen	0.406	--	0.430	--
Total K_2O.	0.69	--	0.72	--
Total P_2O_5.	0.24	--	0.24	--
" Fe_2O_3.	7.24	--	6.80	--
" Al_2O_3.	8.59	--	7.77	--
" CaO.	0.82	--	1.00	--
" MgO.	0.51	--	0.56	--
Available K_2O.	0.015	--	0.013	--
" P_2O_5.	0.024	--	0.021	--
Lime requirement.	Nil.	Nil.	Nil.	Nil.

The two samples show practically the same chemical composition (Table VII), but both soil and subsoil of Sample A. contain more clay that the soil and subsoil of Sample B. This difference in mechanical composition may possibly be a contributory factor towards modifying the soil conditions, and may, therefore, to a certain extent cause the unique distribution of the vegetation.

SOIL MAP OF NANTCELLAN.

The distribution of the various types of soil, described in the preceding pages, is shown in the accompaning map of Nantcellan. A subdivision of the lighter drift soils has been made, so that the lighter drift soil having a depth of 9" - 1' is distinguished in the map from the same drift having a soil depth exceeding 2'. Also a subdivision of the heavier drifts has been considered advisable so as to throw into relief those soils among the heavier drifts which can be regarded as typical boulder clay. The map is a photograph reproduction, the scale as given being correct for the original. The actual scale of the photograph is 11 inches to a statute mile.

CHAPTER IV.

COMPOSITION OF UNDERLYING ROCK AT NANTCELLAN

OBJECTS OF ROCK ANALYSIS IN CONJUNCTION WITH SOIL SURVEY.

Complete analyses of the underlying rock and also of the stones present in various fields at Nantcellan were carried out so as to obtain information regarding the extent to which the glacial matter differed from the sedentary, together with guidance regarding the natural fertility of the sedentary soil, and an indication of the degree to which this natural fertility had been affected by manuring and cultivation. It was also considered that an analysis of these rocks would indicate the proportion in them of less abundant elements which might favourably influence fertility.

METHODS OF ANALYSIS.

The methods adopted in this rock analysis are those used by the Chemical department of the U.S. Geological Survey. (Washington. The Chemical Analysis of Rocks.) In accordance with this procedure the alkalies were estimated by fusing the powdered rock with a mixture of ammonium chloride and calcium carbonate, while the phosphoric acid was extracted by means of a mixture of nitric and hydrofluoric acids.

The manganese present was estimated colorimetrically. The manganous salts obtained by treating the rock material with hydrofluoric and sulphuric acids were for this purpose oxidised with ammonium persulphate in the presence of silver nitrate. A colorimetric comparison was made against standard permanganate.

For the determination of ferrous oxide the prepared sample of rock was warmed for a very short period in the absence of air with a mixture of hydrofluoric and sulphuric acids, the ferrous ion in solution being then immediately titrated with standard potassium permanganate. Other

constituents present in the rock were estimated in the usual way. The following table indicates the composition of the underlying rock, and of the stones present in the soils of different fields.

TABLE VIII.

COMPOSITION OF UNDERLYING ROCK AND STONES AT NANTCELLAN.

	Underlying Rock.			Stones from Sedentary Soil Area.			Stones from Lighter Drift Area.
Sample.	23.	24.		25.	26.		27.
Locality.	Nantcellan Chwarel.	Nantcellan Chwarel.	Mean.	Jericho.	Bank.	Mean.	Ardd Fawr.
Silica SiO_2.	59.98	61.39	60.69	64.10	64.90	64.50	62.65
Alumina Al_2O_3.	19.95	19.45	19.70	16.52	15.54	16.05	18.38
Ferric Oxide Fe_2O_3.	trace.	0.73	0.37	0.84	0.73	0.78	2.07
Ferrous Oxide FeO.	8.10	7.88	7.99	7.78	7.67	7.73	6.27
Phosphoric Acid P_2O_5.	0.29	0.43	0.36	0.32	0.32	0.32	0.40
Potash. K_2O.	2.80	2.54	2.67	2.08	2.06	2.07	2.14
Soda. Na_2O.	2.91	2.98	2.95	2.87	2.77	2.82	3.33
Lime. CaO.	0.88	0.75	0.82	0.76	0.69	0.73	0.74
Magnesia. MgO.	0.98	1.03	1.01	1.01	0.79	0.90	1.08
Manganous Oxide MnO.	0.05	0.07	0.06	0.07	0.08	0.08	--
(Hygroscopic) H_2O.	0.66	0.31	0.49	0.99	0.36	0.68	0.47
(Combined) H_2O.	3.64	3.65	3.65	3.65	3.66	3.66	3.65
Total.	100.24	101.23	100.76	100.99	99.57	100.32	101.18

CLOSE SIMILARITY BETWEEN CHEMICAL COMPOSITION OF ROCKS AND STONES FROM DIFFERENT PORTIONS OF FARM.

All the samples in Table VIII are seen to resemble one another closely in composition in spite of the fact that some of them represent the underlying rock (samples 23, 24), while others represent the stones present in the sedentary soil (samples 25,26), and another the stones found in the light glacial drift (27.) This

close relationship is clearly seen from the amount of alkalies contained in the various samples, the quantity of combined water present, and also the relative amounts of lime and magnesia. All the samples are also characterised by a high proportion of ferrous to ferric iron, although the proportion is somewhat higher in the stones from the sedentary soils than in those from the glacial drift.

ORIGIN OF DRIFT SOILS.

The close resemblance between the stones from the lighter drifts and the sedentary rock tends to support the view that the former have been derived from the latter, or from material closely resembling the rock in composition. The smoothed and worn down appearance of the hills and the broad U shape of the Clarach Valley point to the impression made on the sedentary rocks during the Ice age, the loads of disintigrated material being dropped along the lower part of the valley when the ice finally melted.* An analysis of a much larger number of samples so as to embrace all the various grades of drift would, however, be necessary in order to ascertain that no contribution has been made to the soils of the Clarach Valley from a foreigh source. The numerous specimens of rocks foreign to the district and even to Wales which have been washed ashore from drift lying in Cardigan Bay show that such a contribution is quite probable, but if this has occurred in the case of the soils from the College farm, the ingress of foreign material has not modified the chemical composition of those soils to any appreciable extent. In only one soil examined outside the College farm area were any results

---

* This and subsequent facts regarding the Geology of the district have been derived from "The Physical Features of Central Wales" by Professor O.T.Jones (N.U.T. Souvenir of Aberystwyth Conference 1911. p. 25-51.)

obtained that might be possible indications of such a contribution from foreign sources, an abnormally large amount of phosphates being present in this soil (see Table XIV, sample32, page 40). No certain conclusions can, however, be drawn from this, as it was not possible to trace the manuring of this soil with certainty further back than during the last five years.

