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Papers.

APPARATUS FOR SOIL VOLUME DETERMINATION.

By B. FROSTERUS and H. FRAUENFELDER.

With the object of obtaining the most accurate results possible in volume and pore space determination, especially as regards soil types under natural conditions, FROSTERUS (1) constructed an apparatus in which the volume of the sample is displaced by mercury. With this apparatus accurate results could be obtained, but the determination process involved loss of time through weighing, especially in the case of small samples. As the apparatus was made in Helsingfors during the War, it left something to be desired in the matter of material and finish. With the object of improving the original apparatus, FRAUENFELDER attempted to simplify it, so that the displaced volume could if possible be measured without weighing, and long calculations be thus avoided.

The apparatus shown below is the result of the proposed alterations.

Description of the apparatus. — The apparatus consists of three principal parts.

1) *The volume determination cylinder.* (Plate XXIII, fig. 56). — This consists of an upper cover and a lower part (B). The top part is fastened by means of three lever clamps to the foot, so that the marks on either part pass one over the other. The pointed apex of the cover passes up into a tube, at the end of which there is a tap *b*. In front of this outlet in the cover a glass tripod is attach-

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(1) BENJ. FROSTERUS. *Geol. Komm. in Finland: Agrogeologiska kartor*, No. 2, p. 22, 1916.

ed to prevent the sample from coming into contact with the outlet. From the lower part B a tube issues as far as tap *a*, where the filling funnel A and the continuation of the cylinder C, which lies under tap *b*, branch off.

The inner diameter of B is 50 mm. and its height 100 mm., so that samples up to 100 cc. can be determined.

In order to avoid the breaking of parts A and C, these are attached to the lower part B with the metal band M, to which the lever clamps are also fastened.

2) *Pycnometers.*

3) *Burette.*

In addition to the pycnometers and burette the apparatus includes a mercury tray (Plate XVIII, fig. 55).

Manipulation of the apparatus. — The mercury enters the cylinder from below, whereby the bubbles adhering to the glass are expelled.

The filling is done in the following manner:

The tap *a* is turned off against B (position 2), and the funnel A, filled with mercury and *a*, are brought slowly into position 5. *a* and C are thus placed in communication and the air under the mercury in A is driven out. Now tap *b* must be opened and the space B can, in *position* 1, be filled through A until the excess runs through *b* towards C.; *b* is then closed. The excess in C is then allowed to run out, *position* 2. Tap *a* is lengthened by a piece of tubing about 12 cm. long, so that the mercury may be allowed to flow easily and without loss into a vessel; the mercury in A is likewise expelled by *position* 3. The apparatus is now ready for use. The collecting vessel with the excess mercury is removed and another put in its place. Tap *b* is opened and *a* brought into *position* 4, so that sufficient mercury may be allowed to flow out of B to leave the cover free. The three springs pressing tightly on the cover are then loosened and the latter is removed. The sample, of which the volume is to be determined, having been weighed, is placed on the mercury, the cover is closed, and the filling begins as before (the air being expelled by *position* 5) in the positions 1, 2 and 3. The overflow now collected corresponds to the volume.

In order to determine this volume as exactly as possible, *pycnometers* were found to be most suitable. A series of 6, of 50, 25, 20, 15, 10 and 5 cc. were used. Volumes below 5 cc. were measured in a burette of 5 cc. cubic content by 50 cm. in length, so that $^1/_{100}$ cc.

PLATE XXIII.

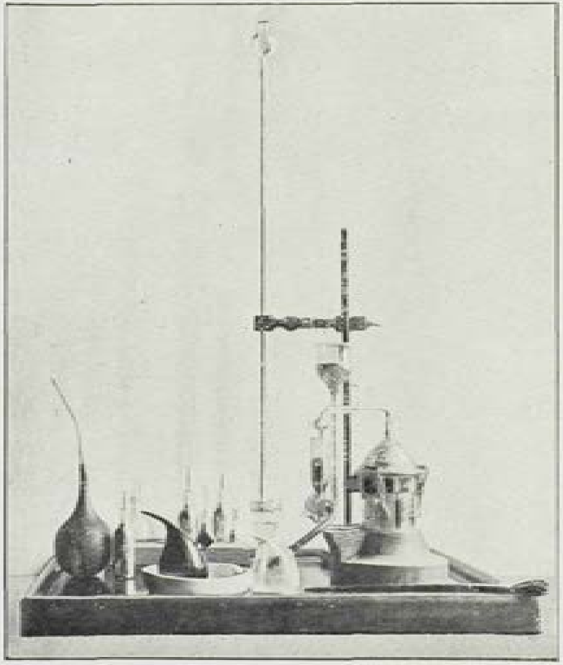

Fig. 55. — Frosterus and Frauenfelder's apparatus for soil volume measurement.

