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Papers.

METHODS OF MECHANICAL ANALYSIS OF SOILS.

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Some years ago I received from a colleague in X. some soil samples with the results of the mechanical soil analysis. Table I shows the results of the investigations carried out at X., and at Groningen, of three samples of soil with the humus removed.

TABLE I.

Soil Sample No.		1120		1121		1122	
	Fraction	X	Gron.	X	Gron.	X	Gron.
%	I . . .	33.6	61.7	47.8	70.3	2.7	1.3
	II . . .	42.6	22.2	31.4	15.1	9.1	5.8
	III . .	20.3	10.1	17.5	10.3	32.9	12.5
	IV. . .	3.2	0.2	3.8	4.0	55.3	80.4
	$CaCO_3$.		5.8		0.3		0.0

I am convinced that results of the kind shown in this table will be the rule in the case of comparative analyses conducted in different laboratories.

The great differences arise mainly from the methods of preparation followed. It is hence a first essential to come to an agreement on the method of perparation of the soil samples for mechanical analysis.

The principal object of this article is tho describe and tho justify those methods of preparation which were fiinalli adopted after a number of analyses conducted in the writer's laboratory jointly by A. DEKKER, M. DEKKER and H. OSTERVELD.

The second part of the mechanical analyses of soils, namely the separation of the soil particles after the preparation of the samples, was always effected in the ATTERBERG decantation cylinders and the samples were separated into the four ATTERBERG fractions.

In conclusion I propose (under heading B) to add some observations in regard to the new sedimentation methods, as followed by WIEGNER, ODÉN, ROBINSON, and KRAUSS.

A) THE ATTERBERG METHOD OF DECANTATION.

At the first meeting of the Committee for the study of Soil Mechanics and Physics in Berlin, on 31 October 1913, I referred to the important influence of the preparation of the soil sample on the results of mechanical analysis. On that occasion I recommended a method by agitation with subsequent decantation, of Fraction I with dilute ammoniacal water, and of Fractions II, III, and IV with water (1). These fractions are the four ATTERBERG fractions: the decantation is carried out in accordance with ATTERBERG's directions, in the ATTERBERG cylinders (2). This type and method of decantation, as also the division of the soil particles according to ATTERBERG into four fractions (2-20-200-2000 μ), was retained throughout the analyses now to be described.

As long as the soil contains calcium carbonate or humus or both, the employment of the method of agitation is hampered by difficulties of various kinds:

(*a*) the calcium carbonate and the humus are distributed by the agitation over the different fractions, and accordingly, to determine the content of the sample in mineral particles of different sizes, the calcium carbonate and the humus must be determined in each separate fraction and removed. It may be noted here that the determination of the humus by means of ignition of the fraction is misleading, as the Fractions I and II contain in the weathered silicates considerable quantities of hygroscopic moisture.

(*b*) Calcium carbonate and humus cement the mineral particles of the soil, and the aggregates thus formed are not fully separable by agitation so that the dilute ammoniacal water used in decantation of Fraction I cannot dissolve all the organic matter. The presence of these cementing constituents (calcium carbonate and humus) is also to be detected in the fact that the decantation especially of Fraction I and also of II takes a long time.

(*c*) It is not unlikely that the quantities of calcium carbonate and humus still present exercise an influence on the flocculation of the mineral soil particles. In the case of the decantation by the Atterberg method this influence becomes in practice very small: in the processes followed by Odén, Wiegner, Krauss and Robinson, small quantities of calcium carbonate and organic matter must modify the results not inconsiderably.

I have attempted to obviate these difficulties by substituting for the agitation method the English method (3), viz., treatment with HCl and decantation with NH_4OH. By the English method the soil sample is worked up with HCl. As this operation is laborious and also gives rise to errors of a subjective kind, I have proposed to stir the soil sample with cold HCl and indeed with 100 cc. 0.2 n. HCl excess of what is required for the solution of the calcium carbonate (4).

As early as 1921 I observed that the Fractions II and III in the case of soils rich in humus continue to retain humus. It proved later that treatment with cold dilute HCl does not even succeed in dissolving all the carbonates in solution, as is shown by the following figures:

TABLE II.

No. of Sample	Total $CaCO_3$	$CaCO_3$ in the fraction			
		I	II	III	IV
B 1459	9.26 %	6.84	2.41	0.01	0.00
Bb 17	12:57 %	10.47	1.68	0.42	0.00
Bb 29	11.12 %	8.50	2.30	0.32	0.00
Bb 74	4.06 %	1.74	2.09	0.23	0.00

The following procedure may be adopted to overcome these difficulties:

The organic matter is removed by boiling with H_2O_2 *by the Robinson method* (5), *while the carbonates are dissolved by boiling with a small excess of dilute HCl,* (100 *cc.* 0.2 *N. HCl excess*).

At the Rome Conference (May, 1924) some opinion adverse to this preparatory treatment was expressed, both during the official discussion of the subject and also in personal conversation. In particular the employment of acids, especially of boiling acids, was deprecated. On this account I shall deal with the question of the preparation of the soil samples with boiling HCl in more detail.

TREATMENT OF SOIL SAMPLES WITH HYDROCHLORIC ACID.

I submit the following five observations for the consideration of opponents of the HCl treatment.

1. *Comparison of the HCl treatment with the agitation method, in the case of clayey soils free from $CaCO_3$ and humus.* — All scientists, including those who intend to make use of the soil in the least altered form, prepare the samples to some extent before decantation. (The various methods are: crushing and rubbing down with rubber pestle, brush or the finger, with addition of a little water, simmering with water, etc.). In all these methods a fairly considerable subjective error is inherent: the more forcibly the sample is rubbed, and the longer it is stirred or boiled in water, the higher is the content in small particles (Fraction I, resp. Fraction I-II). The method by agitation (1) was in this respect undoubtedly a great step in advance, and various opponents of the HCl treatment have consequently adopted this method of preparation. I desire to call the attention of these objectors to the results of analysis of a sample 1458, which was completely free from $CaCO_3$ and organic matter, the single soil particles thus being cemented together not by calcium carbonate and humus, but only by gels of Al_2O_3-SiO_2-Fe_2O_3.

TABLE III.

Method of preparation	Percentage content in fraction			
	I	II	III	IV
a) Agitation (1)	53.8	28.2	17.8	0.2
b) modified English method (4)	54.0	28.7	16.9	0.4
c) as (*b*) but boiling with HCl	54.9	28.0	16.8	0.3
d) Boiling with H_2O, decantation with H_2O	27.5	37.9	34.4	0.2

The decantation of Fraction I took place in (*a*) with ammoniacal water immediately after the agitation: in the case of (*b*) and (*c*) also with ammoniacal water, but only after the HCl and the salts that had passed into solution had been removed by decantation with water (6). The differences between (*a*), (*b*), and (*c*), are very slight. This becomes the more obvious, when methods (*a*), (*b*) and (*c*) are compared with (*d*). And as already remarked the results following on the (*d*) preparation are influenced to a large extent by the length of the boiling.

2. *The 'sandy' character of the sand fractions.* — It is of course a difficult matter to distinguish which of the methods (*a*), (*b*), (*c*) or (*d*) yield the true mechanical composition of the soil sample 1458. The simple fact that method (*c*) gives the highest content in Fraction I is no evidence for its correctness. Perhaps the following considerations may be of use in judging of the different kinds of preparation. Fractions III and IV are called the sand fractions, and it is therefore desirable that after decantation of the Fractions I and II a really sandy mass be left behind. This is the case with methods (*a*), (*b*) and (*c*). When method (*d*) was followed, however, the fractions III and IV, viz. 34.4 + 0.2 = 34.6 per cent., formed after evaporation a fairly compact mass, which might be called 'clayey', but even when rubbed between the fingers had no sandy feel. The separation between 'clayey', and 'sandy' particles was thus not accomplished by the (*d*) method.

The writer has made further experiments to see if the behaviour of the fractions towards different colouring matters may perhaps throw light on the point. Whereas the particles of Fraction III obtained by the methods (*a*), (*b*) and (*c*) only fixed a small quantity of colouring matter (methyl violet), the result was on a much larger scale in the case of the particles obtained by method (*d*). I should like to recommend colleagues to make further experiments in this direction. It must be remembered that it is a question of a kind of adsorptive fixation so that the concentration and the quantity enployed of the methyl violet solution is of importance (7).

3. *Examination of Fresh Soil Samples.* — The following investigation is calculated to remove the prejudice against the HCl treatment. In February 1921, after a very wet winter a recently formed soil (Finsterwolderpolder, Prov. Groningen, dyked 1819) was examined. The soil was quite wet and contained 27 % water (dried at 105° C.). In comparison with other soil samples taken in the neighbourhood the volume weight (the weight of 100 cc. of soil in the natural condition in dry matter) and the specific weight are 1.25 and 2.5 respectively. The pore space is thus nearly 50, and if all pores are filled with water, the water content becomes nearly 28 per cent. Half the sample was examined in the wet state, the other as air-dry fine earth (size of

particles 2 mm.) and the following procedure was adopted in the preparation of the samples:

(*a*) Stir with H_2O in a mortar, allow it to settle, pour off into a litre flask (8), stir the remainder again in the mortar with water and pour off, repeat this several times, and finally rinse the whole soil sample into the litre flask. The litre flask is very slowly rotated in a rotary apparatus for two hours a day for two days, the content is rinsed into an ATTERBERG cylinder and Fraction I is decanted with water only. Fractions II, III and IV are as usual decanted with water. In the different fractions the content in $CaCO_3$ is determined and subtracted. The fractions are dried at 105°C. and not ignited.

(*b*) according to the English method as modified by the writer (4) the sample is agitated with 100 cc. excess cold 0.2 N. HCl and decanted first with water and then with ammonia. Fractions II, III and IV are decanted with water, dried at 105° C. and not ignited.

Finally the air-dried soil sample was treated according to the new method, i. e. boiling with H_2O_2 and 100 cc. excess 0.2 N. HCl and then treated as under (*b*).

It may be noted that only Fractions II, III and IV were weighed: the weight of Fraction I was reckoned from the difference. In the same way the $CaCO_3$ was determined only in the case of fractions II, III and IV, and in the case of I was estimated by difference. The results are shown in dry substance (see Table IV).

Later on it proved (see below) that the calcium carbonate does not pass completely into solution on treatment with cold HCl (method *b*). The figures of Fraction II (possibly also of Fraction III) are accordingly probably too high with method (*b*): the figures relating to Fraction I (44.1 % and 45.5 %) are correspondingly somewhat too low.

TABLE IV.

Soil Sample No. 851	Method	Humus	$CaCO_3$	Content in fractions			
				I	II	III	IV
1 moist	a		8.8	42.2	31.8	16.9	0.3
2 »	b		8.8	44.1	30.0	16.5	0.5
3 airdried fine earth	a		8.8	25.5	36.6	28.6	0.4
4 »	b		8.8	45.5	30.4	15.0	0.3
5 airdried	H_2O_2-HCl (boiling)	2.6	8.8	48.3	25.0	14.8	0.5

It appears from the above that the treatment of the wet soil samples with water only (Method No. 1) yields almost the same results as the treatment with HCl (Methods 2 and 4). Also the differences between the results of (*b*) (Methods 2 and 4) and of the new method (boiling with H_2O_2 and HCl), or method 5, are not great. On the hand the differences are quite considerable between method 3, i. e. (*a*) applied to the air dried sample, and the other four methods. It is unconditionally established that the results of method 3, i. e. rubbing up of the airdried sample with H_2O in a mortar and rotation with water, are incorrect as regards the mechanical composition of this soil On the other hand it is proved that the treatment of the sample with cold HCl (No. 2 and 4, method (*b*)) and similarly with H_2O_2 (the ROBINSON method) and boiling HCl (Method No. 5) gives figures, which in any case do not differ very much from the figures of Method 1, i. e. the treatment and decantation of the wet soil sample with water only.

(4) *Boiling with HCl.* According to the new method, boiling with HCl takes place and by the ROBINSON H_2O_2 method with 100 cc. 0.2 N. HCl excess; thus for example 10 gm. of soil with 7.5 % $CaCO_3$ are boiled with 175 cc. 0.2 n. HCl and 25 cc. H_2O for 15 minutes. The reason for this modification of the method is that the calcium carbonate is not fully dissolved by the cold treatment with dilute HCl. It has been observed that the boiling acid dissolves the clayey substances in not inconsiderable quantities. The writer had previously noted that the cold acid also dissolves the clay (4), and the question arises now whether in this respect there is much difference between the quantity dissolved by the cold acid and that by the boiling acid. Table V gives the results of an examination of certain samples. Naturally in addition to SiO_2, $Al_2O_3 + Fe_2O_3$ (Total acids), bases (CaO, MgO, K_2O, and Na_2O) are dissolved and in particular lime.

The boiling HCl dissolves the $SiO_2 + Al_2O_3 + Fe_2O_3$ more completely than the cold HCl. The difference however is not great, and in any case there is no ground for the view that the quantities dissolved in cold HCl are negligible as compared with those dissolved if boiling is effected. Hence the experimenter who does not hesitate to treat with cold HCl may also in my opinion, confidently employ the treatment with boiling HCl.

In Table V the content in Fraction I and II and the total acids ($SiO_2 + Al_2O_3 + Fe_2O_3$) are expressed in percentages of I and II (last column). Here somewhat considerable differences occur. In part-

TABLE V.

Soil Sample No.	Percentage dissolved of dry substance			Total acids	Fractions I+II in% of dry substance	Total acids in % of I+II
	In cold or in boiling HCl	SiO_2	$Al_2O_3 + Fe_2O_3$			
795	cold	0.8	2.06	2.86	67.1	4.3
	boiling . . .	1.11	2.60	3.71		5.5
509	cold	n. q.	n q.	n. q.	40.2	n. q.
	boiling . . .	0.77	1.20	1.97		4.9
1898	cold	0.42	1.24	1.66	76.3	2.2
	boiling . . .	0.67	1.46	2.13		2.8
1900	cold	0.33	1.23	1.56	74.5	2.1
	boiling . . .	0.64	1.53	2.17		2.9
1432	boiling . . .	0.80	2.63	3.43	44.2	7.7
1433	boiling . . .	0.68	2.52	3.20	43.4	7.4
1440	boiling . . .	0.64	2.77	3.41	53.3	6.4

icular, taking the last three soil samples, somewhat large quantities in percentages of Fraction I and II are dissolved in the boiling HCl. These are three river clays of loamy character. A smaller total in $SiO_2+Al_2O_3+Fe_2O_3$ might have been expected. The proportion of $Al_2O_3+Fe_2O_3$ to SiO_2 is however greater in the case of these three soil samples than with the other samples. Possibly here we are dealing with a soil with a high content in easily soluble Fe_2O_3.

The question now arises whether any allowance can be made for the quantities that have passed into solution with the HCl treatment. They are removed on decantation of Fraction I according to the ATTERBERG method. In particular the acid will have dissolved a good part of Fraction I. Of Fraction II perhaps a rather smaller part will be dissolved, while the Fractions III and IV, on boiling for 15 minutes with the *very dilute* HCl employed remain practically insoluble. Since the total of the acids is not large, it can without hesitation be taken into account in the case of Fraction I: that is to say, that no correction need be applied for the Fractions II, III and IV.