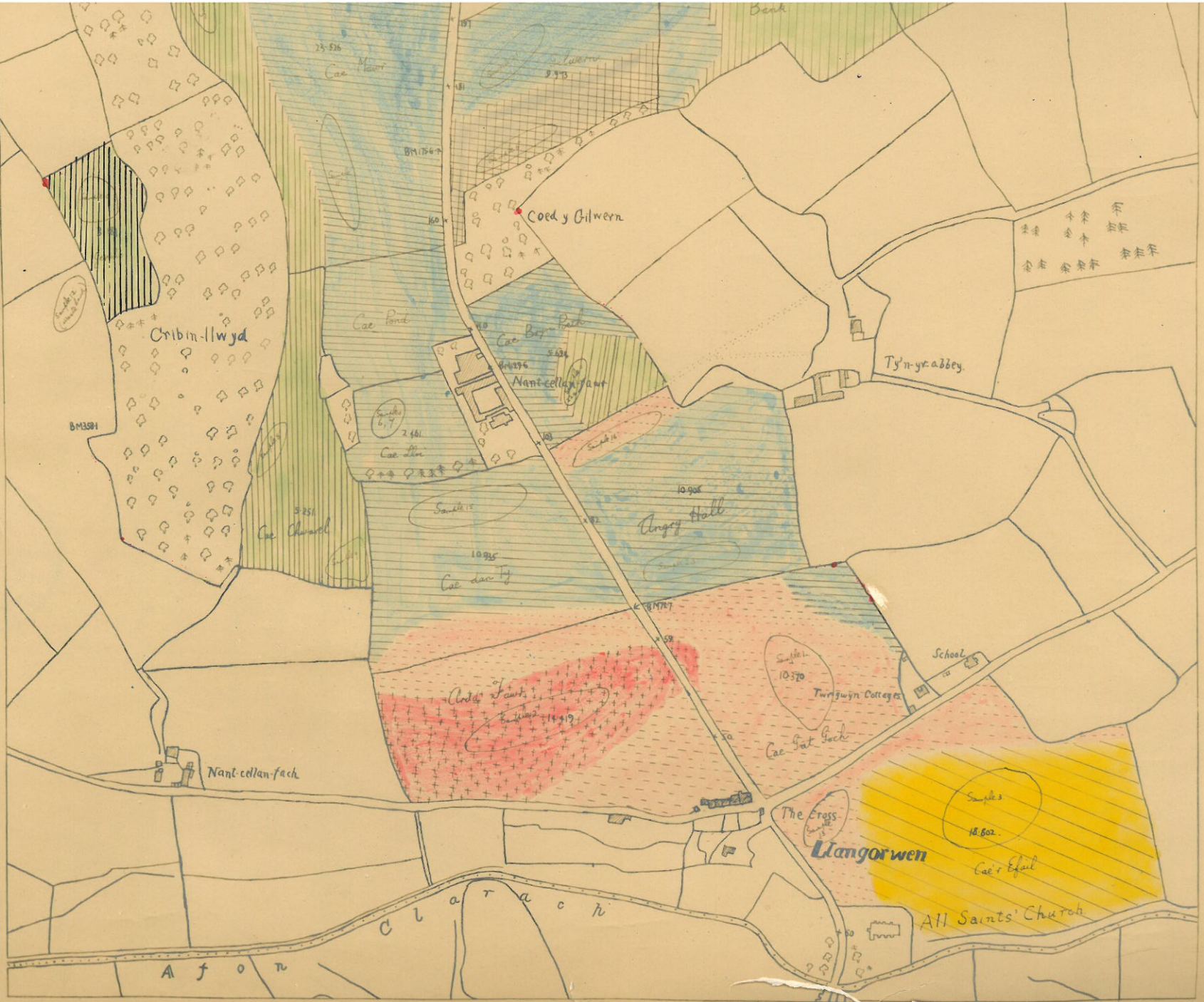
THE DISINTIGRATION OF THE ROCKS TO FORM SOIL.

The rocks from which the soils in Clarach have been formed belong to a gritty strata of the Ordovician and Silurian systems. A comparison of these rocks with the stones derived from them (Table III) indicate that they are composed of an exceptionally stable structure, a fact fully explained when it is considered that they are the remnants of materials subjected to protracted weathering by all manner of agencies. The transformation into soil has as a consequence been effected mainly through the disintigrating effects of mechanical forces, and not through a process of rock decay involving chemical changes which render the soil fundamentally different from the original structure.

The small differences in composition which exist between the rocks and stones at the College farm show an increase in the stones of total silica, accompanied by a diminution in the amounts of potash and alumina present. Thus the original rocks contain 60.7% silica, 19.7% alumina and 2.7% potash the stones derived from them containing 64.5% silica, 16.1% alumina and 2.1% potash. While these differences are partially due to fluctuations which are always found from sample to sample of rock material, they also probably indicate the general lines along which the disintigration of the rock to form soil has occurred. This

disintigration seems to have taken place most readily in those sections of the rock relatively rich in the felspars and poor in free silica. The stones being the less fissile portion of the rock contain more free silica, less potash, alumina, and presumably combined silica than the rock itself, the fragments richer in the latter ingredients having been weathered down to form the finer particles that constitute the soil.

Further reference to these results of the rock analyses will be made in dealing with the chemical composition of the soils.



SOIL MAP OF NANT-CELLAN

CHAPTER V.

CHEMICAL COMPOSITION OF THE SOILS AT NANTCELLAN.

RESULTS OF CHEMICAL ANALYSIS.

Table IX indicates the results obtained in the Chemical Analysis of the soils of Nantcellan.

TABLE IX.