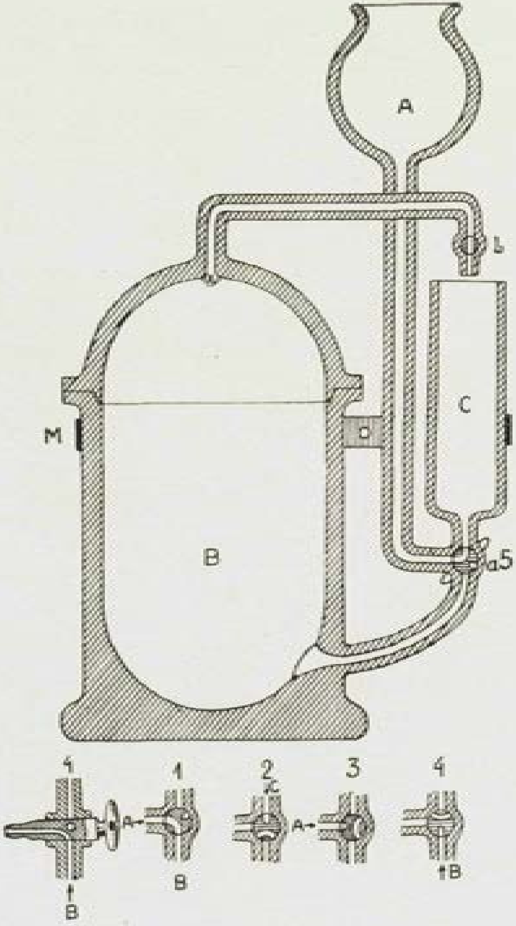

Fig. 56. — Complete apparatus with pycnometers and burette.

can be determined very accurately. The upper part of the burette expands in the form of a bulb.

The filling of the pycnometers is best done in a small flat evaporator with a vent. There is also a brush and rubber ball for blowing out the mercury remaining in the taps and tubes. The apparatus is emptied by first opening tap *b* and then bringing tap *a* into *position* 4; this position is shown in fig. 56, to the left, in the longitudinal·section.

After the removal of the sample, dust, sand, soil and other impurities are often found to be floating on the mercury. These may be removed with a piece of wadding.

If samples soaked with paraffin are tested, the apparatus must be cleaned more often.

Accuracy of the apparatus. — The results are given under the following formulae:

Weight of the sample	w in grams
Volume	v in cc.
Volume-weight	w
Specific weight	s
Pore space (in %)	$\frac{(s - \frac{w}{v})\,100}{s}$

The specific weight of porous substances (checks) is determined, as usual, with the pycnometers.

In order to test the accuracy of the apparatus a number of samples were repeatedly determined.

A red quartzite on which 10 determinations were made on different days, always gave the same results:

Weight of the sample	37.120 gm.
Volume	14.600 cc.
Volume weight	2.54

The greatest errors occurred with porous, non-paraffin substances. For instance, a quarternary clay brick, gave 3 determinations out of 10 which showed 0.015 cc. in excess of the others.

Weight of the brick	49.770 gm.
Vol.$_1$ (7 readings)	25.650 cc.
Vol.$_2$ (3 »)	25.665 »
The volume-weight$_1$ is therefore	1.940
and the volume-weight$_2$	1.939
The specific weight was	2.55

$$\text{Pore space}_1 \ \frac{(2.55 - 1.94)\ 100}{2.55} = 23.92\ \%$$

$$\text{Pore space}_2 \ \frac{(2.55 - 1.93)\ 100}{2.55} = 23.96\ \%$$

The difference is therefore 0.04 %, in the most unfavourable conditions, i. e. when the volume weight of 1.939 is not raised to 1.94.

This, so far the greatest difference shown, naturally arose only from the fact that the porous check was non paraffin, and for this reason mercury penetrated it and escaped measurement.

The application of the apparatus. — The apparatus is adapted for testing: Soils, minerals, various kinds of stone, potter's clay, artificial stones (beton or concrete), etc.