5. *Calcium Carbonate.* — While hydrochloric acid is mainly used by the writer, on account of its solvent action on calcium carbonate, some colleagues give a warning against the use of acids on that account. I am of the opinion that the size of the particles of cal-

cium carbonate is of great importance in judging of the soil, and that it is advisable to determine this. I am unable however to find any indication that the different fractions have been tested as to their content in $CaCO_3$.

I expressed an opinion in Rome in May 1924, that it would be advisable in the case of soils containing $CaCO_3$ to determine, by taking a second sample, the dimensions of the $CaCO_3$ particles separately. The immediate question however is, how the soil samples are to be prepared for the determination of the dimensions of the $CaCO_3$ particles. The determination of $CaCO_3$ in the different fractions involves much time. In the soil sample No. 851 the results with the methods 1 and 3 (wet and airdried soil samples, see Table IV) were nearly the same (see Table VI). In the case of this soil the $CaCO_3$ particles were already separated from each other by rubbing in water.

TABLE VI.

Soil Sample No, B, 851	$CaCO_3$ in percentage of dry substances				
	I	II	III	IV	Total
(a) moist	4.5	2.0	2.1	0.2	8.8
(a) airdried.	4.3	2.0	2.4	0.1	8.8

TREATMENT OF THE SOIL SAMPLES WITH H_2O_2 (the ROBINSON method).

The proposal of ROBINSON (5) to boil the soil samples with H_2O_2 to the point of removal of the humus involves a great advance. This is not the place to enlarge on the whole question of the importance of the H_2O_2 treatment and I refer the reader on that account to the literature dealing with the subject (9). In a later article ROBINSON comes to the conclusion that the hydrogen peroxide has the effect of completely decomposing the organic substances which have become transformed into humus, or of depriving them of water, while it leaves unaltered the fibrous organic substances such as cellulose and lignin. Hence if the microscopic remains of roots etc. are removed by sifting, the H_2O_2 treatment may be expected to remove the humus either altogether or nearly so.

How far this is really the case, will appear from the following investigation.

The preparation of the soil sample was effected by the new method, i. e. boiling with H_2O_2 and HCl and decantation of Fraction I first with H_2O and then with NH_4OH and of the Fractions II and III with water. Fractions II, III and IV of this sample were first dried at 105°C. and then ignited. Table VII reproduces the results of Fraction II. On drying at 105°C. the soil sample No. 824 gave a Fraction II of 16.04 % and on ignition, of 14.17 % of air-dried soil. The loss through ignition was thus out of 100 gm. of soil 1.87 gm.: i. e. in a percentage of Fraction II, 1.87 × 100 : 16.04 = 11.7 % (Table VII, last columm). The content in $CaCO_3$ and humus in dry soil is also shown in Table III.

TABLE VII.

Soil Sample No.	% of dry substance		Fraction II gm. out of 100 gm. of air dried soil		Loss on ignition on 100 gm. Soil.	Loss on ignition in % of Fraction II
	$CaCO_3$	Humus	Dried at 150° C.	Ignited		
824	11.9	3.6	16.04	14.17	1.87	11.7
463	8.7	0	8.66	7.37	1.29	14.9
465	8.7	0	8.60	7.36	1.24	14.4
849	4.8	0	16.07	14.36	1.71	10.6
1100	10.9	0	11.23	9.76	1.47	13.1
796	9.2	2.9	23.38	21.93	1.45	6.2
952	5.0	10.5	20 62	19.07	1.55	7.5
800	0	10.7	19.91	18.72	1.19	6.0
830	0	10.0	25.64	24.37	1.27	4.9
1061	0	4.0	18.47	17.52	0.95	5.1
827	0	0	19.63	18.78	0.85	4.3
828 *a*	0	0.	24.37	22.65	1.72	7.1
828 *b*	0	0	23.63	21.84	1.79	7.6
569	0	8.0	29.07	27.37	1.70	5.8

On ignition of the Fraction II airdried at 105°C., a reduction thus takes place of the content in Fraction II amounting to from 0.85 to 1.87 % on airdried soil: these figures are not large. On ignition of the Fraction III and IV a still smaller reduction takes place of at most 0.6 %, but more usually of some few tenths per cent. The reduction of Fraction II on ignition clearly does not result from the undecomposed remnant of the humus left from the treatment by H_2O_2. For Fractions II of the three samples soils that are completely free from humus and $CaCO_3$, viz. Nos. 827 and

828 (*a*) and (*b*), are also reduced by ignition, and in percentages of Fraction II (4.3 ; 7.1 ; 7.6) which are not less than the other soils free from $CaCO_3$ (for example, 800 with 10.7 % of humus and 6.0 % of loss on ignition), even if these soils are rich in humus. The loss on ignition of the soils containing $CaCO_3$ expressed as percentages of Fraction II, are however, with the exception of 796 and 952, higher, even if the soil is free from humus. The inference would seem to be, that Fraction II, even on boiling with dilute acid, may still contain some carbonate. Whether this is really the case has not up to now been further investigated.

The seven soils that are free from $CaCO_3$ show on an average 6 % of loss in ignition (as percentages of Fraction II), and as this loss is not connected either with humus or with $CaCO_3$ Fraction II thus contains an average of 6 % of hygroscopic moisture (min. 4.3 % and max. 7.8 %). The differences are probably due to the composition of the Fraction, i. e. whether there is more or less weathering of the silicates.

The conclusion is thus reached that the H_2O_2 ROBINSON treatment, subsequent boiling with HCl and decantation of Fraction I with NH_4OH, entirely decomposed and dissolved the humus. Quite different results are obtained on ignition of the Fractions after the old method has been followed, viz. treatment with cold HCl and decantation of Fraction I with ammonia and Fraction II and III with water. The difference is clear from Table VIII.

TABLE VIII.

Soil Sample No.	$CaCO_3$	Humus approx.	Fractions	Percentage in soil		Ignition loss in % of soil	
				dried at 105°	ignited		
805	0	16 %	II	29.1	23.8	5.3	8.1
			III	29.6	26.8	2.8	
812	0	34 %	II	28.3	22.1	6.2	11.0
			III	21.3	16.5	4.8	

Fractions II contained at most 7 % of hygroscopic moisture per fraction, which is approximately in the case of soils 805 and 812 at most 2 % of the soil. The ignition loss of 5.3 + 2.8 = 8.1 % and 6.2 + 4.8 = 11 % is thus due for the most part to the humus (approximately 8.1 — 2.0 = 6.1 % and 11 — 2 = 9 %).

Originally it was my opinion that it was essential to submit the soils containing large quantities of humus to a dull heat before the H_2O_2 treatment. It has however now been established that even when large masses of humus are present (soils with nearly 60 % of humus have been the subject of experiment) the H_2O_2 treatment can decompose them. Treatment was of course carried out on 5 instead of 10 gms of soil. Ignition was not only unnecessary but even prejudicial, as the humus that has been ignited did not decompose fully under the H_2O_2 treatment. Fractions II and III and also IV thus contained humus, and moreover the mineral particles were firmly cemented together with humus that had been ignited and had remained undecomposed on treatment with H_2O_2. On investigation of a series of clay soils containing humus in large quantities the fluid remained turbid on decantation and the results were quite different from those of the non-ignited soils with H_2O_2 treatment. See Table IX.

TABLE IX.

Soil Sample No.	Percentage in dry substance in:			
	Humus approx.	Calcium carbonate	Fraction III IV (Sand)	
			not ignited	previous ignition
1729	39	32.3	3,7	5.0
1730	46	25.9	4.7	5.0
1735	47	6.1	2.1	20.3
1738	66	1.6	2.2	11.0
1739	58	2.4	6.0	20.4
1744	55	0.6	13.4	25.0

DECANTATION WITH NH_4OH.

In my article which has already been quoted (1) I referred on page 7 to the effect of using dilute ammoniacal water for decantation. In an article which appeared recently BLANCK and ALTEN (11) come to the conclusion that a preparation of the soil with ammoniacal water for analysis by decantation on the ATTERBERG method cannot be recommended without reservation, for all soils, as the 2.5 % of ammonia solution under certain conditions has profound chemical effects which, in the instance investigated by BLANCK and ALTEN, have led to a considerable release of silicates whereby the whole decantation result, in the sense of the originator of the method, is rendered illusory. The behaviour of the Dutch soils in this respect has not yet been investigated. It may be noted here, that in the decantation we always use a 0.1 % ammonia solution.

CONCLUSIONS.

On agitation with a slight excess of cold dilute HCl fairly considerable quantities of $CaCO_3$ remain undissolved, which on boiling with the HCl are completely or very nearly dissolved.

Somewhat more of $SiO_2 Al_2O_3 + Fe_2O_3$ and bases are dissolved on boiling with HCl, than on agitation with cold HCl; the differences are however small. These quantities which go into solution on boiling with HCl probably belong for the most part to Fraction I. A correction in the case of Fraction II may probably stand as accepted and certainly without serious error in the case of Fraction III and IV.

On decantation of Fraction I with dilute ammonia — either after agitation or after the HCl treatment — not all the humus is dissolved. The fractions II and III (IV) may in the case of soils rich in humus contain considerable quantities of humus. On ignition of Fraction II, and also to a small extent in the case of Fraction III, hygroscopic moisture as well as humus is lost.

If the larger particles of organic substances such as the remains of leaves, roots, etc., have been removed by sifting the soil sample, the humus is practically completely decomposed by boiling H_2O_2 (ROBINSON method), and by further decantation with NH_4OH after boiling with HCl, or transformed into a dry form. Fractions II, III and IV are then practically free from humus. Ignition of these fractions for removal of humus is thus unnecessary. Since Fraction II still contains hygroscopic moisture, ignition of this Fraction brings out a small error.

Ignition of the soil samples, even if it is very carefully carried out, makes the organic matter harder to attack by the H_2O_2, so that after treatment of the ignited samples with H_2O_2 somewhat large quantities of humus remain in the fractions, which are not even dissolved by NH_4OH. These ignited organic remains cement the mineral particles firmly together, so that a much too low content in clay is found.

A combination of boiling with H_2O_2 (according to ROBINSON) and HCl and decantation of Fraction I with NH_4OH seems to be the most suitable treatment of the soil sample. The cementing humus-$CaCO_3$-Clay-gels are removed so that a thorough separation of the mineral particles is achieved without their being affected in any way worth mention. In consequence of the ease with which separation is effected, decantation of all fractions proceeds very quickly. Boiling with more than 100 cc. 0.2 N. HCl excess is not favourable, as it necessitates more frequent decantation. From experiments which have not yet been published it has been found that with the combination H_2O_2 and HCl the carbonates dissolve more readily in the HCl.

Detailed Description of the New Method of Preparation of the Soil Samples.

10 gm. of air dried soil (in the case of soil very rich in humus 5 gm.), passed through a 2 mm. sieve are placed in the afternoon in a 750 to 1000 cc. beaker and 50 cc. of a 20 % solution of H_2O_2 poured on it. After some time frothing frequently takes place so that cooling off is necessary. On the next day the whole is boiled for 30 minutes in the bath, cooled, 50 cc. H_2O_2 again added and once more boiled for 15 minutes. If necessary the boiling with H_2O_2 may be repeated once again. Subsequently 200 cc. of dilute HCl is added with such quantity of HCl, that with 100 cc. 0.2 N. HCl more is available than is required for the solution of the calcium carbonate: boiling for 15 minutes over a naked flame follows with cooling off and the whole is washed into the Atterberg decantation cylinder. Decantation (10 cm. after 8 hours, or 20 after 16 hours), proceeds first with water till the acid reaction has disappeared, and then again with NH_4OH. After removal of Fraction I, decantation of Fractions II (10 cm. after 7.5 minutes) and III (30 cm. after 15 seconds) is effected with water. Fraction IV remains behind. Fractions II, III, and IV are dried at 105°C. and weighed. Fraction 1 is reckoned at 100 — (II + III + IV + Humus + $CaCO_3$).

As limits of the fractions the Atterberg limits are adopted:

Fraction	Vol. in cm.	Diameter in microns.
I	10 : 8 × 3600	< 2
II	10 : 450	2 — 20
III*a*	30 : 60	20 — 100
III*b*	30 : 15	100 — 200
IV		200 — 2000

COMPARATIVE RESULTS ACCORDING TO THE EARLIER METHOD AND THE NEW METHOD N.

With A the preparatory treatment is carried out with cold HCl and further decantation as above (see *Internat. Mitt. für Bodenkunde*, XI, Page 9). The new method N is that described above. Table X shows the results.

TABLE X.

Soil Sample No.	Content in % of dry soil in										Proportion	
	$CaCO_3$	Humus	I		II		III		IV		I : II = I	
			A	N	A	N	A	N	A	N	A	N
790	0.2	3.0	42.4	49.8	32.0	26.6	22.0	19.7	0.4	0.7	0.75	0.53
795	8.8	6.0	31.9	44.4	32.8	22.7	20.1	17.6	0.5	0.5	1.03	0.51
800	0.3	10.7	19.9	35.2	30.3	20.9	38.2	32.7	0.6	0.2	1.52	0.59
824	11.9	3.6	25.8	32.8	23.6	16.0	34.1	35.5	1.0	0.2	0.91	0.49
830	0.1	10.0	45.8	51.8	31.8	27.6	12.1	10.4	0.2	0.1	0.69	0.53
831	0.9	3.9	29.5	36.6	26.0	19.2	38.7	36.9	1.0	2.5	0.88	0.52
952	5.0	10.5	23.3	32.8	24.8	20.1	35.8	31.5	0.6	0.1	1.66	0.61
1096	1.8	1.3	19.9	25.9	19.8	15.8	52.5	51.0	4.7	4.2	1.00	0.61

According to the old method A the content in Fraction I is always smaller, in Fraction II is always larger, than with the new method N. The differences are very considerable, as also is noticeable in the proportion I : II with A and N (last two columns). The differences in the case of III (and IV) are very slight. To a very small extent the differences are to be ascribed to the fact that Fractions II and III by the A method may still contain $CaCO_3$. They arise mainly however from the fact that (by the N method) the cementing $CaCO_3$ — Humus — Clay media have been removed by boiling with H_2O_2 and HCl.

CONCLUDING OBSERVATIONS.

A brief note may be added on the following points:

(a) *The form of the* ATTERBERG *decantation cylinders.* — Immediately after the war, new decantation cylinders were ordered. The syphon tube of the new cylinders was however differently shaped from that of the old cylinders, which occasioned great differences in the results.

Soil Sample	I + II	III + IV	I + II	III + IV
	Old form		New form	
882	11.8	83.5	16.9	78.4
883	22.9	73.6	37.2	59.3
884	12.2	85.3	18.8	78.8

The old form (2) was retained. If the ATTERBERG decantation apparatus is to be adopted as the standard apparatus (12), it will be necessary to place the order for the instruments with one and the same firm.