CHEMICAL ANALYSES OF NANTCELLAN SOILS.

Type of Soil.	Alluvial	Lighter Drift.				Heavier			
Sample.	3. Cae'r Efail	13. Cae'r Efail	1. Gat Goch	2. Ardd Fawr	16. Angry Hall (high portion.)	15. Cae Dan Ty.	21. Gilwern (lighter portion)	11. Cae Mawr (Southern end.)	6. Cae Lloi.
Moisture.	6.51	2.80	4.73	2.98	1.93	1.74	2.00	3.35	4.75
Loss on Ignition	22.84	11.41	9.23	7.28	9.18	9.98	11.04	11.74	12.03
Nitrogen.	0.769	0.368	0.279	0.227	0.330	0.322	0.392	0.392	0.406
Potash. K_2O.	0.65	0.66	0.61	0.66	0.80	0.60	0.55	0.72	0.69
Phosphoric Acid. (P_2O_5).	0.25	0.30	0.24	0.32	0.25	0.22	0.19	0.24	0.24
Oxide of Iron. Fe_2O_3.	6.38	--	6.76	6.31	--	--	--	6.70	7.24
Alumina. Al_2O_3.	7.91	--	8.55	9.62	--	--	--	8.74	8.59
Lime. CaO.	1.20	--	1.22	0.91	--	---	--	0.97	0.82
Magnesia. MgO.	0.35	--	0.58	0.67	--	--	--	0.62	0.51
†Available Potash K_2O.	0.013	0.019	0.012	0.012	0.014	0.016	0.015	0.010	0.015
†Available Phosphoric Acid P_2O_5.	0.045	0.045	0.047	0.044	0.012	0.014	0.018	0.023	0.024
*Carbonates.	Nil.	0.01	0.03	Nil.	--	--	--	0.01	--
Subsoil.									
Moisture.	3.16	2.33	2.44	3.65	1.13	1.01	1.85	2.54	2.37
Loss on Ignition.	6.60	8.52	5.74	11.10	6.05	6.65	3.00	8.26	6.76
Nitrogen.	0.286	--	0.193	0.329	--	--	--	0.252	0.266

* Reckoned as Carbonate of Lime CaO_3.
† Soluble in 1% Citric Acid.

CHEMICAL COMPOSITION OF THE SOILS AT NANTCELLAN.

RESULTS OF CHEMICAL ANALYSIS.

Table IX indicates the results obtained in the Chemical Analysis of the soils of Nantcellan.

TABLE IX.

CHEMICAL ANALYSES OF NANTCELLAN SOILS.

Type of Soil.	Alluvial	Lighter Drift.				Heavier Drift.				Heavier Drift.				Sedentary.						
Sample.	3. Cae'r Efail	13. Cae'r Efail	1. Gat Goch	2. Ardd Fawr	16. Angry Hall (high portion.)	15. Cae Dan Ty.	21. Gilwern (lighter portion)	11. Cae Mawr (Southern end.)	6. Cae Lloi.	7. Cae Lloi.	20. Angry Hall. (bottom.)	17. Cae Mawr. (northern end.)	5. Gilwern (heavier portion)	10. Jericho.	18. Cae Mawr.	8. Cae Chwarel	9. Cae Chwarel	14. Bank (Higher portion.)	4. Bank (lower portion)	12 Waste land.
Moisture.	6.51	2.80	4.73	2.98	1.93	1.74	2.00	3.35	4.75	3.88	1.64	2.53	3.99	4.25	2.33	2.50	3.26	2.45	3.35	3.12
Loss on Ignition	22.84	11.41	9.23	7.28	9.18	9.98	11.04	11.74	12.03	12.32	9.46	14.69	11.41	15.84	13.09	9.78	11.71	13.97	12.05	15.00
Nitrogen.	0.769	0.368	0.279	0.227	0.330	0.322	0.392	0.392	0.406	0.430	0.315	0.471	0.440	0.569	0.442	0.269	0.300	0.542	0.428	0.466
Potash. K_2O.	0.65	0.66	0.61	0.66	0.80	0.60	0.55	0.72	0.69	0.72	0.59	0.59	0.89	0.75.	0.55	0.77	0.78	0.65	0.60	0.51
Phosphoric Acid. (P_2O_5).	0.25	0.30	0.24	0.32	0.25	0.22	0.19	0.24	0.24	0.24	0.16	0.20	0.17	0.27	0.26	0.23	0.27	0.30	0.34	0.30
Oxide of Iron. Fe_2O_3.	6.38	--	6.76	6.31	--	--	--	6.70	7.24	6.80	--	--	6.60	6.40	--	7.60	7.40	--	6.52	--
Alumina. Al_2O_3.	7.91	--	8.55	9.62	--	--	--	8.74	8.59	7.77	--	--	9.41	10.12	--	8.60	9.24	--	9.31	--
Lime. CaO.	1.20	--	1.22	0.91	--	---	--	0.97	0.82	1.00	--	--	1.14	0.87	--	0.60	0.72	--	0.97	--
Magnesia. MgO.	0.35	--	0.58	0.67	--	--	--	0.62	0.51	0.56	--	--	0.42	0.55	--	0.60	0.74	--	0.71	--
Available Potash K_2O.	0.013	0.019	0.012	0.012	0.014	0.016	0.015	0.010	0.015	0.013	0.038	0.042	0.015	0.020	0.034	0.020	0.017	0.036	0.017	0.020
Available Phosphoric Acid P_2O_5.	0.045	0.045	0.047	0.044	0.012	0.014	0.018	0.023	0.024	0.021	0.028	0.034	0.026	0.029	0.032	0.033	0.028	0.022	0.034	0.019
Carbonates.	Nil.	0.01	0.03	Nil.	--	--	--	0.01	--	--	0.01	--	--	--	--	--	--	--	0.01	--
Subsoil.																				
Moisture.	3.16	2.33	2.44	3.65	1.13	1.01	1.85	2.54	2.37	2.27	1.00	1.60	3.16	3.45	1.66	2.19	2.26	1.01	2.27	3.00
Loss on Ignition.	6.60	8.52	5.74	11.10	6.05	6.65	3.00	8.26	6.76	7.38	5.02	9.79	6.60	13.36	8.93	7.71	8.33	6.65	7.38	12.20
Nitrogen.	0.286	--	0.193	0.329	--	--	--	0.252	0.266	0.204	--	--	0.226	0.484	--	0.213	0.183	--	0.204	--

* Reckoned as Carbonate of Lime CaO_3.
/ Soluble in 1% Citric Acid.