A number of examples are given below:

Pore space	Specific weight	Volume weight	SAMPLES
			Soil types.
57.5	2.66	1.13	Gystje type Postglacial clay, Odnaes, Pojo.
43.1	2.69	1.53	Postglacial clay, Aeminne - Halikke.
39.8	2.61	1.57	Glacial band clay Vestankvarn.
40.2	2.73	1.63	» » » Pargas.
39.1	2.73	1.66	Mo, Odnaes - Pojo.
37.2	2.71	1.70	Light mjaela clay, Mustiala
31.9	2.72	1.85	Light mjaela clay, Kelivaara.
28.3	2.68	1.92	Cambridge clay, Kiviniemi.
29.2	2.77	1.96	Cambridge clay, Kiviniemi.
			Soil section.
67.8	2.27	0.73	Mo rich in humus A - bed } Karis.
53.3	2.57	1.20	» » B - bed
22.9	2.71	2.09	Marshland, marl (bituminous soil) upper bed } Zurich.
25.8	2.67	1.98	middle bed
29.0	2.68′	1.90	Marl under bituminous soil (subsoil) »

Pore space	Specific weight	Volume weight	SAMPLES
			Minerals and Stones.
		1,24	Anthracite.
		1,88	Schungite (Schunga) - Olonetz.
		1.92	Graphite Schungite from Suojaervi - Finland.
		2,09	Graphite (earth) from Krumau - Bohemia.
		2.46	» (crystal) » Maentyharju - Finland.
	2.65	2.65	= Quartz.
	2.60	2.60	= »
	2.44	2.44	= Tradyminite (somewhat impure, graphitic).
	2.42	2.42	= Chrystobalite (somewhat impure, graphitic).
	2.19	2.20	Quartzglass.
		2.55	Feldspar from Kimito - Finland.
		3.15	Tourmaline from Tyrvea »
		4.10	Gadolinite from Kimito »
		2.57	Rapakivi granite from Aeland - Saltvik.
		2.68	» » Mariekamn.
		2.65	» » Kotka.
		2.64	» » Simola.
		2.69	Granite from Kalajoki.
		2 66	» » Iisalmi.
		2.65	» » Nystad.
		2.79	Diorite » Kaalamo.
		2.99	Diabase » Lavia.
		2.88	Gabbro » Kyvinkaeae
		3.40	Amphibolite » Leppaevirta.
			Brick earth products.
36.8	2.96	1.87	Cambridge clay heated to 900° C.
24.0	2.66	2.02	» » » » 1000° »
12.5	2.55	2.33	» » » » 1100° »
9.3	2.57	2.33	» » » » 1150° »
30.1	2.65	1.85	» » clinkers
11.2	2.58	2.30	» » »
23.9	2.55	1.94	Builders' bricks, postglacial clay (Aminne) heated to 900° C.
21.3	2.62	2.06	Quartz-clay bricks from Sweden.
25.4	2.44	1.82	Quartz-lime bricks from Sweden.
28.5	2.56	1.83	" Stella " bricks.
22.4	2.41	1.87	Quartz-limestone 10 from Germany.
20.0	2.39	1.91	» 12 »
26.1	2.49	1.85	» 22 » Finland.
40.1	2.69	1.57	» 30 » »

HYDROGEN-PEROXIDE CATALASE OF MARSH SOILS.

By Dr. L. Smolík,

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The influence of the soil as a positive catalytic agent in the combination of hydrogen with oxygen at an ordinary temperature was already known by Theo. De Saussure (1), Liebig and H. Immendorf. The last named ascribed this interesting property to the microorganisms of the soil. A. J. Nabokisch, Lebedeff (3), Kaserer and others further investigated this question.

The converse phenomenon, that the soil liberated molecular oxygen from hydrogen-peroxide was known to Berzelius (4), Frass and Schoenbein (5), and in recent times was investigated by J. Koenig (6), C. Koppenrath, Hasen-Baeumer and Papa Kalantarian (7). In this respect the soil resembles certain catalytic agents, such as the fine dust (of almost colloidal fineness) of some metals: gold, silver, platinum; many oxides (8), manganese dioxide, manganese tetroxide, ferric-oxide, super-oxides, sesquioxides, the ultra-violet rays and some enzymes (9).