(b) *Angle of inclination of the plane of setting up of the decantation cylinder.* — A portion of the soil particles as they settle are deposited in the front limb of the syphon tube of the cylinder. It seemed likely that these particles, at least in part, would be floated off. In order to prevent this, the Fraction I was always in the first place syphoned off very slowly, in 10 or 15 minutes. Later on the plane surface on which the cylinders stand was given a slight inclination of 3°, and in such a way that the syphon was somewhat raised. Contrary to our expectation we found that in this way rather more of Fraction I was decanted.

Soil Sample No.	Angle of Inclination	Fraction (average of 6 determinations			
		I	II	III	IV
B	0.	45.5	30.4	15.0	0.3
	3°	47.0	28.8	15.1	0.3

In the case of very sandy soils the results, especially for the sand fractions, were much altered:

Soil Sample	Angle of Inclination	Fraction		
		I + II	III	IV
960	0°	2.0	19.1	78.5
	3°	1.7	10.7	87.2
961	0°	2.2	20.0	77.4
	3°	1.8	13.5	84.4

The separation of fractions III and IV is probably better effected with the KOPECKY apparatus. In the case of a series of very sandy soil samples a complete separation of the fractions III and IV cannot be successfully effected.

(*c*) *The rate of decantation and the size limits of the fractions.* — Following ATTERBERG decantation, the point of removal of Fraction I takes place with a height of water in the cylinder of 10 cm. after 8 hours (or 20 cm. after 16 hours). In the STOKES equation:

$$V = K \times r^2$$

which is naturally only true for spherical particles, thus becomes $V = 10 : 8 \times 3600$ and $r = 0.0001$, which gives $K = 34722$. The other two rates of decantation by the ATTERBERG method are $V = 10 : 450$ and $V = 30 : 15$, which with $K = 34\,722$ gives $2r = 16\mu$ and $2r = 152\mu$. The ATTERBERG fractions thus would lie between the following limits:

Fractions		Dimensions in Microns
I.	< 2	< 2
II	2– 16	instead of 2– 20
III.	16– 152	» » 20– 200
IV	152–2000	» » 200–2000

We have however always retained the limits of the fractions as stated by ATTERBERG (2 — 20 — 200 — 2 000 as in the last column of the above table). It is essential in each case to mention the rate of decantation in use.

(d) *The* SIKORSKY *decantation apparatus.* — SIKORSKY decants after 1000 seconds and with a height of water of 20 cm.: thus $V = 20 : 1000$, which with $K = 34\,722$ gives a diameter $2r = 15.2\mu$. The so-called clay fraction of SIKORSKY is thus nearly equal to the fractions I + II of ATTERBERG, which we found to be established for a large number of soil samples. The SIKORSKY apparatus is very rapid in working. If therefore it is a question of a large number of soil samples of the same type the sand content (size of particles $2r = 15\text{-}16$) may be determined according to SIKORSKY and then an exact mechanical analysis made of some typical soils into Fractions I, II, IIIa, IIIb and IV.

B. SEDIMENTATION METHOD.

(Odèn-Wiegner and Krauss-Robinson).

Some brief observations on the sedimentation method may be made here. While in the decantation method the electrolytes present in the soil or added to it are removed by decantation of Fraction I together with a part of Fraction I, the removal of these electrolytes in the case of the different sedimentation methods must take place *before* the sedimentation and without any removal of particles of Fraction I. Thus there must be filtration and washing out with distilled water before the sedimentation. A short time ago Mieczynski and Sokolowsky (13) pointed out that in the separating out of the soil particles a reversible process was involved, so that as in all reversible reactions the freed particles must be removed. In this case it will be necessary to treat the mass of soil afresh after the filtration and washing out, for example, by agitation with dilute ammoniacal water.

Of the various sedimentation methods I have had personal experience only of the pipette method according to Robinson (14). The following detailed observations thus apply only to the Robinson method and the Krauss similar method (15).

1. In the Atterberg decantation method Fraction I is estimated from the difference (100 — ($CaCO_3$ + Humus + II + III + IV)). Since the quantities of SiO_2 $Al_2O_3 + Fe_2O_3$ and other bases dissolved in the course of the treatment with HCl originate mainly from Fraction I, no correction is necessary. In the sedimentation methods Fraction I is weighed, and hence a correction must be made for the substances which are dissolved in the course of the HCl treatment.

2. The same holds good, if the fractions are ignited instead of being dried at 105°. Fraction I in particular contains much hygroscopic moisture, so that on ignition of this fraction there may be a fairly large error. In the case of very clayey soils there may be found up to approximately 5 % of hygroscopic moisture (in percentage of dry soil).

In Table XI some comparative analyses made by the Robinson pipette method and the Groningen method are placed side by side. The preparatory treatment by the pipette method was carried out by the new method, viz. H_2O_2-HCl treatment. According to a verbal account given by Robinson the material was then filtered and washed out with H_2O, the whole mass of soil placed in a litre flask with 500-600 cc. of water, mixed with 50 cc. of 10 % ammoniacal water and rotated for three days. This soil washing was then filled up to one litre with water, thoroughly shaken and placed in a cylinder. Pipetting was then employed at the 20 cm. level after 15 minutes (V = 20 : 200, hence the ATTERBERG fractions I + II) and at the 20 cm. level after 16 hours (V = 20 : 16.3600) hence the ATTERBERG fraction I. Fraction I + II and I are dried at 105° and not ignited. The loss from ignition has all the same been estimated and is inserted under G in the last column of Table XI. In the liquid filtered off after the HCl treatment, SiO_2. Al_2O_3 + Fe_2O_3 and CaO were identified and inserted on Table XI in K as value in a percentage of the soil. This correction is taken into account, i. e. that Fraction I is already increased by that value. If this correction K is not made and it moreover the fractions are ignited instead of dried at 105°, the following results are obtained, for example in sample No. 795, by the ROBINSON pipette method (R) : I = 37.2 (instead of 46.2), II = 21.5, III = 26.5, (instead of 17.5). The effect is thus very noticeable in the case of these heavy soils.

TABLE XI.

Soil Sample No.	Content in percenteges of dry soil in									
	$CaCO_3$	Humus	Fraction I		Fraction II		Fraction III + IV		K	G
			Gr	R	Gr	R	Gr	R		
509	4.0	1.5	24.9	26.8	15.3	12.4	54.3	55.3	2.0	3.9
795	8,8	6,0	44.4	46.2	22.7	21.5	18.1	17.5	3.7	5.3
1898	0.4	2.5	47.2	47.6	29.1	26.1	20.8	23.4	2,8	4.7
1900	0.2	3.0	46.2	46.5	28.3	24.9	22.3	25.4	2.9	5.3

There is a fairly close correspondence; in comparison with the correspondences usually existing between similar analyses it may be called very close. It is to be hoped that ROBINSON will issue precise instructions for the use of his pipette method, and will give particular attention to the following points: (1) treatment with cold or boiling HCl; (2) correction K; (3) ignition or drying at 105° of the Fractions.

NOTES AND BIBLIOGRAPHY.

(1) *Int. Mitt. f. Bodenkunde*, IV, pp. 7-18, 1914.

(2) *Int. Mitt. f. Bodenkunde*, II, pp. 320, 1912.

(3) A. D. Hall, *J. of the Chemical Society*. Transactions 1904, Vol. 85, Part II, 950 and 946.

(4) *Int. Mitt. f. Bodenkunde*, XI (1921), Page 9.

(5) Gilbert Wooding Robinson, M. A.; Note on the Mechanical Analysis of Humus Soils *Journal of Agricultural Science*, XII, pp. 287-291, 1922.

(6) König and Hasenbaeumer have criticised this method in the *Landwirtschaftlichen Jahrbüchern* (Agricultural Yearbooks) (LVI, 1921, page 449). On page 443 emphasis is laid on the fact that to avoid flocculation of the soil colloids distilled water must be used for the decantation of the first fraction, and that on this account the use of HCl as by Hissink gives rise to errors. They have obviously failed to note that the decantation of Fraction I is carried on with distilled water until the electrolytes are removed. This stage in the process is recognised by the fact that the suspended matter in the cylinder becomes markedly turbid.

(7) The figures supplied by König (see edition 1923, page 112) have only relative value.

(8) The Stohmann litre flasks were employed, as in the analysis for superphosphate.

(9) In this periodical, Part I, page 6, an article by Dr. L. Smolík appears on the hydrogen peroxide catalysis of the Moravian soils.

(10) *Journal of Agricultural Science*, XV, Page 29.

(11) Ein Beitrag zur Frage nach der Vorbehandlung der Böden mit Ammoniak für die Atterberg'sche Schlämmanalyse by E. Blank and F. Alten; *J. f. Landwirtschaft* (1924) Page 153-163.

(12) See Resolution 4 of the Berlin Meeting, *Int. Mitt. f. Bodenkunde*, IV, Page 30.

(13) Die Untersuchungen über den Einfluss verschiedener Vorbereitung der Bodenprobe auf den Verlauf des Schlämmprozesses by F. Mieczynsky and Mayan Sokolowski. *Mémoires de l'Institut national Polonais d'économie rurale à Pulaw*. Vol. IV, 1923, Summary 109-111.

(14) Gilbert Wooding Robinson, A new method for the mechanical analysis of soils and other dispersions; *The Journal of Agricultural Science*. XII, 306-321, 1922.

(15) Gustav Krauss, Ueber eine neue Methode der mechanischen Bodenanalyse etc. by *Int. Mitt. f. Bodenkunde*, XIII, pp. 147-160, 1923.

THE DEGREE OF SOLUBILITY OF PHOSPHATE AND POTASH FERTILISERS NECESSARY TO MAINTAIN THE SOIL SOLUTION AT THE CONCENTRATION REQUIRED BY PLANTS.

Romualdo Avattaneo.

Phosphorus and potassium are necessary to plant life and if these two elements are lacking, plants, after having assimilated the small quantity of phosphorus and potassium contained in the seeds, lose their vitality and die.

Phosphorus and potassium are deficient in most soils, except those of volcanic origin ; hence the necessity of supplying non-volcanic soils with the quantity of phosphorus and potassium necessary for plant life.

Phosphorus is contained in large quantities in the natural phosphates, and potassium in rocks of the leucite and phonolite type.

Phosphorus and potassium, in order to be absorbed by plants, must be dissolved in water. It is also necessary that these phosphate and potash solutions should contain only a minute percentage of dissolved matter ; for instance, a one per cent solution ceases to be nutrient and becomes toxic, and the plant in contact with it withers and soon dies.

The optimum *total* saline concentration of nutrient solutions for wheat, for instance, has been found to be 0.3 parts per 1000. A solution of this concentration, however, contains such a small quantity of dissolved nutrient substances, that the plants would soon exhaust them, when plant life would become impossible.

In order that this very weak solution should not become impoverished, an intermittent supply of nutrient salts is necessary, which would replace only those substances in the solution as they become exhausted or deficient, and in such quantities as to reach, but not exceed, the necessary concentration.

This may appear to be an unattainable ideal, and yet it is realised to a considerable extent in naturally fertile soils, and the process may be regulated by a far from complicated method.

No chemical transformation of the crude phosphatic or potassic substances is necessary, it is sufficient if they be finely ground and well mixed, and applied to the soil in the same quantities and in the same manner as is done in the case of other chemical fertilisers.

The mineral phosphates alone are too insoluble, *i. e.*, they give solutions which are too weak ; when merely mixed with crude potassic compounds they become much more soluble in water, and give stronger solutions than when alone (a chemical phenomenon of double decomposition), and of the strength required by plants (*Proceedings of the IV International Pedological Conference* — Report No. 20 — Commission II).

As the mineral phosphate is brought to the optimum degree of solubility by the presence of the slightly soluble potassic salts of the leucite type, so these potassic salts attain the required solubility by the presence of the raw phosphate.

The degree of solubility adapted to plant life is thus attained ; it follows that in applying the mixture to the soil, if the soil solution is too weak it would quickly be strengthened to the desired degree, which cannot be exceeded as the mixture cannot give stronger solutions.

By the presence of the mixture in the soil, therefore, every decrease of nutrient phosphatic and potash salts in the soil solution, from whatever cause, would be followed by a corresponding increase, and the percentage of phosphorus and potassium in the nutrient solution would remain constant and retain that value which is adapted to plant life.

Thus, by simply grinding and mixing, the natural phosphates and volcanic rocks of the leucite type are made suitable for fertilising purposes, and from both a scientific and economic point of view the method cannot be improved.

The present system of chemical fertilising dates back to 1840 and corresponds to the scientific knowledge existing at that time.

It was only known then that plants derived nutriment from the matter dissolved in the soil water ; it seemed that the optimum must be attained by transforming the mineral phosphate into a compound which would dissolve in water like the more soluble salts.

The mineral phosphate was treated with sulphuric acid, and a mixture was obtained of double the weight of the original substance and of which about 50 % was chalk and very acid phosphate. This mixture, owing to the large quantity of sulphuric acid necessary and the cost of manufacture, cost about four times as much as the original phosphate. The name of superphosphate was given to this mixture (it does not contain the slightest trace of superphosphate) and its property of dissolving in a small quantity of water was thought to be a great advantage in agriculture. Erroneously, it was said to dissolve completely because very soluble, as though the slightly soluble matter did not also dissolve completely. The difference between very soluble and slightly soluble, consists only in the fact that the former needs less water than the latter to dissolve completely, and that consequently if the former is not in contact with large quantities of water it gives very strong solutions, whereas the latter whatever be the quantity of water gives weak solutions.

When the dissolved substance is taken (as, for instance, by plant absorption) from these weak solutions, obtained from slightly soluble substances, other matter immediately dissolves, bringing back the solution to its original strength, this process continuing until the soluble substance is exhausted. Hence, the whole of the said substance is completely dissolved and utilised in its best form, for the plant is thus always in contact with the dilute solution best suited to it.

Now that it is known that strong solutions are not an advantage but an absolutely toxic factor for plants, the " superiority " of the highly soluble salts gives way to that of the slightly but sufficiently soluble substances. As the slightly but sufficiently soluble salts cost about a fourth of the highly soluble, this information should be made known to farmers in order that in their own interest and in that of the nation they should take measures towards a more scientific fertilisation of their land.

Mention should be made of the following advantages which may also be derived from this solution of the problem of chemical phosphatic and potassic fertilisation:—

The utilisation of all phosphate deposits, on the sole condition that their phosphorus content be not so low as to render their transport inconvenient. In Italy, the utilisation of Italian and Lybian natural phosphates is made impossible in agriculture, not because they are of poor quality, but because they are rejected by the superphosphate industry. These phosphates indeed contain on an average more phosphorus than those existing in superphosphate. Too much sulphuric acid however would be required to convert it into acid phosphate (superphosphate) as it contains a deacidifier, carbonate of lime (a valuable substance for agricultural soil), in larger quantities than the French African phosphates.

The proper utilisation of the deposits of slightly soluble potash (in Italy they are of the leucite type);

No increase in the weight of mineral phosphate, as caused for the mere object of dissolving the phosphate ; in superphosphate the weight is double;

The fresh impetus given to chemical fertilisation, an enormous quantity of sulphuric acid being no longer necessary (the annual requirement in Italy is at present about six million quintals);

No detrimental effect of the fertiliser on acid soils, or on those deficient in carbonate of lime. The use in agriculture of potassium and phosphorus in their natural state, at about half the present cost of phosphates.