TOTAL AND AVAILABLE MINERAL INGREDIENTS IN SOILS.

The amounts of the total and available ingredients in the different types of soil are summarised in Table X.

TABLE X.

COMPARISON OF MINERAL INGREDIENTS PRESENT IN VARIOUS TYPES OF SOIL AT NANTCELLAN.

Type of Soil.	Alluvial.	Lighter Drift.	Heavier Drift.	Sedentary.	Waste land of sedentary type.
Total K_2O.	0.65	0.68	0.67	0.66	0.51
Total P_2O_5.	0.25	0.28	0.21	0.28	0.30
Total Fe_2O_3.	6.38	6.54	6.84	6.98	--
" Al_2O_3.	7.91	9.09	8.63	9.32	--
" CaO.	1.20	1.07	0.98	0.78	--
" MgO.	0.35	0.63	0.53	0.65	--
Available K_2O.	0.013	0.014	0.021	0.023	0.020
" P_2O_5.	0.045	0.037	0.024	0.030	0.019

DEDUCTIONS FROM TABLE X.

1. A REMARKABLE SIMILARITY IN THE TOTAL AMOUNTS OF MINERAL INGREDIENTS PRESENT IN DIFFERENT TYPES OF SOIL.

The various types of soil show such a marked resemblance to each other in the total amounts of mineral ingredients present, that it is probable they have all been derived from the same type of raw material.

2. ALL THE VARIOUS TYPES OF SOIL ARE RICH IN TOTAL AND AVAILABLE PHOSPHATES COMPARED WITH OTHER SOILS IN MID-WALES.

The general experience with the soils in Mid-Wales is that they are inclined to be deficient in phosphates, but the soils

at Nantcellan are richer in both total and available phosphates than the majority of soils which have been dealt with at the College Agricultural Chemistry Laboratory.

3. HIGHEST AMOUNT OF AVAILABLE PHOSPHATES IN ALLUVIAL SOIL AND LIGHTER DRIFTS, LOWEST AMOUNT IN HEAVIER DRIFTS AND WASTE LAND.

The Alluvial and lighter drift soils are exceptionally rich in available phosphates. The lowest amounts of the latter are met with in the heavier drifts, while the sedentary soils are intermediate between the two types of drift in this respect. The sedentary soil from waste land, however, contains less available phosphate than is generally found present even in the heavier drift soils.

4. NO DEFICIENCY IN AVAILABLE POTASH.

While the amount of available potash is low in some of the soils examined at Nantcellan, the lowest amounts are probably sufficient under the favourable conditions of water supply for most occasions apart from those when crops are grown that make a special demand on the potash.

NITROGEN CONTENT OF NANTCELLAN SOILS.

The amount of Notrogen in all the College Farm soils is high (see Table IX, page 28), and in the case of the alluvial soil (see Table IX, sample 3, page 28) it is associated with conditions so unfavourable as to prevent the decomposition of organic debris. In all the other soils it is due to an abundance of valuable non-acid organic matter; the conditions, however, being unfavourable to rapid decomposition and nitrification *. The high clay and fine silt content of

---

* cp. page 335. Soil Conditions and Plant Growth - Dr.E.J.Russell.

most of these soils (see page 14) together with high rainfall (see Table 1, page 5) largely contribute towards retarding this decomposition by diminishing the aeration in the soil. The nitrogen in the soils and subsoils is found to bear a close relationship with the loss on ignition, being about 30 times greater than the nitrogen content *.

CALCIUM CARBONATE PRESENT IN NANTCELLAN SOILS.

The amount of calcium carbonate in these soils is negligible, (see Table IX, page 28)but the reactions of the majority of the soils indicate that no marked sourness has developed (see Table XII, page 33).

SIGNIFICANT DIFFERENCE IN RATIO OF LIME TO MAGNESIA ON PASSING FROM ROCKS TO SOIL.

A comparison of the lime and magnesia contents of the indigenous rock with the amounts of these ingredients present in the soil shows that while in the former the magnesia exceeds the lime, the lime content of the soil is greater than the amount of magnesia present (Table XI). The fact that the average percentage of lime present in the soil is greater than that found in the rock indicates the prevalence of a liming system which more than compensated for the losses in lime through drainage. Table XI. shows the quantities of lime and magnesia found in the rock and soil at Nantcellan, and indicates the marked difference in the $\frac{\text{Lime}}{\text{Magnesia}}$ ration on passing from rock to soil.

---

* Cp. page 334. Soil Conditions and Plant Growth - by Dr. E.J.Russell.

TABLE XI.

SHOWING DIFFERENCE IN LIME RATIO OF THE ROCK AND THAT OF THE SOIL.
MAGNESIA

	Nantcellan Rocks & Stones.			Nantcellan Soils.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
Percentage CaO.	0.83	0.69	0.76	1.22	0.60	0.95
Percentage MgO.	1.08	0.79	0.98	0.74	0.35	0.57
Ratio $\frac{CaO}{Mgo}$	0.81	0.87	0.78	1.65	1.71	1.67

It should be noted that while the figures for the rocks and stones in Table XI indicate the total quantities of the various ingredients present, those for the soil indicate the amounts of those ingredients soluble in hot strong hydrochloric acid. The total amounts of lime and magnesia in the soils wouldbe greater, and the fact that the soil has gained lime from some source to more than compensate for the losses through drainage would be more markedly emphasised.

DEGREE OF ACIDITY OF COLLEGE FARM SOILS.

The lime requirements of the Nantcellan soils were determined by means of Hutchinson and McLennan's method,* which depends upon the withdrawal of calcium bi-carbonate from solution by the soil. The soils were also subjected to the Comber and Truog tests. The former † depends upon the fact that iron enters into the soil solution in the presence of a neutral potassium salt when the soil is sour, the iron present giving the characteristic colour with thiocyanate solution. In the latter ‡ test hydrogen sulphide

---

* Jour. Agric. Science 1915, Vol. VII. p. 75-105.