Koenig considers the hydrogen-peroxide catalase of the soil (he finds it absent after liberating molecular oxygen from H_2O_2) to be a very important property (10) of the soil, and ascribes it in the first place to the enzymes in the micro-organisms and vegetable matter, for he found that this property of the soil diminished after partial sterilisation by heating, chloroform (11) or carbon disulphide. Like Coppenrath and Hasenbeaumer, he explains this by its close connection with the humus content. May and Gille held the same opinion (13). Many investigators consider it of very great importance in estimating the properties of the soil (14), others, for instance D. Chouchatk (15), measure the biological index by it. Koenig gives numerous instances of catalytic action before and after soil sterilisation, and from his discoveries it is evident that inorganic matter also plays an important part and that it is a question not only of soil catalytic action (16) by bacteria or the residues of organic matter. This is found to be the case also as regards marsh soils.

In spite of the fact that the origin of this soil catalase cannot be attributed strictly to the characteristic properties of the soil only, it will not be without interest from a purely soil science point of view, to compare the catalytic capacity of some marsh soils and endeavour to ascertain some relations, or at least tendencies among them. It will be shown how in a large number of soil types the hydrogen-peroxide catalase in vertical sections alters, and how it is changed by drying the soil at different temperatures. Types of different texture and, where possible, from different climates will be considered. An attempt will be made to find a connection between this soil catalase and the physical structure, hygroscopicity and constant and variable soil reaction.

The degree of soil catalase was measured eudiometrically. As the decomposition of the hydrogen peroxide of most of the catalases also depends on the H_2O_2 concentration and the reaction temperature, the working conditions were in every case identical and constant. Five gms. of fine earth were treated, 20 cc. of H_2O_2 were added and the temperature kept at exactly 17° C. The first determinations of liberated oxygen were made without reduction of atmospheric pressure, the second were ascertained after such reduction (the second result is therefore much smaller than the first).

Types were examined, the majority of which in the Zemedelsky Archives (17) showed that they were related in physical composition. Here, for the sake of brevity, their physical composition will not be discussed, but only their pedological classification (according to Kopecky), and for a more complete soil determination is added the hygroscopicity according to Rodewald-Kitschnerlich (18) and the calcium carbonate content estimated approximately with the Kreidl volumetric apparatus.

As may be seen from Table I, the soil substance varies very much in composition.

The oxygen set free by the treatment of air-dried soils (under conditions given above) is shown in Table II, column *a*.

(Table I, *see page 8*).

TABLE I.

Origin	Depth in cm.	Soil type	Hygroscopicity	Ca CO_3	pH reaction	
					constant	variable
		I. — AGRICULTURAL SOILS.				
1. Hulin	10–20	humous loam — dark brown	5.28	0.1	7.3	7.0
»	30–40	" " " "	5.98	0	7.1	7.0
»	60–70	" " " "	5.75	0	7.1	7.0
»	90–100	" " " "	6.25	0	7.0	7.0
»	120–130	yellow loess loam	3.19	0	7.3	7.0
»	300–310	" " "	—	9.64	7.3	7.2
2. Břest-Hulin	10–20	sandy loam — brown	4.40	0.3	7.3	7.2
»	20–30	" " — dark brown	4.49	0.4	7.3	7.2
»	40–50	slightly clayish sand — yellow	1.63	0	—	7.2
3. Slapanice 84	20–30	clay loam — brown	6.87	0	7.2	7.0
»	40–50	clay loamy soil — brown	7.74	0.1	7.2	7.2
»	60–70	yellow loess loam	5.45	19.6	7.2	7.2
»	120–130	" " "	5.07	17.0	7.2	7.3
»	140–150	" " "	—	32.7	7.2	7.3
4. Slapanice 85	10–20	clay loam — brown	7.08	0.2	—	—
»	40–50	clay loamy soil — brown	8,18	0	—	—
»	80–90	yellow loess loam	6.77	0.2	—	—
»	130–140	" " "	—	12.0	—	—
5. Ivanovice	10–30	humous clay loam — dark brown	6,18	0	7.2	7.2
»	44–60	clay loam — yellow	6.56	0.5	7.2	7.2
»	60–75	loam — yellow	5.22	10	7.3	7.3
»	80–90	" "	4.88	14.7	7.3	7.3
6. Hrušovany-Sanov	20–30	humous, sandy, clay loam — black	8.58	0.3	7.3	7.2
»	90–100	clay loam — greenish	11,62	19.4	7.2	7.2
Hrabitice	10–20	loamy sand — brown	2.38	0.1	7.1	7.0
7. Hustopeč	5–15	loam — brown	5.53	11.6	7.3	7.3
»	20–30	" — grey	6,08	6.5	7.3	7.3
»	35–45	" "	4.94	26.9	7.3	7.2
»	80–90	fine sandy loam — yellow	3.89	18.4	7.2	7.3
8. Olomouc	20–30	sandy loam — brownish — yellow	3.06	0	7.1	7.0
»	50–60	loamy sand	1.10	0	7.0	6.5
» Upper Ortstein	60–65	slightly clayish sand — reddish.	1.65	0	6.5	6.5

TABLE I (*continued*).