By bringing about and maintaining the concentration of soil solution to plant life, as shown by soil science and plant physiological research, it is evident that all the characters in plants most useful to us will be reinforced, and both the quality and quantity of agricultural production will be increased.

Abstracts and Literature.

General.

Animal Life in Deserts.

BUXTON, P. A. *Animal Life in Deserts*, published by Edward Arnold and Co. Price 10s. 6d. London, 1923.

The notes on desert climate in the first chapter should be of interest to the soil scientist. All the climatic factors are treated; water, temperature, relative moisture, wind, evaporation and light. The second chapter describes the soil and the water courses in their relation to the fauna, the subject being handled with special vividness.

When the author goes on to show that dune-sand, resting on impermeable rock, is especially indicated for grape-growing and gives as an example the region south of Jaffa (Page 42), it would seem that the possibility of cultivation in that particular spot is due to the fact that the dune sand rests partly on a so-called " Chowrah " of red earth, and in many places it is of such recent origin that signs of previous cultivation can be observed in the subsoil.

The third chapter describes the flora, while the fourth and fifth are devoted to the fauna and the physical conditions of their surroundings. The sixth chapter deals with the relations between animals and plants, and the seventh contains certain observations on the colouring of desert animals.

The author is well acquainted with the desert of South-west Persia, Lower Mesopotamia, Syria and Palestine. It is impossible to deal in a brief note with the full detail which is of great interest. The value of the book is increased by the excellent photographic reproductions. The first edition is exhausted. REIFENBERG.

Geology.

POTONIÉ, R. and SEITZ, O. in collaboration with other experts, *Bücherei für Landwirte*, edited by H. V. LENGERKEN, Published by Walter de Gruyter and Co. 150 illustrations, 274 pages. Price 10.80 M. Berlin-Leipzig, 1925.

The agriculturist, like the engineer and the miner, has the right to expect that geological knowledge shall be available for him in a form and to an extent such as fall naturally into the framework of his scientific education and in some relation to the work which comes to him in the course of this vocation. The present volume " Geologie ", in the " Bücherei für Landwirte " series, meets this requirement, as besides giving the general scientific principles of general and historical geology, it treats in full detail the subjects especially important for the agriculturist, such as the transformation of rocks, weathering and soil formation, soil water, etc., while dealing with the theory of stratification, and more especially with palaeontology as shortly as is compatible with any kind of geological studies and the comprehension of geological maps. The authors have hereby taken the best line that a " Geology for Farmers " can take, so that the book is undoubtedly one to recommend. It contains a series of instructive diagrams ; but it would have been advisable to have added a geological outline map or a rough sketch of a geological land map. SCHUCHT.

Soil Morphology and Agricultural Science.

SACHAROW, S. *La Pédologie*. NOS. 1-2, MOSCOW, 1924.

1. The results of the examination of soils should be utilized to a much greater extent by scientific agriculturists.
2. In practice, agriculturists are mainly concerned with soil morphology and topography. All knowledge of the soil begins with the knowledge of soil morphology.
3. Of all the subjects included under soil science, soil morphology is the one that can be chiefly applied to agricultural practice.
4. It is therefore desirable that both theoretical and practical instruction in the subject of soil morphology and soil topography should be given in the form of higher school courses, and that both laboratory and field work should be carried out. *Author.*

Peat and its Applications.

STEINERT, Joh., Der Torf und seine Verwendung. Published by Walter de Gruyter and Co. Berlin and Leipzig, Göschen Series, Vol. 895, 66 illustrations. 1925 : Price 1.25 Marks.

In this book all essential information as regards peat and the uses of peat has been put together in small compass by an experienced hand. The scientific section deals with the origin and different kinds of peat, as well as its physical and chemical properties; the technical section describes the preliminaries of the enclosure of moorland, the removal of the peat from the moor, transport and drying. Further treatment and uses and possibilities of development are also discussed. SCHUCHT.

Properties of the Soil and their Improvement as a Basis for a general Farming Scheme.

VITINS, J. (J. WITYN) 32 pp. (Lettish). Riga, 1923.

In consequence of the land reform in Latvia there has been a great increase in the number of medium-sized farms (14-16 hectares). On some of the farms improvement of arable land has been carried out with the following results as to quality of soils: Class I to II, less than 0.5 %; Class III, 4 %; Class IV, 13 %; Class V, 28 %; Class VI, 18 %; Class VII, 2 %. A large number of determinations of soil reactions, in all more than 600, went to show that, speaking generally, only the soils of Classes I to III are completely or nearly neutral; that the soils of Class IV often require lime, although good yields may be obtained from them by careful cultivation and plenty of manure. All the other soils, i. e. 87 % of the total, respond to treatment with lime, especially from Class IV onwards. The majority of the farms have poor, highly "podsolic" soils, the average yields of which are from 7-12 quintals per hectare. It is difficult for the farms to maintain existence with such yields, nor can any satisfactory scheme of farming be established. The strongly podsolic soils are usually found in regions with heavy rainfall (more than 600 mm.), while on lighter mother rock they occur everywhere. The first steps to be taken by the landowners and also by the authorities for the improvement of these soils must be in the direction of diminution of acidity. This treatment should not present difficulty since there is an abundance of calcareous material in Latvia. The treatise contains numerous soil analyses and descriptions of good soil requiring no lime, and also of the poor soils with high lime requirements. L. FREY.

Short Manual of Soil Science for the Use of Surveyors and Agricultural Technicians.

VITINS, J. (WITYN, J.), 110 pages (in Lettish). Riga, 1923.

The author gives in this book a general outline of the science of Pedology together with a description of the most important mother rocks of Latvia and of the soils formed from them, i. e. of the extent of the transition of soils into the podsol type. The degree of podsol formation may be considered as a basis for improvement of new, recently cleared soils.

The soils of Latvia are divided into 8 principal categories as regards mprovement. The fertility of the heavy clay soils and of the sandy soils is markedly diminished by transition to the podsol type, in the sandy soils by the formation mainly of a smooth very acid horizon of "Ortstein". The fertility of the sandy clays with a clay content of 10-30 % is diminished only very gradually, but the yields are much reduced if the lime requirement of the soils is about 6 tons $CaCo_3$ per hectare.

The author recommends that special attention be given, when undertaking improvements, to the development of the soil profiles, to the colour, structure and the soil water conditions. In particular, attention is to be paid during improvements of soil which is rich in humus. Richness in humus of soil in the Podsol zones is either the sign of neutral soil — the yields in this case are very high if the subsoil is not too coarse-grained — or the sign of poor aeration and the proximity of soil water — in the latter case, the soils are of little value as arable land although well suited for artificial meadow and pasture.

The content in organic matter of the higher categories of arable land is about 1-2 %, and only reaches 4 % in the non-podsol soils: in the lower categories it often falls below 2 %, usually it is about 3 %, although these soils are much lighter in colour. L. FREY.

Experiments with Subsoiling, Deep Tilling and Subsoil Dynamiting.

The Illinois Experiment Station Bulletin, No. 258.

Deep plowing and subsoil dynamiting experiments in Illinois, as well as in other States, indicate that these tillage methods cannot be expected materially to increase crop yields. That such methods are not superior to ordinary or medium-depth plowing has been indicated by subsoiling experiments conducted by the Illinois Agricultural Experiment Station on grey silt loam on light clay at Odin, Marion county: subsoiling, deep tilling, and dynamiting experiments on grey silt loam on light clay at Toledo, Cumberland county; and deep tilling experiments on brown silt loam at Urbana, Champaign County.

Soil moisture determinations made during two seasons on the variously tilled plots at Toledo show that none of the tillage treatments used increased the downward movement of moisture through the soil.

X.

Soil Physics.

The Temperature of the Surface of Deserts.

BUXTON P. A. *Journal of Ecology*, Vol. XII, No. 1. January, 1924.

The author while studying animal life took up the study of the temperature of desert soils. There is no difficulty in the estimation of the temperature of light soils, whereas heavy soils present various obstacles. When working on gravel or lava soils, the author has overcome the difficulties of the ordinary thermometer by the utilization of a thermometer in the form of a wax scale, with different melting points. In June and July the temperatures of the soils of Palestine are between 55 and 62°C. While theoretically the temperatures of the soils in the Jordan valley, which in some cases are over a 1000 m. below the elevation of Jerusalem, should be lower than the temperature of the mountain soils (due to the fact that the sun's rays are absorbed by atmospherical vapours), in reality the contrary is the case. The author states that this is caused by the walls of the valley which act as reflectors of the sun's rays.

The author has also found that the slope of the ground has an important bearing upon temperature. REIFENBERG.

Note on Capillary Rise in Soils.

GAROLA C. V. Etudes sur l'ascension capillaire dans les sols. *Annales de la science agronomique*, No. 1, pp. 1-32, graphs. Chartres, 1925.

These notes of the late agronomist have been compiled by Mdlle Garola, his collaborator.

The first chapter deals with the calculation of the probable height of capillary rise, dependent upon the diameter of the tubular passages and consequently of the soil pore spaces, using the following formule :

$$h = 2\,f : dr.$$

h = the height in mm. ; f = surface tension of the liquids ; d = its density ; r = radius of tube in mm.

As there are, per gm. of soil, 43 milliard grains of raw clay (of a diameter 0.000279 cm.) ; or 34 million grains of silt ten times larger ; or 5 thousand grains of sand of half a millimetre.

Consequently these last are not concerned with capillarity

Çhapter II deals with the experimental determination of capillary rise in different soils, by the use of an apparatus which resembles the " Evaporomètre enrégistreur " of HOUDAILLE. The experiments refer to sand, silt and silicious clay.

In sand, water rises very quickly but only to the small height of 55 cm. after 3 days and remains at that height.

On the other hand, in the silts of the high plains of the province of Beauce the absorption is slower at the beginning but continues during a week and reaches a height of nearly 80 cm.

In the sample of silt from Lomas de Zamora near Buenos Ayres and in silicious clay, the capillary rise is considerably slower, as the water takes 191 days to attain the height of 1 metre.

In the last experiment the heights reached after equal intervals of time represent a logarithmic scale. The quantity of absorbed water follows a similar curve.

The data of experiments are as follows :

	Percentage of clay present	Time required to reach 0,50 m.	Relative speed.
Silt without clay	0	12 hours	100
» from Beauce	18	37 »	33
» » Zamora	32	123 »	10
Silicious clay	37	576 »	2

If there is more than 18 % clay the capillary rise takes place as in the case of pure clay, because it fills all the empty spaces and thus the diameter of the capillary tubes is determined. PIERRE LARUE.

New Apparatus for Determination of Soil Permeability.

SPIRHANZL, J. *Zemedelsky Archiv.* Prague, 1924.

A sample of the soil is taken by means of a steel cylinder. This column of soil, having a height of 10 cm., is subjected to the penetration of water at a constant hydrostatic pressure. The relative permeability of the soil is expressed in cc. of water which have penetrated the column of soil having a basal area of 10 cm^2 and a height of 10 cm. and with a hydrostatic pressure of 100 cm., for a period of 24 hours. SMOLÍK.

Soil Chemistry.

Researches on the Formation and Decomposition of Humus in the Soil.

BALKS, R. Untersuchungen über die Bildung und Zersetzung des Humus im Boden. *Landwirtschaftliche Versuchstationen*, 103-221, 1925.

The catalytical power of the soil produced by enzymes and colloids is increased by the use of farmyard manure when it is first applied, but later on diminishes. The same effect is shown with pure nitrogen and its easily soluble compounds; after the use of dung the effect first increases and then diminishes. The author states that the amount of carbon found in the soil is less after oxydation with an aqueous solution of chromate than that found in a preliminary analysis. The experiment with chromate of silver, carried out by von SIMON, corresponds with the results of the analysis. The experiment carried out by PIETTRE with the pyridin method proved less successful. TOLLENS method for the determination of pentozans in the soil is useful, but no suitable method has yet been established for the investigation of hexosans. The methoxyl data given by ZEISEL and FANTO show the amount of lignin in the soils. The gradual oxydation of the humus was shown by a slow decrease of the carbon content after the application of farmyard manure. The author observed that the quantity of humus decreases more slowly in chalky soils than in soils with little chalk. This observation differs from the general opinion hitherto held, but is in accord with the experiments of ZOSSOWITSCH and FRETJAKOW. This phenomenon can probably be explained by the fact that the soil acids are combined with the excess of calcium carbonate and are thus protected from rapid oxydation.

K. SCHARRER.

Chemical Decomposition in the Egyptian Deserts.

BLANK, C. and PASSARGE, S. with the co-operation of RIESE, A. and HEIDE, F. University of Hamburg. Die chemische Verwitterung in der ägyptischen Wüste. *Abh. a. d. Gebiete der Auslandkunde*, Vol. M, Serie C, Naturw. V. 6. Hamburg, Komm. Publ. by L. Friedrichsen u. C°, 1925.

In this book, PASSARGE gives illustrations of materials collected in Egypt in 1914, dealing with researches in soil experiments. The analysis of PASSARGES's experiments have been carried out by C. BLANK and collaborators in the Institute of Agricultural Chemistry and Soil Research at Göttingen University.

The first part deals with the geological formation of the territory travelled over and of the phenomena of decomposition of the soil Then follows a full description of the Assuan plain. PASSARGE classifies his results as follows: In the Egyptian deserts are found various soil. strata in a state of decomposition lying anderneath the superficial layer which was formed by alluvial deposits. The decomposition is apparently caused by the corrosive action of salts, which absorb and retain great quantities of water, due to the fact that the rainfall is sometimes very heavy. These decomposed soil strata found underneath the superficial layer, formed by alluvial deposits, have a depth similar to that of the soil strata found in Germany under dense vegetation, which is from 10 to 50 cm. Even the most resistant rocks, such as granite, gneiss, quartz, etc. are altered into an ashen, salty dust by the corrosive action of the salts.

All stony particles in the decomposing layers of earth are thickly covered with a reddish, or yellowish-brown dust. When such stone particles are transported to the surface they become darker, due to the loss of water, which is caused by the absorption of moisture by the sun and warm winds. These stony particles when exposed to the air for any length of time undergo a further decomposition both mechanical and chemical. In the first case, mechanical, the change is caused by the temperature variations. In the second case, chemical, it is brought about by the penetration of the salty-yellowish dust into all the fissures and crevices of the stony soil, which causes the breaking away of scales and all sharp particles. Smooth surfaces, such as for example, the old Egyptian blocks of stone, for a long time are not affected by any corrosive action, or decomposition. On the other hand, rough surfaces such as pieces of shale-like rock decompose very readily when exposed to the air, owing to the penetration of the dust into the fissures, as occurs in Germany in rocks found under moss.

The conclusion of the first part of the article can be summarized by the statement, that, the Egyptian Desert may be considered as a region of important chemical decomposition. In the second part C. BLANK supplements the information of the chemical decomposition of the Desert already known, and in the third part deals with research work concerning decomposition in Egyptian deserts.

The results can be briefly stated as follows:

(1) Chemical decomposition in the deserts is progressing at a much greater rate than scientists in the past believed to be the case. Especially to be noted is the diminishing of silicic acid and the rapid decomposition of calcium silicates, in contrast to the greater resistance of sodium silicates. This contrast is to be found in nearly all rocks and their products of decomposition, and characterizes the process of decomposition by definite features.