† ibid. 1920, Vol. X. p. 420.

‡ Science, N.S. Vol. 40., pp. 246-248. 1914.

is evolved in the presence of zinc sulphide and calcium chloride when the soil is of an acidic nature, and hence the stain on the lead acetate paper (Table XII). In the column under Comber's test "no colour" indicates the absence of acidity, "pink" a slight acidity, and "red" a marked acidity. The degree of acidity in the case of Truog's test is ascertained from the intensity of the stain.

TABLE XII.

DEGREE OF ACIDITY OF NANTCELLAN SOILS.

Type of Soil.	Reference No.	Tons $CaCO_3$ required per acre. Soil.	Subsoil.	Colour with Thiocyanate solution. (Comber's test.)	Darkening of lead acetate paper. (Truog's test).
Alluvial.	3. Cae'r Efail.	1.03	1.01	Red.	Distinct darkening.
Lighter drift.	13. Cae'r Efail.	0.35	--	Pink.	Slight do.
do.	1. Gat Goch.	Nil.	Nil.	None.	No do.
do.	2 Ardd Fawr.	0.29	0.21	Pink.	No do.
Heavier drift.	11. Cae Mawr.	Nil.	Nil.	None.	Slight do.
do.	6. Cae Lloi.	Nil.	Nil.	None.	No. do.
do.	7. Cae Lloi.	Nil.	Nil.	None.	No do.
do.	5. Gilwern.	Nil.	Nil.	None.	No do.
do.	15. Cae Dan Ty.	0.60	--	Pink.	Slight do.
do.	20. Angry Hall.	0.40	--	Pink.	No do.
Sedentary.	10. Jericho.	1.68	1.42	Red.	Slight do.
do.	8. Cae Chwarel.	0.93	0.50	Red.	Slight do.
do.	9. Cae Chwarel.	1.18	0.88	Red.	Distinct do.
do.	4. Bank.	0.12	0.04	Pink.	No do.
do.	12. Waste Land.	3.43	2.33	Red.	Very pronounced darkening

The results from both the colour reactions are in general harmony with the lime requirement, but the gradations in the latter from soil to soil are followed more closely by the results from Comber's test. The above lime requirements confirm the deductions made from field observations, that, generally, lime must have been laid on in large quantities, and at a fairly recent period. Distinct indications of liming were evident in all the soils examined with the exception of Cae Chwarel; and many soils were characterised by the presence of a large number of particles consisting of practically pure calcium carbonate, these particles, however, being negligible, compared with the total bulk of soil. While the lime requirement of adjacent waste land, on which no liming had ever been practised, amounted to 3.4 tons per acre, the mean lime requirement of the soils at Nantcellan was found to be equivalent to 0.5 tons calcium carbonate.

The only soils that showed an appreciable lime requirement were the alluvial soil (Cae'r Efail) and two sedentary soils (Cae Chwarel, Jericho.) The state of the vegetation, and the reactions of the soil in Cae'r Efail indicate that the frequent dressings of compost consisting of a mixture of lime and road scrapings, applied in former years, were sufficient to meet the lime requirement of the glacial portion of the field, at the same time being totally inadequate for the alluvial section. In the case of Cae Chwarel no traces of lime could be detected in the soil, and the last liming probably occurred at an earlier period than that of most of the fields at Nantcellan. No detrimental effect, however, could at the time of sampling be traced to the deficiency of lime; the pasture being on the whole satisfactory and containing a good percentage of clover. At Jericho, where indications of liming were noticeable, it is at the same time evident, owing to the almost inaccessible position of this field, that any liming done here must have been negligible

compared with that accomplished on the other regions of the farm.

Although the results show that with a few exceptions no appreciable amount of lime is necessary for the neutralisation of the soils at the College farm, it by no means follows that these soils would not respond to further applications of lime. It is quite probable that liming especially on the heavier drift soils would still have a very marked effect on the fertility, as it would ameliorate the unfavourable physical properties caused by the high proportion of clay in these soils.

THE BEHAVIOUR OF DIFFERENT SOILS IN RELATION TO MOISTURE CONTENT.

1. EFFECT OF DROUGHT ON NANTCELLAN SOILS.

The greater part of the land at Nantcellan is not very liable to suffer from drought. The heavy drift soils from their very nature are not easily affected, and although the lighter drifts show the effects of dry periods at an earlier date, these effects as a rule are not very marked. Both on account of its situation and nature the alluvial soil shows to advantage during dry weather, while most of the sedentary soils largely escape the harmful effects of drought, in some cases because of their north westerly aspect and in others because the soils are situated so as to receive the advantage of underground water supply from a higher level. As a consequence it is only the small area of sedentary soil in Cae Bryn Poeth that is by aspect and situation liable to suffer markedly from drought.

2. THE BEHAVIOUR OF SEDENTARY SOILS IN RELATION TO MOISTURE CONTENT.

The harmful effects of the dry period in 1921 were soon to be seen on Cae Bryn Poeth, parching being noticeable on the steep slopes towards the end of May. The following are the moisture contents of this field (Table XIII) taken when the parching had only occurred on certain plots, other portions of the field being at that time entirely free from any bad effects of the dry weather. The samples were taken at equal intervals along a straight line

commencing at the summit, passing along the steepest slope, and terminating in the gradual undulation at the bottom of the field. The moistures were determined at 100° C.

TABLE XIII.

SHOWING THE STATE OF THE VEGETATION ON VARIOUS PARTS OF A SEDENTARY SOIL DURING DRY WEATHER, TOGETHER WITH THE MOISTURE CONTENT OF THE SOIL IN THOSE PARTS. SAMPLES TAKEN ON 28/5/1921.

Samples.	Position of Sample.	State of Vegetation.	% Moisture.	Mean.
22a.	Summit of hillock.	Flourishing. No bad effect due to dry weather.	16.90	17.06
22b.	do.		17.22	
22c.	Gradual slope at higher portion.	Effect of slight parching just noticeable.	16.00	
22d.	do.		13.25	14.42
22e.	do.		14.00	
22f.	Abrupt slope middle portion of hillock.	Vegetation badly parched. Coarser grasses than in other sections of field. Marked decrease in proportion of butter cups.	11.65	
22g.	do.		9.90	9.39
22h.	do.		7.20	
22i.	do.		8.80	
22j.	Gradual slope at lower portion of hillock.	Effect of slight parching just noticeable.	14.05	
22k.			12.75	13.62
22l.	do.		14.05	

These results indicate that whereas no detrimental effect on the vegetation could be detected at moistures of 17%., a noticeable parching occurred on those plots having a moisture content slightly lower than this, generally in the neighbourhood of 14%. After further days of continuous dry weather, the whole area of the hillock suffered conspicuously from the effects of parching. The following table (Table XIV) indicates the state of the vegetation and the moisture content of the soil in different parts at the end of this period.

TABLE XIV.

SHOWING THE STATE OF THE VEGETATION ON VARIOUS PARTS OF A SEDENTARY SOIL AFTER CONTINUED DRY WEATHER, TOGETHER WITH THE MOISTURE CONTENT OF THE SOIL IN THOSE PARTS. SAMPLES TAKEN 9/6/21.

Sample.	Position of Sample.	State of Vegetation.	% Moisture.	Mean.
22 m.	Summit of hillock.	Badly parched.	10.56	
22 n.	Gradual slope at higher section.	do.	9.12	9.48
22 o.	do.	do.	8.77	
22 p.	Abrupt slope, middle section of hillock.	Soil surface bare.	6.76	
22 q.	do.	do.	7.58	6.88
22r.	do.	do.	6.87	
22 s.	do.	do.	6.30	
22 t.	Gradual slope, lower section of hillock.	Badly parched.	8.62	
22 u.	do.	do.	9.73	9.69
22 v.	do.	do.	10.72	

From Table XIV it is seen that serious parching occurred in those portions where the moisture had diminished to an average of 9 - 10 %. Those parts of the field on the steepest slope are liable to attain this figure in the majority of dry seasons, and as a result a special type of vegetation has established itself which is poor in the clovers and finer grasses, while containing a higher proportion of the coarser grasses and deeper rooted plants generally. Where the moisture had diminished to 7%, the surface of the soil in those parts was bare.

3. THE BEHAVIOUR OF THE HEAVIER DRIFTS IN RELATION TO MOISTURE CONTENT.

The heavier clay on the College Farm is liable to suffer from long periods of dry weather through hardening, and the

consequent formation of cracks (see page 20). Portions of the boulder clay at Gilwern that suffered in this respect on 18/6/1921 contained an average moisture content of 21%, a much higher moisture than that at which harmful effects were noticeable on the sedentary soils (see Tables XIII, XIV). This moisture of 21% was found present in the Gilwern soil although nine days of dry hot weather had elapsed since the moisture in the sedentary soil had diminished to the much lower amounts indicated in Table XIV. This shows clearly that the heavier drift soils retain moisture much more tenaciously than the sedentary soil, but that the heavier drifts are liable to be unfavourably affected at a much higher moisture content than is the case with the sedentary soil.

CHAPTER VI.

THE SOILS AT NANTCELLAN IN RELATION TO THOSE OF CLARACH VALLEY.

REASON FOR EXTENDING SOIL SURVEY.

After completion of the survey at the College Farm, soil samples were taken from various positions along the whole length of Clarach Valley from Bow Street to the sea. The land thus covered reached a mile to the east and a mile to the west of Nantcellan, and included several farms containing fields known to be exceptionally productive through many years in connection with particular crops. It was considered that a study of the soils in this area would throw additional light on the nature of the soils at the College Farm, and would to some extent indicate the suitability of the various types of soil on the farm for the most important crops of the valley.

CHARACTERISTICS OF SOILS IN CLARACH VALLEY.

The evidence obtained from farmers throughout the valley shows that while all the ordinary farm crops generally flourish in Clarach, there are some of the soils which seem to be specially adapted for the production of wheat and barley. Very satisfactory crops of wheat and barley are obtained on a variety of soils, but there are fluctuations in the quality and yields which can not be fully explained without reference to properties of the soil which give one field an inherent advantage over the other. Thus there are fields in the valley which are characterised by the consistently good results they have given with wheat over a long period, and other fields noteworthy as being exceptionally suitable for barley. By consulting with those farmers resident for some time in the valley a selection of soils giving the most satisfactory results with wheat and also of soils specially suited for barley was made. The analyses of these soils are given in the following table (Table XV). The analysis of a sedentary soil from land under permanent pasture is also included.

TABLE XV.

ANALYSES OF TYPICAL SOILS FROM CLARACH VALLEY.

MECHANICAL ANALYSIS.

Sample (No & Position)	WHEAT SOILS. 28. Nantsiriol.	29. Nantsiriol.	30. Nantsiriol.	BARLEY SOILS. 31. Glanymor.	32. Nantllan.	PERMANENT PASTURE. 33 Nantsiriol (sedentary soil)
Fine Gravel.	15.8	11.9	18.2	22.9	19.6	21.2
Coarse Sand.	9.9	9.8	9.7	15.9	13.4	9.1
Fine Sand.	11.1	13.5	12.4	10.0	11.1	13.9
Silt.	12.7	14.1	12.6	13.7	11.4	12.3
Fine Silt.	26.7	27.9	25.2	15.2	22.4	21.5
Clay.	11.9	10.6	9.6	11.4	8.4	7.8
Moisture.	3.0	3.9	3.5	2.8	3.4	3.3
Loss on Ignition.	7.8	7.5	9.1	7.1	7.7	10.1
Calcium Carbonate.	-	-	0.00	-	0.00	-
SUBSOIL.						
Fine Gravel.	19.7	12.1	24.8	29.8	14.5	23.3
Coarse Sand.	8.4	9.1	7.1	11.6	15.3	10.7
Fine Sand.	17.4	13.2	12.2	9.9	11.8	11.1
Silt.	13.8	14.0	12.0	12.4	11.4	12.5
Fine Silt.	23.4	27.7	22.0	18.3	23.7	20.2
Clay.	13.0	12.1	10.8	10.5	9.0	7.9
Moisture.	2.2	2.0	2.9	2.5	3.1	2.0
Loss on Ignition.	5.8	6.1	7.2	5.4	5.8	8.2
CHEMICAL ANALYSIS.						
SOIL.						
Moisture.	5.00	3.93	3.48	2.78	3.35	3.29
Loss on Ignition.	7.82	7.54	9.06	7.10	7.74	10.09
Nitrogen.	0.244	0.162	0.260	0.300	0.402	0.253.
Potash K_2O	0.65	0.70	0.69	0.64	0.58	0.87
Phosphoric Acid P_2O_5.	0.30	0.32	0.34	0.30	0.68	0.30
Available Potash K_2O*	0.019	0.029	0.036	0.015	0.020	0.031
Available Phosphoric Acid P_2O_5. *	0.032	0.019	0.028	0.019	0.081.	0.013
SUBSOIL.						
Moisture.	2.20	2.00	2.87	2.49	3.13	2.04
Loss on Ignition.	5.79	6.12	7.21	5.34	5.78	8.21
Lime requirement of soil (tons per acre $CaCO_3$)	0.20	-	2.10	1.20	0.85	-
Colour with thiocyanate.	Pink.	-	Red.	Pink.	Pink.	-
Darkening of lead acetate paper	None.	-	Very pronounced.	Slight.	Slight.	-