(2) Of the soluble salts that may cause crust or concretion formations, it is found that gypsum and sodium chloride are the most prevalent; while there are other sulphates, they are only found in small quantities. Calcium carbonate and other carbonates are in such small quantities that they need not be considered.

This statement agrees with the theory of FUTTERERS in so far as a a small percentage of NaCl and $CaCO_3$ on the one hand and a predominance of sulphate on the other, but not Na_2SO_4 but $CaSO_4$°.

(3) The zone in which gypsum is found according to BLANCKENHORN ends in the South in the neighbourhood of Thebes, but through the investigations described in this article it is further extended to the region of Assuan.

(4) The so called " Protecting crusts " which are principally composed of iron or manganese, are consequences of some internal force or action and are not caused by any external agents.

(5) In the Schellal Desert the soil formation may be considered as semi-arid and in some places is even humid. These soils are of silicate decomposition products similar to those of laterite. Contrary to expectations, the investigations have been unable to prove that the soils of the desert are of an extremely arid nature.

(6) There are two different theories in regard to the formation of ithese soils: first, that the decomposition is caused by the action of chemcal agents that rarely appear, but when they do, the reaction is violent and definite; secondly, that in some remote period during formation of the soils, there existed a very humid climatic condition. In regard to the first supposition, no satisfactory proof can be offered by us, because our present knowledge of the reaction of the chemical agents found in the desert is not sufficient. The possibility of attributing the decomposition to the rains, which are of high temperature, although very rare, is a unanswered question. Also, can it be attributed to the influence of dew, the crystallization of salts, the influence of ozone, of nitrates or similar agents? Other authors have declared these to be determining agents in this process of decomposition, but we have no proof of this.

Taking into consideration all the above mentioned theories: we are of the opinion that the decomposition is rather caused by a former humid period, as the layers of soil and their chemical composition substantiate this theory. It is quite possible that after this humid period there developed an arid period and this is more or less substantiated by leading authorities on the subject to-day. However, in view of the available information on the subject we are of the decided opinion that the question of decomposition in purely arid places is a problem yet to be solved. This is in great part caused by the fact that up to the present time we have not had the opportunity to carry out researches in a region which has been shown always to have been arid.

SCHUCHT.

A Chemical Examination of Sand from the Mediterranean Coast of Palestine.

BRAVER, A. I. Die Resultate einer chemischen Untersuchung des Sandes an der Mittelmeerküste Pälastinas. *Zeitschrift der jüdischen Gesellschaft für Landeskunde und Archäologie Palästinas*, Vol. 1, 2-4, 148. (Hebrew). Jerusalem, 1925.

The results of the analysis was first published in Volume 9 of the "*Economic Data of the Department of Commerce and Industry of the Zionist Executive*" in Jerusalem. It includes the analysis of 187 samples of sand of the dunes along the coast of Palestine between Ras Nakura and Rafa.

The author finds a relation between the sand and the rocks from which sand is formed, a relation which was to be expected. The conclusion that the sands in the south of Akko contain more silicates and less chalk and ferric acid is in perfect harmony with the opinion in ancient history to the effect that in this region the Phoenicians manufactured glass. Tyre and Sidon are situated at a small distance from Akko but the soil in the immediate neighbourhood of these towns is not suitable for glass manufacture. REIFENBERG.

The Effect of Iodine on Soils and Plants.

BRENCHLEY, Winifred E. *Annals of Applied Biology*, XI, pp. 86-111, 1924.

In pot cultures iodine in NaI solution in quantities of 0.1 to 0.0008 gm. per kg. of moist soil has been shown to affect the germination and growth of tomato (*Lycopersicum esculentum*), mustard (*Sinapis alba*), and barley (*Hordeum*) to slightly varying degrees. Germination of tomato seeds in rich soil was not affected, but loss of seedlings from " damping off " was not reduced.

Germination of Mustard was inhibited or checked by the higher concentration; of the plants that recovered some gave greater green and dry weights than the untreated plants. Barley was less resistant to any toxic action of iodine.

Bacterial numbers fluctuated, but in no definite direction, and there was no evidence of partial sterilisation with dressing of iodine in NaI solution in quantities of 0.00095 gm. per kg. of moist soil.

P. H. H. GRAY.

Soil Acidity and its Relation to the Production of Nitrate and Ammonia in Woodland Soil.

CLARKE, G. R., *Oxford Forestry Memoirs*, No. 2; p. 27, 1 plate. Oxford, 1924.

The production of nitrate in the soil is essentially a process of biological oxidation, which takes place in three stages: the decomposition of organic matter for the supply of ammonia; and the oxidation of the latter into nitrous- and of the last-mentioned into nitric acid. It is generally held that the formation and subsequent accumulation of nitrates in the soil is in some way related to the scarcity of acidity in the soil itself.

The tests made by the author in woodland soils show that in reality soil acidity has a certain influence on the accumulation of ammonia and nitrates. The former accumulates much more in very acid soils than in slightly acid or neutral; in very acid soils however it is liable to rapid fluctuations; the soil has the greatest power of retaining ammonia under certain conditions of moisture.

Nitrates are found in appreciable quantities in very acid soils and are apparently unaffected by seasonal changes. In less acid soils they tend to reach a minimum towards August They do not vary to any extent during the day. A. F

The Necessity for Improvement in the Chemical Analysis of Agricultural Soils.

MARCHADIER and GOUJON. De la nécessité d'une évolution dans l'analyse chimique des terres arables. *Annales de la Science agronomique*, I, pp. 32-64. Paris, 1925.

After having made general observations concerning micro-organisms and parasitism in relation to chemistry the authors compare the methods of analysis by solvents

As regards potash in particular, the analysis of 16 different soils demonstrate that the quantities required for treatment with hydrofluoric acid and with nitric acid vary from 1.3 to 10, which makes it almost impossible to compare results. Investigations on soil reaction show satisfactorily the amount present of lime and magnesia. But the acidity only appears at the rate of less than 1 per 1000 in relation to the base where iti s necessary to add lime at the rate of 5 per thousand

According to the authors the relation between phosphoric acid, nitrogen and potassium should be expressed as follows:

$$\frac{N + P_2O_5}{K_2O} = 0.8$$

Also the relation chalk soluble in HNO_3 magnesia soluble in HNO_3 should be equal to, or higher than unity.

Very little is knowns about silica, aluminium and iron in this connection

The sulphur content in soils varies very much.

In regard to the function of manganese, the authors have come to no definite conclusions.

The formula $\frac{\text{total } K_2O}{\text{total } Na_2O}$ is always higher than unity.

This work show the great progress that has been made in the study of the practice of agriculture. PIERRE LARUE.

Biochemical Studies on the Acidity of Forest Soils.

NĚMEC and KVAPIL. Biochemische Untersuchungen über die Azidität der Waldböden. *Veröffentlichungen des Landwirtschaftsministeriums*, No. 2. Prague, 1923.

Having determined the effective and exchangeable acidity (by the colorimetric method of MICHAELIS) and the catalytic power of different forest soils, the authors have come to the following conclusions :

(1) The soil of a dense, evergreen forest shows a greater acidity than a deciduous forest of the same region. The degree of acidity of the humus layers of soil under closely wooded conifers is always higher than that of the mineral layers underneath.

In thickly wooded deciduous forest the degree of acidity of the layers of mineral soil is rather high. The P_H of the mineral soil is greater than that in the corresponding layers of humus.

(2) In woods thinly covered with evergreen trees the humus or the upper layers of the soil show less acidity than that of the corresponding strata in the thickly wooded forests of the same character in the same region.

(3) The humus or vegetal soil in the thinly covered forests of deciduous treed show less acidity than the corresponding beds in the thickly wooded forests of similar species. The mineral sub-soil of thinly covered coniferous woods has about the same degree of acidity as that of thickly wooded forests of non-deciduous trees.

The mineral subsoil of thinly covered forests of deciduous trees is less acid however than that of densely-covered forests of the same kind of trees.

(4) In cases of forests which consist partly of non-deciduous and partly of deciduous trees the humus soil always shows a P_H lower than the corresponding strata of purely coniferous woods. The degree of acidity of such soils is about the same as that of thinly covered coniferous forests or that of dense forests of deciduous trees. The mineral subsoil of mixed forests (non-deciduous and deciduous trees) had less acidity than the humous soil that covers it. The latter is also less acid than the humous strata of purely acicular forest and sometimes has a lower degree of acidity than forests consisting only of deciduous trees

(5) The lower degree of acidity of the humous and mineral soils when conifers are mingled with other types offers more favourable conditions to the micro-organisms of the forest. For this reason the biological process of mineralisation proceeds more easily in the soils of mixed forests.

(6) The degree of acidity of the layers of soil vary continuously during the year, in this respect, that the P_H is higher in the autumn than in the spring.

(7) The catalytical power depends on the presence of organic matter. The intensity of this reaction has a certain relation to the degree of acidity as well as to the number of micro-organisms in the soil.

L. SMOLÍK.

Application and Significance of Electrometric Titration for the Determination of the Reaction of Soils.

NIKLAS, H. and HOCK, A. Anwendung und Bedeutung der elektrometrischen Titration bei der Reaktionsbestimmung unserer Böden. *Zeitschrift für angew. Chemie*, XXXVIII, 195. 1925.

To judge of the soil reaction, the actual acidity (hydrogen-ion concentration) as well as the potential acidity (total or titration acidity) must be determined. This latter is established, as is well known, by titration on the DAIKUKARA method or one of its modifications, while the former is ascertained by the electrometric or colorimetric method. For an exact study of the soil reaction, next to determination of the sizes of the soil fractions, knowledge of the buffer action is important. The azotobacter method gives an approximate idea of the content of the soil in buffer-action, such method being the biochemical expression of the buffer-action of the soil, which is measured with precision by means of electrometric titration. This process is carried out in the following way : the soil reaction is ascertained by means of an electrometer, and the modification of the existing acidity controlled by adding exactly known quantities of acids or alkalis, after which the added quantities of acids or alkalis are marked on the abscissae and the corresponding values for P_H on the ordinates of a graph and the respective titration curves drawn. If a soil with exchangeable acid is agitated with potassium chloride, there is formed, as is to be expected according to KAPPEN, aluminium chloride, which gives with electrometric titration a typical series of curves. The majority of the acid mineral soils gave, on electrometric titration of their potassium chloride extracts, curves which indicate the presence of aluminium chloride and consequently exchange acidity, while forest soils show a completely different series of curves, because in their case the acidity is caused by humic acid and phosphatic acids. To carry out the electrometric titration, 50 gm. of soil are agitated with 125 gm. of 7.5 % KCl solution for half an hour; after decantation has been effected 10-20 cc. (of the solution) are pipetted, and this treatment is repeated. The authors recommend the use of the universal indicator prepared by themselves, with a view to establishsing an important point, viz. how much alkali should be added, so as not to cause too great divergences in the curve. If the turbid decantation residue is used, the electrometric titration becomes more difficult ; with sandy and light soils it is still practicable, but with heavy clays and loams it becomes quite impossible on account of the fouling of the electrodes by the soil colloids. K. SCHARRER.

Electrometric Filtration and the use of Quinhydrone.

NIKLAS, H. and HOCK, A. Die elektrometrische Titration unter Verwendung von Chinhydron, *Zeitschrift für angewandte Chemie*, XXXVIII, 407. 1925.

The investigations of the authors showed that the quinhydrone electrode may be successfully employed up to P_H 8 for determination of soil reactions.

The values found are useful and in conformity with those obtained by the use of the hydrogene electrode. The quinhydrone-electrode may also be used successfully in electrometric titration. K. SCHARRER.

Studies on Base Exchange in Rothamsted Soils.

PAGE, H. J. AND WILLIAMS, W. *Trans. Faraday Society*, XX, 573, 1925.

The Rothamsted soils which have been manured in the same way since 1843 (Broadbalk) and 1856 (Park Grass) show in an accentuated form the effects of basic exchange.

On Broadbalk where potash has been supplied, exchangeable potash is higher than on plots receiving no potash. Values for exchangeable Mg are smaller, for Na and NH_4 very little. After accounting for K removed by crops and drainage the exchangeable K, in soils receiving K exceeds the exchangeable K in soils not receiving K by only a fraction of the amount known to have been supplied. There is reason for supposing that this potassium can change into a non-exchangeable form.

The soils in question contain about 3 % chalk. Considering the ratio of exchangeable Ca, Mg and K to total exchangeable base, Ca is highest and has maximum value in soils receiving no manure or only NH_4 salts and Na salts. Next in order come soils receiving K and lowest are those receiving Mg. Farmyard manure increases amounts of total exchangeable base. Variation of absorption capacity is due to two factors.

(I) Total exchangeable base increases with increase in quantity of clay and fine silt II.

(II) Organic matter is approximately twice as effective an absorptive agent as clay and fine silt II.

On Park Grass soils the effect of liming on the quantity of exchangeable base is very marked. Exchangeable Ca increases with increasing P_H. Saturation for Ca is reached at a point where 1 % of chalk is added to a mixture of soil from the limed and unlimed portion of a plot receiving complete artificials. The HISSINK method of determining exchangeable base is not suitable for soils containing chalk, because of the absorbed H ions in the presence of NaCl solution. The difference between the basic exchange definition of " Saturation " and RAMANN's definition is discussed. T. E.

Base Exchange in Relation to the Problem of Soil Acidity.

ROBINSON, G. W. and WILLIAMS, R. *Trans. Faraday Society*, XX, 586, 1925.

Lime requirement is a conventional determination with no constant correlation with practice. Acidity is due to the presence in the soil of complex alumino-silicic acids, humic acids and their salts. According to the degree of acidity or desaturation with respect to base, the free acid rather than the salt phase preponderates.

Most lime requirement methods measure degree of desaturation.

On some Welsh soils devoid of $CaCO_3$, a high degree of unsaturation for Ca is accompanied by fertility and unresponsiveness to lime. All such soils show considerable amounts of exchangeable Ca by the HISSINK method.

Soils responding to lime show very small exchangeable Ca content. Response to lime is a function of actual exchangeable Ca rather than a saturation deficit. Exchangeable Ca is approximately proportional to Ca availability when the latter is measured by extraction of Ca by dilute CO_2 solutions. This generalisation only applies to the soils of low clay content and high exchangeable Ca content. The distribution of soils in Wales shows those of low exchangeable Ca to be upland soils subject to severe leaching and those with high exchangeable Ca content to be the valley soils. T. E.

The Relation between the P_H Value, the Lime Requirement, and the Thiocyanate Colour of Soils.

SAINT, S. I. *Trans. Faraday Society*, XX, 594, 1925.

Comparable data for a series of soils are given for: (I) P_H measurements by the quinhydrone electrode, (II) HUTCHINSON and MACLENNAN lime requirements, (III) a standardised thiocyanate determinaition. A general connection between the three is displayed. The correlation improves if the soils are divided into a light and a heavy group. The heavy soils give greater absorbing surface and absorb more base in lime requirement determination, but do not necessarily give correspondingly darker thiocyanate colour. Organic matter increases lime requirements without corresponding increase in thiocyanate colour. Colour is influenced by the amount of iron present.