* Soluble in 1% Citric Acid.

CHEMICAL COMPOSITION OF SOILS FROM CLARACH VALLEY.

In connection with the chemical composition of these soils, a high percentage of total and available phosphate is found present in the barley soil from Nantllan (see Table XV. sample 32). It has not been possible so far to trace this to any definite cause, as no certain indication of the history of this field during the last decade is available. This very abnormally high phosphoric acid content, however, has nothing to do with the favourable conditions for barley production, as another field from Glanymor (see Table XV, sample 31) equally favourable for this purpose contains amounts of both total and available phosphate ordinarily found in the soils of Clarach. Neither can the suitability of these soils, for special crops be traced to any other feature of their chemical composition, seeing that chemically they show a close resemblance to other soils examined which do not possess the same potentiality for the production of either wheat or barley.

MECHANICAL COMPOSITION OF CLARACH WHEAT SOILS.

With regard to the mechanical composition of the wheat soils, although they are identical in this respect with the lighter drifts at the College Farm (see Table III, samples 1,2,13,16 page 13 and compare with Table XV. samples 28 -30, page 40) they are seen to lie on finer grained subsoils. These changed conditions are such that an efficient drainage will still prevail, while a greater amount of water will be returned to the soil by capillarity during dry periods. The composition of these soils stands out in marked contrast to that of soils regarded as specially suited for wheat in the south-east of England, and this emphasises the importance of climatic conditions in determining the suitability of a soil for a certain crop. The following figures indicate the mean composition of the wheat soils in the south east of England*:-

---

* Agriculture and Soils of Kent, Surrey and Sussex. Hall and Russell, p. 142.

Fine Gravel.	1.5
Coarse Sand.	4.0
Fine Sand.	24.4
Silt.	22.9
Fine Silt.	13.3
Clay.	18.7.

The soils in Clarach which conform most closely with the above, especially in the amounts of coarse sand and fine gravel present are the heavier drifts; but although the lighter soils among this type of drift give good wheat crops, the heavier drift is not generally regarded by farmers to be the best type of land for wheat in the valley as it is liable to become excessively wet during the winter.

MECHANICAL COMPOSITION OF CLARACH BARLEY SOILS.

The barley soils in Clarach contain a higher proportion of fine gravel and coarse sand than the wheat soils. The subsoils are identical with the lighter drift subsoils (see Table III, samples 1, 2, 13, 16, page 13 & cp. Table XV. samples 31, 32, page 40), but the surface soil is distinctly lighter than the surface soil of the lighter drifts. Thus the barley soils contain a higher percentage of fine gravel and coarse sand than the lighter drift soils at Nantcellan. About the same amount of clay is present as in the latter soils, but a lower proportion of fine silt. These differences all contribute towards a more rapid drainage, and render the formation of a "kind" seed bed easier in the case of these typical soils than in the lighter drifts of Nantcellan. There is no reason to suppose, however, that the lighter drift soils are not well adapted to the growth of barley, and evidence is available of very good barley crops having been obtained at Nantcellan from both Ardd Fawr and Cae Gat Goch.

THE SUITABILITY OF THE SOILS IN CLARACH FOR BARLEY PRODUCTION.

The large crops of barley eminently suitable for malting purposes which have been grown in Clarach have undoubtedly contributed towards the pre-eminence of the Cardiganshire barley, the superiority of which was recognised as far back as the end of the 18th. century.* From enquiries among the farmers in Clarach one found that the valley throughout is exceptionally favourable to the production of malting barley, although they as farmers considered some of the farms a good deal superior to others in the valley for this purpose. Alderman Fosset Roberts of the Aberystwyth Brewery, who has had a long experience in this connection, also emphasised the exceptionally good quality of the malting barley from Clarach, but was not disposed to draw a distinction between farm and farm, as he considered that all the farms from Bow Street to the sea could produce equally good barley. All the supplies of malting barley for the Aberystwyth Brewery were obtained during the latter half of last century from the district, and in so far as Cardiganshire is concerned Alderman Roberts was of the opinion that Clarach Valley and Llanrhystyd are the only districts possessing suitable conditions for the production of malting barley. Llanrhystyd barley has always been reputed to be of a particularly good quality, but he was of the opinion that Clarach barley is quite equal to, if not better, than Llanrhystyd barley, and would regard it as equal in quality to that produced in any other part of the country. Judging from the composition of the soils considered by the farmers in the valley to be the most superior for barley production the inference may be made that their exceptionally light character (see Table XV, samples 31, 32 page 40) gives them an inherent advantage over most other soils in the Valley for this particular purpose.

---

* Agriculture of South Wales - Gwallter Mechain - Volume 1 pages463 - 4.

Apart from the suitability of the soil, the situation of the land and the climatic conditions in Clarach have a very important part to play in the success which attends the production of malting barley here. Although a satisfactory barley can be raised in adjacent farms a little north of the valley, such as Wileiriog and Riwel, which do not possess as favourable an aspect as farms in the valley itself, yet the grain is not quite equal to that obtainable in Clarach. The higher rainfall experienced is largely responsible for the very pronounced deterioration in the quality of the barley which occurs on proceeding inland into the county.