Data are given for similar light soils with different thiocyanate colour but same $P._H$ lime requirement and titrateable acidity in thiocyaate extract, and for a light and heavy soil with differing colour and P_H values but same lime requirement and titrateable acidity in the extract. T. E.

Cause and Nature of the Transformation of Lime in the Soil.

SCHEFFER, FRITZ. Ueber die Art der Umwandlung des Ätzkalkes im Boden und ihre Ursachen. Inaugural Speech, Göttingen, 1925.

The author shows by his analytical experiments, that the transformation of CaO into $CaCO_3$ does not take place quantitatively but that a part of the CaO enters into other combinations. The quantity of CaO that does not change into $CaCO_3$ depends upon the various absorbing chemical agents that are found in the different soils The principal absorbing agents are silicic acid gel and the gel mixture SiO_2-Al_2O_3. The combination of CaO and SiO_2 gel are facilitated also by the $CaCO_3$ which is already decomposed. The above experiments tend to correct the results obtained by LOHMANN on the same subject. HELLMERS.

Quantity and Nature of the " Black Substance " in certain Moravian Soils.

SMOLÍK, L. *Zemědělsky Archiv.* Prague, 1924.

The author has made use of the American method for the determination of the " black substance " (washing the soil with 1 % HCl and extraction with 3 % NH_3. The results lead to the following conclusions :

(1) The content of the black substance varies in the soils of Moravia from 0.718 to 2.598 % in the cultivable soil and from 0.211 to 2.75 % in the subsoil.

(2) In the cross section the black substance generally increases at lower levels until it reaches a maximum after which it diminishes rapidly. It may therefore be the case that the subsoil contains a larger quantity of the black substance than the cultivable soil above.

(3) The colour of the black substance in the above mentioned section is darkest in the layer of cultivable soil and gets lighter and lighter as the depth increases and becomes finally light yellow. The soil sections of more arid climates show exceptions to this rule. In these the lightest colour was to be found immediately under the upper layer of soil. The colour of the black substance from the limy cultivable soil of more arid climates was darker than that of similar soils from regions with a wetter climate.

(4) The amount of humus varies from 12 to 67.8% of the total of humus soil.

(5) The quantity of these substances also increases to a certain depth after which it decreases. In this respect the maximum of black substance does not correspond however to the maximum of the humus material in the soils.

AUTHOR.

Soil Biology.

Soil Analysis by Means of Bacteria.

CHOUCHACK, D. Analyse du sol par les bactéries. *Comptes rendus Académie des Sciences*, No. 22, pp. 1842-1844. Paris, 1924.

The author has made use of the catalytical action of soil bacteria on water saturated with oxygen. This action is due to the organisms and also to the mineral substance in the soil.

In order to determine the part that these mineral substances have in the catalytical action, the reaction is examined before and after boiling, which kills the bacteria.

By adding nitrogen, phosphoric acid, potassium, alone or in combination, the catalytic decomposition of the water saturated with oxygen makes it possible to ascertain which is the element present in the minimum proportion, which knowledge can be used in subsequent experiments.

PIERRE LARUE.

Partial Sterilisation of Soil by Antiseptics.

Mathews, Annie, *Journ. Agr. Science*, XIV, pp. 1-57, 1924.

" Quantitative determinations have been made of the effect on soil protozoa and bacteria of various antiseptic substances, including benzene and its homologues and derivatives, carbon disulphide, formaldehyde, and chloropicrin. It was found that nearly all of the substances disappeared from the soil fairly quickly, and at the same time bacterial numbers fluctuated... the process was much slower in field soil than in the richer greenhouse soils.

The increase of the bacteria during the early days varied in the same direction as the molecular weights and heats of combustion of the antiseptics, and is attributed to the latter property ".

The author concludes that the rise in the number of bacteria is largely due to the bacteria feeding on the antiseptic.

In an appendix are given tables showing relative stability and the amounts of the various compounds found to be effective in inhibiting or destroying protozoa, eelworm (*Heterodera*) and fungi, in relation to their effect on bacterial numbers. P. H. H. Gray.

Preliminary Investigations on the Relationship of Protozoa to Soil Fertility with Special Reference to Nitrogen Fixation.

Nasir, S. M. *Annals of Applied Biology*, Year X, pp. 122-133. 1923.

In artificial culture media, and in sand cultures, with mannitol, more nitrogen was fixed by free N—fixing bacteria in the presence of protozoa than in their absence. The percentage gain over nitrogen fixed by bacteria alone varied from 8 % to 28 % in artificial media with different species of protozoa or mixed faunas, and reached the following figures in sand cultures.

	Maximum figures of N. fixed % gain over bacteria alone.
Bacteria with Ciliates	36
» » Amoebae	25
« » » and Ciliates. . . .	19.4
» » » and Flagellates .	2.7

Out of 36 experiments made in duplicate or triplicate, 31 showed a positive gain. P. H. H. Gray.

Protozoa from the Soils and Mosses of Spitzbergen.

Sandon, H. *Journ. Linnean Soc. Zoology*, XXXV, pp. 474-475. 1924.

Three samples of mud, 8 of soils, and 15 samples of mosses, collected by the Oxford University Expedition to Spitzbergen, 1921 and 1922, were examined qualitatively for Protozoa, which were found to consist of types generally met with in temperate soils. The severity of climate appears to result not in the occurrence of local species, but in elimination of the less adaptable forms. Many forms found in tropical soils are identical with some occurring in Spitzbergen.

P. H. H. GRAY.

Soils and Vegetation.

The Forestery Value of the Sands of the Dunes and of Sandy Soils in General.

ALBERT, Der waldbauliche Wert der Dünensande, sowie der Sandböden im allgemeinen. *Zeitschrift für Forst- und Jagdwesen*, Year XLII, pp. 129-139 (from the Laboratory for Soil Science of the Forestry School of Eberswalde).

The usefulness of the method adopted by ATTERBERG for the valuation of sandy soils has already been indicated in an earlier publication by the same author, in which he wrote upon the deep diluvial sands of the forests of Lieberosen (*Zeitschrift für Forst- und Jagdwesen*, Jahrg. 56, p. 193).

In the present article, the author examines particularly sand from the Dunes of the State Prussian Forests of Bienenthal by the use of the ATTERBERG method. It was surprising to find that these sands were not nearly so regular in respect to the size of their grains as had hitherto been supposed. The detailed table in his article shows, that not only the single sandy soils, but also the various layers of each cross section have grains of different size. Coarse sand (over 0.2 mm.) is found at a rate of 43 to 97 %. ATTERBERG states that sand must not be under 0.2 mm. in order to allow water to pass through. This condition is of course very important for the fertility of the soil. In other words the natural value of sand depends upon the percentage proportion of the constituents of soil that consist of particles of a diameter over 0.2 mm., and those parts consisting of smaller particles.

It is therefore possible to divide the sands of the Dunes within the same region into 5 types taking as a bassis the percentage of fine sand in each group for each type (under 10 %, 15 %, 20 %, etc.). These types of sandy soils are characterized by definite flora which is significant for each type. For instance, soils of the IVth type (30 % of fine sand) support rbeech trees and pines in about equal numbers.

GROSSKOPF.

The Influence of the Amount of Nutritive Substances and of the Soil Acidity on the Growth of Trees in the Flottlehmgebieten of Syke in North-West Germany.

GANSSEN, R., and GOERZ, G. Der Einfluss des Nährstoffgehaltes und der Azidität des Bodens auf das Wachstum der Holzarten im nordwestdeutschen Flottlehmgebiet von Syke. *Zweite Mitteilung der vorläufigen Untersuchungs ergebnisse aus dem Laboratorium der Preuss. Gest. Landesanstalt.* Vol. 5. Berlin, 1925.

In connection with the results of the chemical investigations carried out in the same region, the authors state that GOERZ by determining the elative conductibility obtained data that allow a valuation to be made of the amount of soluble nutritive substances in the soil. Dr. LIESE of Eberswalde suggests the application at the same time of a method of investigating the conductibility of the sap by the use of a special electrode. This enables a valuation to be made of the different degrees of growth and shows the difference of growth in relation to the amount of nutritive substances soluble in water.

Numerous estimations have been grouped into a table, approved by a specialist in forestry which offers a means of valuation of the growth of the total forest. The table states besides the data for acidity of the soil, relative conductivity of the soil, relative conductivity of the sap, all of which factors have been classified in relation to the various timber species. The influence on the growth of the trees of the amount of nutritive substances soluble in water, is clearly seen in the data for conductivity of the soil and more so in those which determine the conductivity of the sap. It is also clear that the energy of growth of the tree, which is expressed as conductivity of the sap greatly depends upon its location. GOERZ.

Effect of Soil Alkali on Plant Growth.

HARRIS, F. S.

Results of over 18 000 determinations on the effect of alkali in the soil on the germination of seeds and the growth of plants were presented. From these data the following conclusions were drawn :

The effect of the various alkali salts in soils on plant growth and the quantity of alkali that must be present to injure crops, are of great practical importance to farmers in arid regions, as well as of considerable interest to the scientist.

Only about half as much alkali is required to prevent the growth of crops in sand as in loam.

Crops vary greatly in their relative resistance to alkali salts, but for the ordinary mixture of salts the following crops in the seedling stage would probably come in the order given, barley being the most resistant: Barley, oats, wheat, alfalfa, sugar beets, maize and Canada field peas.

Results obtained in culture solutions for the toxicity of alkali salts do not always hold when these salts are applied to the soil.

The percentage of germination of seeds, the quantity of dry matter produced, the height of plants, and the number of leaves per plant, are all affected by alkali salts in about the same ratio.

The period of germination of seeds is considerably lengthened by the presence of soluble salts in the soil.

The anion, or acid radical, and not the cation, or basic radical, determines the toxicity of alkali salts in the soil. Of the acid radicals used, chlorine was decidedly the most toxic, while sodium was the most toxic base.

The injurious action of alkali salts is not in all cases proportional to the osmotic pressure of the salts.

The toxicity of soluble salts in the soil was found to be in the following order : Sodium chloride, calcium chloride, potassium chloride, sodium nitrate, magnesium chloride, potassium nitrate, magnesium nitrate, sodium carbonate, potassium carbonate, sodium sulphate, potassium sulphate and magnesium sulphate.

The antagonistic effect of combined salts was not so great in soils as in solution cultures.

The percentage of soil moisture influences the toxicity of alkali salts.

Salts added to the soil in the dry state do not have so great an effect as those added in solution.

Land containing more than about the following percentages of soluble salts are probably not suited, without reclamation, to produce ordinary crops. In loam, chlorides, 0.3 per cent. ; nitrates, 0.4 per cent. ; carbonates, 0.5 per cent. ; sulphates, above 1.0 per cent. In coarse sand, chlorides, 0.2 per cent. ; nitrates, 0.3 per cent. ; carbonates, 0.3 per cent., and sulphates 0.6 per cent. H.

The Cultivation of Corn, Weed Control and Moisture Conservation.

The Illinois Experiment Station Bulletin No. 259

The principal object and greatest value of corn maize cultivation on Brown Silt Loam is the destruction of weeds. Weedy corn probably suffers more from a lack of nutrients than from a moisture deficiency. The depth and frequency of the cultivation of corn should be determined by the weed growth.

Deep cultivation of corn may result in root injury and decreased yields in comparison with shallow cultivation. The effect of excessive and deep cultivation seems comparable to that of actual root pruning. Proper cultivation should kill the weeds with minimum injury to the corn roots.

The need for cultivation seems to be no greater in dry than in wet years ; it may, in fact, be less. However, on heavy soils which work badly, cultivation may be necessary in order to fill the large cracks and thus stop the direct loss of moisture from the deeper strata.

The data and brief discussions presented in this bulletin are intended to be of assistance in developing the principles underlying the successful cultivation of corn and are not intended as recommendations of specific methods or particular implements.

D. C. Wimmer and M. B. Harland.

Regional Soil Science.

The Nature of the Rocks and Soil of the Upper Layers of Soil in the Kursk District (Russia).

Afanassieff, J. N.

(1) The slightly irregular geological formation of the Kursk District is due to the fact that this elevated plateau, which belongs to the middle Russian hills, has been untouched by the Greater-Scandinavian Glacier.

The redeeming feature of this District is the entire absence of moraine deposits.

(2) The original rocks that lie on the surface in the Northern part of the District (about as far as the river Sseim) form Cretaceous groups — marly wacke (Opoka, marl from which the chalk has been removed by silicic acid), marl, chalk.

The Southern half of the district is composed of sands of the Tertiary System and of clay soils of a loamy and sandy character belonging to the stratum of Poltawa-Charkow. The Post-Tertiary sands are also to be found occasionally in the Northern part of the District.

(3) Over a considerable surface of the territory in question the mother rocks are covered with a layer of deposits belonging to the IVth period. These layers have a maximum thickness of 12 metres and form the natural area for agriculture. They are composed of the following horizontal strata (from the surface down) :

Fourth Period :

Stratum where the loess plateau is being denuded ; surfaces which are being washed away along the slopes of the lowlands ; deposits of the terrace slopes of the rivers.

Third Period (alluvial) :

1. Loess, nutbrown loam to a depth of 2 metres.
2. Loess, sandy loam, dull yellow to a depth of 3 metres.
3. Loess-like sandy loam, chestnut brown.

Second Period (lake alluvial) :

4. Inundated soil, marsh meadow soil.

4. A. Loess-like loam, yellow to dark-brown.

4. B. Sandy loams and clays sometimes loess-like, sometimes coarsely sandy, loamy sands and sands.

First Period (river glacial period).

5. S. Inundated, marshy meadow soil.

5. A. Dark brown loam with rubble and boulders from marl.

6. A. Rubble stones and residues of rocks of Cretaceous Period.

7. A. Cretaceous groups, marly wacke, marl and chalk.

5^1-B. Large sandstones.

5-B. Coarse sands with gravel and boulders of the mother rocks, rare crystal stones.

7-B. Formations of Tertiary System grey sands, and glaucous sands.

Note 1. The different kind of strata sub letter " A ", are regions where the deposits of the 4th period have a substratum of Cretaceous formations ; those under letter " B " have a sub-soil of Tertiary formations.

Note 2. It has been possible to show that each period had 3 phases : (1) an accumulative phase in which the stones were deposited ; (2) a stationary phase, in which upon these stones the ancient types of soil formed themselves, and (3) the erosion phase when the soils and stones were inundated.

These phases were demonstrated by characteristics of the middle strata of inundated soils and furthermore by the stones that form a limit betwen the two phases. These stones are frequently brought to the surface in the steep forests on the right side of the river and on the slopes in the south and the west of the country.

(4) With regard to the general topographical aspect of the Kursk District :

It is a region that is sharply divided by numerous gorges and indentations. These divisions are remarkable for their great age and depth, and the predominating feature of the surface in this district is steep slopes. The elevated embankments of the watersheds are generally circular ridges with a diameter of about 150 Fade (300 metres).

(5) An efficient drainage of the watersheds and of a great part of the slopes is required as otherwise the steep slopes would render the country unfit for agricultural purposes.

In different places at a low level, underground water-courses were formed which acted as a drainage system, and in consequence formed moist soils upon the slopes.

(6) The moisture and the rise to the surface of the original stones at certain points along the slopes, and their lateral developments, together with the level tracts along the rivers. served in a primeval age as roads and as land suitable for the development of forests on the originally bare steppes of the Kursk district This perpetual struggle for existence between forests and steppes has caused the formation of the Kursk Forest steppe. These Forest steppes are a peculiar formation which covered in places the originally monolithic steppes, like a carpet with beautiful designs, in some places compact masses of forests, in others merely strips and groups of coppices.

(7) The upper stratum of earth which forms the soil in the district of Kursk is in accordance with the above described historical and natural conditions. In the whole region the " Black Earth " (Tschernosem) is predominant. This is the most ancient type of earth and is a product of the period of the formation of the steppe. As the forests covered the steppes the black earth suffered a degradation. The results of the various degrees of transformation of black earth under the pressure of the woods are the following types: (1) Degraded black earth as the first product of transformation ; (2) forest soils in various degrees : (3) podsol soils.

(8) These 4 types of soils may be devided as follows in regard to the hydrographical formation of the region and its general topographical character: (1) The Northwestern part of the District forms a region where forest soils predominate with small areas of degraded black earth ; (2) The Northeast and the East (as Southern limit the river Sseim) a complex of degraded and pure black earth with small areas of forest soils and finally, (3) the South and South-East of the District predominating normal black earth, with certain places showing degraded black earth and various forest-soils.

(9) In order to give a definition of each type of soil in regard to

the topography of each region the following scheme may be used: the river plains and slope soils are composed of dark coloured meadow lands, sandy terraces and plains that are not exposed to inundation and the edges of the slopes (those that are moist from the leaching of water) or the mother rocks that obtrude from the side slopes all form strips of podsol soils. Higher up and at a greater distance from the rocks, forest soils are found that gradually pass over into degraded black earth and this in turn merges into normal black earth.

In the case where woods cover the steppes near to the side slopes, or when the plateau has suffered a considerable depression, the division of the soil presents itself in the following manner: Very deep down the soil presents a very decomposed condition which gradually, in layers, merges into normal black earth as the surface is approached.

(10) Due to the breaking up of the loess plains into deep and large slopes the micro-relief of the Kursk district shows very few small depressions. In the lower areas of the watersheds there are moist meadow lands.

(11) For the same reason mentioned in the first part of (10), that is the breaking up of the loess plain into deep and long slopes, the marsh is not represented in this District, nor is the salty earth which is always found in connection with marshes on the watersheds and on the slopes.

In the South and the South-East of the District the dark coloured soils also contain salt soils which have deposits of carbonate on the surface. These soils therefore may be considered as a climatic and geological bounary.

(12) In this District the "Stolptschatye Solonzy" (Salt deposits in columnar layers) are not found. These lands are characteristic of East and South-Eastern European Russia as an accompanying phenomenon of the Black Earth complex. Only in the above-mentioned South-East and Southern corner of the District salt formations have been discovered. These "Stolptschatye Solonzy" have not been found in the District of Tschernigow, but in the Woronesch District they exist in great quantities.

This fact together with other characteristics causes the author to suppose that a climatic boundary passes through the District of Kursch. East of this boundary the characteristics of a continental climate greatly increase, in the form of recurring periods of great aridity. West of the boundary however the mildness and humidity of the climate increases and makes it more like our Western climate which is not subject to injurious periods of aridity. THE AUTHOR.

The Soil of Russia and the Surrounding Regions.

GLINKA, K., S. 1-348. Moscow-Leningrad, 1923.

The book contains a detailed description of the soils of pre-war European and Asiatic Russia, from a morphological, geographical and topographical point of view. In the Preface the author describes the processes of soil formation and the various types of soil; he then proceeds to a description of the level zones of Russia (tundra-zone, forest-zone, steppes-zone and the zone of deserted steppes), with their climate, vegetation, original rocks and soils. The author gives a similar survey of the vertical soil-zones of the Krim, the Ural, the Caucasus, Altai and Turkestan. The last chapter treats of the ancient and fossil soils of Russia.

Author.

An Agronomical and Scientific Examination of the Soil in the Welwarn District.

Janota, R.: Agronomisch-bodenkundliche Untersuchung des Bezirks Welwarn. *Publikationen des Zentralkollegium des Landkulturrates f. d. Königreich Böhmen*, Vol. 8, map scale 1 : 25,000. Prague, 1923.

This soil research work was begun by Professor Kopecky and finished by Janota. Prof. Kopecky has described the work in Volume 4 of the same review. An area of 217 km² has been closely examined; 2550 mechanical, 780 physical and 520 chemical analyses have been carried out for this investigation.

The leading Bohemian soil science specialists have taken part in this excellent work, particularly Prof. Kopecky, who initiated it, Ritznka, R. Janota, etc. The volume contains 216 pages and describes the soil research work carried out in the laboratories of Czechoslovakia.

The introduction draws attention to the necessity for scientific soil research. A description is given of the methods hitherto adopted and an explanation of the map. In the third part the characteristics of the soil are described, the climate, geological conditions and the scientific conditions. The work closes with a chapter on the production and manuring of the various soils and a chapter on the necessity of marling light soils.

The detailed descriptions of each type of soil form the largest part of the book.

As in the case of Kopecky's book (1908) this work is also full of valuable practical experiences in the field of soil science. This book should be read by those interested in the progress of this science in Czecholovakia.

L. Smolík.

Chalk in Lettonia.

Rozensteins, S. and Lancmanis, Z. (in Lettish with a short summary in German). 50 pages, 20 photographs, Riga, 1924.

The authors mention 80 places where chalk is found. Some of these places have been thoroughly studied; the percentage of tufa chalk was determined and chemical analyses were carried out.

The authors divide these deposits into 2 group: 1) loose and grainy deposits; 2) hard stony deposits (tufa chalk). The last group has received special attention, because this kind of deposit can be useful for technical and building purposes. The microscopical structure has been studied and the technical characteristics of tufa chalk and phothomicrographs have been taken.

Tufa chalk may be easily worked with saws and adzes while in humid condition, has a great resistance to weathering and is very adaptable for facades, statues and as building material in general.

From a point of view of chemical composition the samples examined represent a relatively pure $CaCO_3$ without $MgCO_3$; some samples show an addition of $CaSO_4$ and of $FeCO_3$.

Often the deposits of tufa chalk show remains of plants, leaves and shells.

The study of these deposits may therefore produce very interesting data for the study of the characteristic climate and the flora of the period after the glacial epoch.

The numerous deposits of chalk in Lettonia — (which are far more numerous than indicated in the above mentioned work) — are also of great importance for the chemical industries that require pure $CaCO_3$, and they are useful for the improvement of podsol soils.

L. FREY.

Agricultural Conditions in Palestine.

SAWYER, E. R. (Director of Agriculture). A Review of the Agricultural Situation in Palestine. Department of Agriculture and Fisheries, Palestine, 1923. (Price 10 Piastres).

This work contains statistical material in addition to a large number of scientific articles, and gives a summary of the agricultural situation of Palestine during the year 1922. A communication by Sir WILLIAM WILLCOX "Extracts from a Report on the Irrigation of Sania Lands in the Jordan Valleys" speaks very favorably of the possibilities of cultivation and irrigation in this district, which lies between the Lake of Tiberias and the Dead Sea. The soil appears to have plenty of phosphates and lime. Data are given respecting the total amount of soluble salts of 9 different soils that have been analysed.

In Part IV it is stated that about half a million hectares are already cultivated and another 300,000 hectares are ready for cultivation.

Twelve soil analyses are given, and concern principally soils of the plain, near the coast and the mountains of Judea. Some of these soils have been chosen in order to present typical examples of soils suitable for tobacco planting, wine, oranges, almonds and sugar cane. As is to be expected in a semi-arid region, these soils are generally poor in nitrogen and rich in soluble salts.

Most of the analyses were made by the State agricultural and chemical laboratory in addition to two analyses by M. VINIK, which have been already published in "Der Boden Palästina's" by BLANSENKHORN.

REIFENBERG.

The Soils in the Drina, Save and Morava Areas.

STEBUT, ALEX. A. *Zemljista Drino-Savo-Moravska oblasti.* Published by the Ministery of Agriculture. Belgrade, 1924.

This work records the beginning of a systematic investigation of Serbian soils. The following is a summary of its contents: Introduction;

Part. I. Methods of investigation, processes of soil formation ; climate and types of soils in Europe (1-26). — Part. II. Chapter 1st : The factors which have most influence on the formation of the soils in the D. S. M. region ; climate, vegetation, deposits, original rocks (27-51). — Types of soil : Black earth called " smoniza " (smola means pitch) and its varieties ; brown earth called " gajngatscha " (gaj means grove) : podsols called " pepeljusche " and " bolowatsche " ; pasture lands called Kumsatschka, (51-96). — Chemical and mechanical analysis of some of the types of soil (97-109).

III Part. The most important agricultural characteristics of the soil-types in the D.S.M. region ; measures for their improvement (110-161). — Conclusion. (162-163). — Resumé of the text in French (164-180).

The work concludes with 6 photographic reproductions and an index.

A. Seiwerth.

The Soils of Lettonia.

Vitins J. (J. Wityn) (printed in Lettish) 50 pages. Riga, 1922.

In a short study on soil formation the author describes the process as follows : (1) Transformation of the mineral substances and their translocation nearer to or farther from the surface. (2) Development of the humus layers and (3) Transformation of the physical qualities of the mother rock as a consequence of the change in the mineral substances. He points out the principal factors of soil formation and the most important and common mother rocks (morainic, loams and their products) The process of soil formation of heavy clay soils is described. These heavy clay soils represent about ⅓ of the total territory of Lettonia and are to be found in all the different gradations of the podsol. The clays contain $CaCO_3$ at the depth of 60 to 70 cm., even when the upper layers are of a strongly podsol type. The heavy marly soils in Lettonia contain about 20 % of $CaCO_3$, which has been admixed with the clay during the glacial epoch by the Silurian limestones of Estland.

The author says that the degree of podsol depends upon the climatic conditions, principally the quantity of rainfall. The rainfall varies from 400 mm. (Bauske) to 680 mm. (Hasempoth, Goldingen). In the region of Bausken above the morainic loam, layers of ground are found that in character resemble thè Tschirnosem and Rendsimen soils. Generally the $CaCO_3$ is washed out to a depth of 50 to 60 cm. In the region af Hasenpoth and Goldingen are found typical Podsol soils, though the line of demarcation also in these soils lies at a depth of 50 to 70 cm.

After studying the process of formation of the podsol soils in Lettonia, the author distinguishes 4 phases in that process.

Ist Phase : Development of an immense layer of humus (40 to 50 cm.) ; the washing out of the $CaCO_3$ only begins in this phase.

IInd Phase : The layer of humus being devoid of $CaCO_3$, the calcium ion absorbed by the humous and zeolitic parts of the soil are attacked by the washing out process. The soil contains bad physical qualities and is almost impermeable to water or roots. Few soils in this condition are found ; they very quickly change into the next phase.

The 3rd Phase shows the further washing out of the finer particles of the upper layer and its deposition into deeper layers. This is due to a greater dispersion of the soil particles. The nature of the soil in this phase is very marshy and its colour grey.

IVth Phase. The layer of humus becomes smaller, the bottom stratus becomes ashy grey and lies on a bed of thick loam; the reaction of the soil is strongly acid. The point of " demarcation " in this phase is from 50 to 70 cm. depth, therefore little water passes into the deeper strata.

The author points out in his conclusions that there is a connection between the degree of podsol of the soils and their fertility. The production of strongly podsol type soils is 2 to 5 times smaller than that of soils in the first or second phase.

The decrease of acidity of the podsol soils is of great importance for fertility. Soils that have been very acid and in which the acid condition has been decreased produce in the same measure as non-podsol type soils. L. FREY.

Report on the Soil Survey of the Dialah Area (Right Bank).

WEBSTER, I. F. and VISWANATH, N. *Department of Agriculture Mesopotamia. Memoir No.* 2, 1921 (The Times Press. Bombay, 1921). Price 1 R.

This report gives the results of soil researches in a district in which a reconstruction of the old irrigation works had been planned. The hihg percentage of salt in the soil is due to the water used for irrigation purposes. (The analysis of this water shows 70-100 parts per 100000 of soluble salts, of which 15 to 25 parts are NaCl).

Thirty three soils were mechanically analysed and subjected to a chemical analysis in respect to the principal salts and nutritive substances.

The authors came to the conclusion that if the proposed drainage system is carried out good results may be expected. REIFENBERG.

Alkali Soils in Iraq, a Preliminary Investigation.

WEBSTER, J. F. *Department of Agriculture, Mesopotamia, Memoir No.* 1, 1921. The Times Press, Bombay, 1921. Price R. 1.

In Mesopotamia, as in nearly all arid or semi-arid lands, alkali or sandy soils are to be found. The author calls the vilayets of Bagdad and of Basrah arid, giving as his personal opinion however that it would be more correct to call them " extremely Mediterranean ".

During the summer the temperature risis to about 120° F. in the shade, while the humidity during that period is about 38 %. Under these conditions it is evident that a complete desiccation of the soil takes place. In winter the temperature in Bagdad is 27.5° F. and the relative humidity is 80 %. In this season there is about 5 inches of rainfall.

The author considers it of the greatest importance to take measures to prevent the soil from becoming over saturated with salt and when this condition exists, where possible, to carry out improvements.

The salts that are principally found in these regions are sodium sulphate, sodium chloride, and sulphate and chloride of calcium and magnesium, while the so-called "Black Alkali," sodium carbonate, is not found.

It has proved to be impossible to wash away the salts by flooding and drainage; this method only drives the salts into the deeper levels of the soil, after which they return to the surface owing to capillary ascension.

Mesopotamia, which at one time was one of the most fertile countries, is in danger of becoming a desert, this condition being due to the fact that the ancient methods of drainage have been forgotten.

According to the author the only solution is in drainage by percolation, by which the salts are finally conducted into the principal drainage system of the country. This system could only be applied by the Government.

The appendix of the work contains a number of analyses, illustrating the percentage of salts and their probable compounds. The map shows the division of the Dialah District intodifferent salt areas.

REIFENBERG.

Further Studies on Alkali-Soils in Iraq.

WEBSTER, J. F. and VISWARATH, B. *Department of Agriculture, Iraq, Mémoir No.* 5, 1921 (The Times Press, Bombay 1921). Price Rs. 2.

In the first part of this book a study is made of the influence of soluble salts on the phyisical condition of the soil. The work was carried out as follows: A sample of soil was continuously washed until it was practically free of salts. At the same time the original soil was examined. Besides making a mechanical analysis, the authors studied capillary attraction, permeability, the absorption of salt solutions, hydroscopic power, pore space, degree of acidity and evaporation capacity of the soil.

In the second, part the influence of salts on saplings is demonstrated as well as the growth of young trees in naturally sandy soils. One experiment concerns the growth of saplings in soils with a variable percentage of salts but, with a constant percentage of nutritive substances. Another experiment investigates the maximum content of salts in a soil intended for wheat cultivation.