SUMMARY AND CONCLUSIONS.

REVIEWING THE RESULTS OBTAINED THE FOLLOWING CONCLUSIONS ARE ARRIVED AT:-

A. MECHANICAL COMPOSITION OF COLLEGE FARM SOILS. (see Table II. AND III.

1. The soils at the College Farm can be divided into four distinct types, viz., Alluvial soil, Lighter Drift soil, Heavier Drift soil, and Sedentary soil.

2. An abnormal amount of organic matter is present in the alluvial soil on account of unsatisfactory drainage. This soil is also characterised by a high percentage of clay.

3. The lighter drift soils contain a good proportion of fine gravel and coarse sand, and lie on an exceptionally open subsoil.

4. The percentage of these coarser particles in the heavier drift is low, and the drift lies on a very finely grained subsoil. Wide and abrupt variations are met with in this type, but many of these soils are remarkably heavy even compared with the heaviest soils in Mid-Wales. Such heavy soils might not be unmanageable with a low rainfall, but with an average yearly rainfall of 38" their cultivation is extremely difficult and in some cases impossible.

5. The sedentary soils are of a light nature on account of the high percentage of stones present. This percentage is so great as to modify very considerably the significance of the analysis of the fine earth.

B. ANALYSIS OF ROCKS AND STONES AT THE COLLEGE FARM. (see TABLE VIII.

1. A close resemblance exists between the chemical composition of the stones from the lighter drift soils and that of the sedentary rock, and it is, therefore, likely that the former have been derived from the latter or from material of a similar nature.

2. The transformation from rock into soil has been effected mainly through the disintigrating effect of mechanical agencies, and no chemical changes have occurred to render the soil fundamentally different from the original structure.

C. CHEMICAL COMPOSITION OF THE COLLEGE FARM SOILS (see TABLES IX, X, XI, and XII.

1. A remarkable similarity exists between the total amounts of mineral ingredients found present in the different types of soil.

2. The soils are rich in phosphates compared with other soils from Mid-Wales. An exceptionally high percentage of available phosphate is present in the alluvial and lighter drift soils.

3. The amount of nitrogen present in practically all the soils is high.

4. The lime content of the soil usually exceeds the amount of magnesia present, although the reverse is the case in the rocks.

5. With a few exceptions no appreciable amount of lime is necessary for the neutralisation of the College Farm soils. It isprobable, however, that liming, especially on the heavier drift soils would still improve fertility as it would ameliorate the unfavourable physical properties caused by the high proportion of clay.

D. THE BEHAVIOUR OF DIFFERENT SOILS IN RELATION TO MOISTURE CONTENT (see TABLE XIII, XIV, also data on page 38).

1. The earliest and most conspicuous effects of drought at Nantcellan occur on the sedentary soil with a southern aspect.

2. A diminution of the moisture in the case of a sedentary soil to the neighbourhood of 14% has a harmful effect on the pasture.

3. A special type of vegetation establishes itself on those parts of a sedentary soil liable to attain a moisture of 9 - 10 % in the majority of dry seasons.

4. A diminution of the moisture in the case of a heavier drift soil to 21% has a detrimental effect. This type of soil has a great capacity for retaining moisture.

E. THE SOILS AT THE COLLEGE FARM IN RELATION TO THOSE OF CLARACH VALLEY (see TABLE XV.)

1. Typical wheat soils in Clarach valley are very similar to the lighter drift soils at the College Farm. The conditions in the subsoils, however, differ; so that a greater return of water to the wheat soils through capillarity is possible.

2. The subsoils of the typical Barley soils are identical with the subsoils of the lighter drifts at the College Farm (see this summary under Mechanical Analysis 3), but

the surface soil is distinctly lighter than even the surface soil of the lighter drifts. For this reason a very rapid drainage is obtained, and the formation of a "kind" seed bed is facilitated.

3. Information received from farmers throughout the valley and from persons who have had a long connection with the local brewery proves very clearly that the lighter soils of Clarach Valley are particularly suitable for the production of good malting barley. The analytical results obtained indicate that the lighter soils at Nantcellan provide conditions favourable for this purpose.

4. The Valley has a name for its earliness in growth, maturity and ripening of crops; particularly the side with a southern aspect on which the College Farm is situated.

ACKNOWLEDGMENT.

The writer wishes gratefully to acknowledge his indebtedness to Mr. J.J.Griffith for valuable guidance and suggestions, and to Professor A.E.Jones for his kind interest in the work.

APRIL. 1922.

R.O. Davies. 27/4/22.

Llyfrgell Genedlaethol Cymru
The National Library of Wales

Llyfrgell Genedlaethol Cymru
The National Library of Wales
Aberystwyth SY23 3BU

Ffôn/Tel: +44 (0) 1970 632800
Ffacs/Fax: +44 (0) 1970 615709
Ebost: www.llgc.org.uk/holi
Email: www.llgc.org.uk/enquire
www.llgc.org.uk

un o lyfrgelloedd mawr y byd
one of the great libraries of the world

Cyf / Ref : LLRHY
Dyddiad / Date : 09/04/2013

Mr Gareth Wyn Griffith
IBERS
Prifysgol Aberystwyth

Annwyl Mr Griffith

Ar ran Bwrdd Ymddiriedolwyr Llyfrgell Genedlaethol Cymru, y mae'n bleser mawr gennyf gydnabod derbyn y rhodd a nodir isod a dymunaf ddiolch yn gynnes ichwi am eich cefnogaeth i'r Llyfrgell.

Yr eiddoch yn gywir

Dear Mr Griffith

On behalf of the Board of Trustees of the National Library of Wales, it gives me much pleasure to acknowledge the receipt of the gift, which is detailed below and would ask you to accept my warm thanks for your support to the Library.

Yours sincerely

Traethawd MSc R. O. Davies, yn dwyn y teitl 'Soil Survey of Clarach Valley', wedi ei gyflwyno gan Brifysgol Aberystwyth, 1922 *(NLW ex 2809).*

R. O. Davies's MSc Thesis, entitled Soil Survey of Clarach Valley, presented by Aberystwyth University, 1922 (NLW ex 2809).