Further experiments are made on osmotic pressure and toxic influences. The investigation finally deals with sodium carbonate and the toxic effect of other soluble salts.

In Part III the authors discuss some conclusions drawn from their experiments.

Though many of the results of these experiments are not new, the work is very interesting. It is to be regretted that colloid chemistry in connection with the problem has not been treated.

REIFENBERG.

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General Notices.

International Society of Soil Science. — The number of members of the International Society of Soil Science has very considerably increased n the last six months, so that the total is now 533. The list of members will appear in the next number of the Review.

Our Society has sustained the loss of one of its leading members in Professor MURGOCI, of Bucharest. The death of our friend and colleague, is a loss which is deeply regretted, not only for our Society and for the science of pedology, but also on personal grounds. MURGOCI was among those of my colleagues, who from the earliest days, that is from the first Soil Science Conference in Budapest, in 1909, took a deep interest in the progress of the Science. An appreciation of his conspicuous services will appear elsewhere in this Review.

When in May 1924 I expressed my willingness, in response to repeated requests, to undertake the work of General Secretary and Treasurer in addition to the office of Acting President, I could not suppose that this post would entail so much work. In future it will not be possible for me to devote so much time to the business of the Society. A part of the work must be undertaken by the National Sections, which in accordance with paragraph 6 of the Rules of the Society may be formed in the separate countries. My own idea is that Treasurer and the Secretaries, of these national sections, will in future assist me by making themselves responsible for correspondence with members, the collection of annual subscriptions, records of changes of address and so on, reporting to me on these points and sending me the subscriptions in a single account.

I should therefore be glad if the members would work for the formation of National Sections and report to me on the composition of the executive committees. It may be mentioned that each National Section of more than 15 members has the right to be represented by one member on the General Committee. For the present I should like to ask, (1) that members will reply at once to my enquiries, whether made by letter or circular, (2) that the annual subscriptions may be sent to me in Dutch florins, either by Post Office Order or paid into the "Geldersche Credit Vereeniging", Groningen, (Holland) on account of the International Society of Soil Science.

D. J. HISSINK,
Groningen, June 26, 1925. *Acting First President and*
General Secretary.

The International Commissions. — The lists of members sent to me by the chairmen contained a whole series of names of collaborators who ar not members of the Society. It is however obvious that only members of the Society can be members of a Commission, or a Section. On the other hand it should be a matter of concern to new members to attach themselves to one or more Commissions. By agreement with the chairmen of the Commissions, therefore, all members are asked to inform me which Commission or Commissions they intend to join (See Circular of May 1925). As you may already be aware, the first Soil Science Congress will be held in May 1927 in Washington, U. S. A. The American Organising Committee, which includes Mess^rs LIPMAN, MARBUT, McCALL, will provide all preliminary information. The first duty of the Congress is to consider the recommendations of the International Commissions. The Chairmen of the Commissions are expected to forward these recommendations at the proper time, and to come to an understanding with the American Organisation Committee. I am always perfectly willing to act in an advisory capacity, but the Commissions must themselves regulate their activities and methods of organisation independently.

The second International Soil Science Commission has already decided to hold at Groningen in the spring of 1926, a meeting for the preliminary discussion of the questions of soil acidity and soil adsorption. A circular has been sent out by the Organising Committee to all members of the Society and also to a large number of non-members, who will probably become members. It may be mentioned that the expenses of this meeting will not be defrayed out of the funds of the Society.

The Third Commission (Chairman, Prof. STOKLASA) also proposes to meet this year in advance of the Congress. The Committee for the Soil Map of Europe met on 8 and 9 May in Berlin. Prof. STREMME was elected Chairman in place of Prof. MURGOCI. Prof. WOLFF, Secretary of this Commission, which is a Sub-Commission of the Fifth Commission (Chairman, Prof. MARBUT), will report in detail on the Berlin meeting.

D. J. HISSINK,
Groningen, 26 June 1925. *Acting First President*
and General Secretary.

Notice of May, 1925 — The foundation subscription for the year 1924 was fixed at 2 dollars.

The subscription for 1925 has been fixed at 6.50 Dutch florins. New members who have not paid the foundation subscription of 2 dollars pay an entrance fee of 2.50 florins.

Institutions, societies, libraries, etc., are eligible for membership as well as individuals.

Members receive the journal, edited by Prof. F. SCHUCHT, Berlin, free of cost. The journal is printed at and despatched from the International Institute of Agriculture, Rome, and appears in French, German, English, Italian and Spanish. Members are asked :—

1. to forward to me before 15 July 1925 the subscription for 1925 of 6.50 florins, in the case of new members with the entrance fee of 2.50 Fl ;

2. to send with the subscription their exact address *type-written* or *in block capitals ;*

3. to inform me in which of the five languages they desire to receive the journal ;

4. to inform me which Commission or Commissions they intend to join ;

5. to state whether they wish to obtain the Proceedings of the Fourth International Soil Science Conference (Rome, May 1924) at the reduced price of 80 French francs, the ordinary selling price being 100 francs. Members of the Rome Conference naturally receive the Proceedings free of cost.

The attention of members is called to the fact that it is absolutely essential to reply to these five queries at latest by 15 June 1925.

Dr. D. J. HISSINK,
Acting First President and General Secretary.
Groningen (Holland), Hermans Colleniusstraat, 25

II. **International Commission for the Study of Soil Chemistry.** — To the members of the International Society for Soil Science.

At the meetings of the Commission for the Study of Soil Chemistry held uring the Fourth International Soil Science Conference (Rome, May 1925) dhe following questions received special attention: — soil acidity, soil adsorpttion (exchangeable bases, point of saturation, etc.).

The conduct of the further study of these questions was entrusted to Dr. H. R. CHRISTENSEN and Dr. D. J. HISSINK.

A detailed preliminary discussion of these questions in a meeting of the second Commission seems to be desirable in preparation for the First Soil Science Congress which is to be held in America in May 1927. With this object the undersigned have formed themselves into a preliminary Committee and have decided to hold this meeting of the second Commission in the spring of 1926, either April or May, in Groningen. The Committee is making the following arrangements for the meeting :—

Members of the Society who are specially interested in the above questions are asked to communicate their views in connection with particular subjects in as brief a form as possible at latest by 1 November 1925 to Dr. D. J. HISSINK. The papers should be forwarded in duplicate and typed in German, English or French. It is intended to print papers in the order in which they are received. The meeting in Groningen will be given up to the discussion of these papers.

In addition members are asked to state at the same time, or at latest by 1 November 1925, whether they intend to take part in the meeting at Groningen in the spring of 1926 and what date would suit them best, either the beginning of April (the Easter holidays) or the second half of April, or the begining or end of May. It is of course understood that this communication is only preliminary and that a final decision will be asked for only at the beginning of 1926.

Although it is mainly those members who are interested in the study of Soil Physics and Chemistry who will take part in the preparation for the meeting and in the discussions, it has been considered best to send this circular to the 500 members of our Society and moreover to our collaborators, who are not yet members but who may become so. We hope that this may prove an incentive to join. It may be remarked that only members of the Society have the right to send papers and to take part in the meeting.

Budapest (Hungary)
Leeds (England)
Lyngby (Denmark)
Groningen (Holland)
May 1925.

Prof. ALEXIUS A. J. von 'SIGMOND, Budapest.
Prof. N. M. COMBER, Leeds.
Dr. H. R. CHRISTENSEN, Lyngby.
Dr. D. J. HISSINK, Groningen, Holland,
Herman Colleniusstraat, 25.

Report of a Meeting of the Supervisory Committee for the International Agro-Geological Map of Europe on 8 and 1º May 1925 in Berlin.

The Supervisory Committee for the International Soil Map of Europe, a section of the Fifth Commission of the International Society of Soil Science, deeply regrets the death of its Chairman, Prof. MURGOCI, which took place on 5 March and cut short a life of remarkable activity and success. As a consequence of this event and in view of the necessity for carrying out the preliminary work for the Soil Map on a uniform plan and with due regard to the experience gained and the proposals made since the Rome Conference, the Secretary found it necessary to invite members, as well as other foreign experts in the subject, to a conference, as had already been suggested, at the Rome meeting. As is always the case with international conferences, only a certain number of those invited could undertake the journey. There were present: Prof. STREMME, Danzig; Dr. TAMM, Stockholm; Prof. von MIKLASZEWCKI, Warsaw; Prof. TREITZ, Chief Geologist, Budapest and Prof. WOLFF, Berlin.

The first business of the Committee was to elect a chairman, who might be expected to render active support to the work in such a way as to command the confidence of all experts. On the written proposal of Dr. FROSTERUS of Helsingfors Dr. STREMME of Danzig was elected. The Committee then filled the vacancy in its numbers by electing Prof. A. TILL in Vienna, in whose company the late Prof. MURGOCI had worked out his schemes. Among the other formal decisions may be mentioned one urging that the active co-operation of the European Geological Institutes that have not so far taken part in this work should be invited, and that the International Society of Soil Science should be requested to make a contribution of 100 marks towards the Committee's expenses in this connection, which will be later reimbursed out of the receipts from the sale of the outline map of the Soil Map of Europe. Finally on the invitation of P. TREITZ it was decided to hold a meeting in the latter part of July (1926) in Budapest, so that the local soil conditions may be inspected together with the sketch map of the Hungarian soils that has already been prepared, and that suggestions may in consequence be made with a view to ensuring a right conception of the scheme and the proper presentation of the material in other countries.

The adoption of the lines suggested by Prof. MURGOCI and the continuation of the work on the map was recommended. The difficult conditions, especially the want of recognition of pedological research in most of the countries within the sphere of operations of the Committee, make it advisable that there should appear in the first place a sketch map on the scale of 1 : 10 million, which should show only the outstanding features of the nature of the soils. The map is to represent : by hatched lines, the sandy gravels and the clay loams, and also peat and rock : by three shades of green, the types of soil which are distinguished by excess of sesquioxides (Podsol types according to the degree of saturation ; coloured violet in two shades, the types of soils which have only the upper mould (the A horizon) stained with humus (Tschernosem type) but not the B horizon with the excess of sesquioxides. As a working map the black print of the International Geological Map of Europe (1 : 1,5000,00) is recommended. The main principles of the map with the scale of 1 : 2,500,000 should first be definitely established, even if certain countries have prepared their maps on the scale of 1 : 10,000,000 as may very well be the case up to the Budapest conference in the summer of 1926. An estimate of the cost of maps with scales of 1 : 10,000,000 and 1 : 2,500,000 may be obtained from any cartographical institute, so as to give the committee and idea of the possibility of publication and the general style of the map.

W. WOLFF, *Secretary,*
Berlin, N. 4 Invalidenstr. 44.

Journal " Pédologie ". — The readers of the above mentioned paper are informed that the Journal *" Pédologie "* appears once more under the Direction of Prof. JARILOW (Moscow). This Journal deals principally with publications in the field of soil science in Russia, and contains articles and reports. The journal is published in the Russian language and in a foreign language. The subscription for the year 1925 is 6 roubles ; please apply to " User ", Moskau, Smolensky, Bulw. 57, Committee for Soil Science ; Office of the authorized representatives of the specialists in soil science of Russia.

Personal. — Hofrat (Court Councillor) Prof. Dr. Ing. agr. JULIUS STOKLASA, Professor at the Technical High School, Prague, known both as a scientist and as a man of pratical experience, celebrates the 50th anniversary of his scientific career. At the same time he has been for a quarter of a century Director of the chemical-physiological experimental Station of Prague.

Professor STOKLASA has published a great many works some of which are already considered as standard works, for instance *Der biochemische Kreislauf der Phosphations im Boden* (the biochemical series of recurrent changes of phosphates in the soil) and another called *Über die Verbreitung des Aluminiums in der Natur.* (The distribution of Aluminium in nature), etc.

Dr. STOKLASA is also well known for his studies on the biogenetic elements in the plant organism, mainly phosphorus, sulphur, iodine, potassium, and aluminium, and for his work on the biochemistry of soil. Besides this he has done some very valuable work in the field of biology and his work has been of great use to soil science.

STOKLASA is the promotor of the International Commission for Soil Biochemistry and Soil Bacteriology. As President of this Commission he has taken part in several International Congresses. His knowledge and personality have ensured him a large following of friends in his own country as well as abroad. NIKLAS.

Forest officer Dr. KRAUSS, assistant at the Experimental Station of Forestry at Munich, has been appointed " Privat-Dozent " for soil science and agricultural forestry and chemistry at the University of Munich.

Professor RAMANN, Munich, was elected foreign member of the Hungarian Academy of Science and Professor A. A. J. von 'SIGMOND, hitherto a foreign corresponding member was elected an ordinary member of the same Academy.

Professor Ing. Dr. ADOLF SEIWERTH, lecturer of the Agricultural and Forestry Department of the University of Zagreb (Jugoslavia) was appointed Professor of Soil Science at that same University.

Professor SEIWERTH has been made President of the Institute of Agricultural Chemistry at Osyek.

We expect to receive an obituary notice of MURGOCI from Prof. POTOPOPESKU-PAKE.

Dr. FRIEDRICH KATZER, member of the Commission on Mapping of Soils, Director of the National Geological Institute, died in Sarajevo on the evening of 3 February 1925 at the age of 64.

Dr. KATZER was born on 5 June 1861 in Rokycany (Bohemia). After passing through the intermediate school in Prague, he devoted himself to the study of natural science, especially geology and chemistry at the University and technical higher school of Prague. After his career as a student he acted as assistant teacher of mineralogy and geology in the Prague technical school, In 1887 he gave up this post so as to specialize in the study of geology in Breslau, Berlin, Tubingen, Marburg and Giessen. In Giessen he obtained the doctorate in philosophy in 1890. He then did some temporary work at the Prague Analytical Laboratory, and subsequently in 1892 at the Institute of Mines at Loeben. After three years of active work in Brazil, he returned to Europe and took service under the provincial government of Bosnia and Herzegovina in the capacity of State geologist, from that time devoting his life and his work to those countries. The results of his scientific labours are embodied in more than 140 articles in scientific journals. Among the most important of these may be mentioned the following: *Geologische Karte Bosniens und d. Herzegowina; Geologischer Führer durch Bosnien u. d. Herzegowina; Fahlerze u. Quecksilberlagerstätten Bosniens u. d. Herzegowina; Die Braunkohlenablagerungen Bosniens u. d. Herzegowina; Die Eisenlagerstätten Bosniens u. d. Herzegowina; Karst und Karsthydrographie.* KATZER did not live to see the accomplishment of his last monumental work "*Die Geologie Bosniens*" in 4 volumes, the publication of which has been begun by the Mining Section of the Bosnian Government, only the first volume having up to now appeared in German. F. KATZER received a number of decorations. He was also honorary member of several scientific societies and was elected in the year before his death member of the Belgrade Academy of Science. Quite recently the appreciation by the authorities of his scientific and official activities took the form of recognition by the conferring of the Royal Order of St. Sava. By his death a serious gap in the ranks of the scientific circles of Yugoslavia has been occasioned. But although removed by death, his work will endure and Yugoslavia together with Bosnia and Herzegovina will honour his memory.

A. SEIWERTH.