Origin	Depth in cm.	Soil type	Hygroscopicity	Ca CO$_3$	pH reaction	
					constant	variable
8. Olomouc Lower Ortstein	75–80	slightly clayish sand — strong reddish	1,86	0	6.3	6.5
9. Hodonin	10–20	slightly clayish sand — dark brown	1,01	0	7.1	7.0
»	35–45	slightly clayish sand — brown.	0,61	0	7.1	7.0
»	80–90	slightly clayish sand — yellow. .	0.48	0	7.0	7.0
»	250	clay loam — greenish	6,69	3.2	7.2	7.1
10. Hrušovany	10–20	clay sand — black	3.91	0.3	7.3	7.2
»	30–40	clay loamy sand — brown . . .	5.73	0	7.2	7.1
»	60–80	clay loamy sand — brown-yellow	5.24	0	7.1	7.0
»	150–160	clay loamy sand — yellow . . .	1,62	6.1	7.3	7.2
11. Poštornà	10–20	sandy loam — brown	3.06	0	7.1	7.0
»	30–40	" " "	3.94	0	7.1	7.0
»	60–70	loamy sand — yellow-brown . .	2,88	0	7.1	7.0
»	150–160	slightly clayish sand — yellow .	1,50	0	7.3	7.0
12. Val Mezerici	10–20	slightly humous clay loamy sand — yellow	3.14	0	6.4	6.4
»	30–40	sandy loam — yellow	2.61	0	6.5	6.3
»	60–70	yellow loam.	5.95	0	6.5	6.3
»	120–130	loam — yellow	5.85	0	6.4	4.9
13. Radomin	8–13	" "	3.81	0	7.1	6.4
»	30–40	" "	4.26	0	6.4	4.6
»	80–90	loamy sand — yellow	4.51	0	6.4	4.4
14. Tichà	5–15	loam — grey	5.07	0	6.6	6.4
»	20–30	loam — yellowish	5.43	0	6.6	6.3
»	70–80	fine sandy loam — yellow . . .	9.67	0	6.3	4.4
»	150–160	clay loamy soil — yellow . . .	8.55	0	6.3	4.4
		II. — FOREST SOILS.				
15. Adamov	0–3	forest litter	10,72	0	0	5.4
»	3–17	clay loam soil — light yellowish	4.28	0	0	4.5
»	17–34	" " " — nearly white .	3.67	0	0	6.1
»	34–49	" " " — yellow	6.01	0	0	6.3
»	49–74	" " " — bright reddish	8.10	0	0	6.3

TABLE II.

Origin	Depth in cm.	*a* Air-dried soil		*b* dried at 55° C.		*c* dried at 100°C.		*d* boiled in water for 1 minute	
		Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.
I. — AGRICULTURAL SOIL.									
1. Hulín	10–20	10	57.2	5 10	38 58.2	5 10	27.2 43.4	5 10	29.6 50.5
»	30–40	10	52.4	5 10	33.5 56.6	5 10	27 42.6	5 10	27 49.2
»	60–70	10	36.4	5 10	24 39	5 10	19.8 31.3	5 10	20.7 36.4
»	90–100	10	20	5 10	14.4 22	5 10	12.2 18	5 10	9.2 16.3
»	120–130	10	25.6	5 10	18.8 28.5	5 10	15 23.8	5 10	8.6 18.8
»	300–310	6′50″	80	5	80	5 5′40″	73.2 80	5 5′4″	75 85
2. Brešt-Hulín.	10–20	5 10	26.4 40	5 10	24 39	5 10	22 35.6	5 10	19.8 34.3
»	20–30	5 10	28.2 41.8	5 10	25.2 39.6	5 10	21.6 35.4	5 10	16 31.7
»	40–50	5 6	70 80	5 6′33″	63.6 80	5 7′6″	60.4 80	5 7′45″	56 85
3. Šlapanice 84	20–30	5 5′55″	72.3 80	5 6′4″	71 80	5 6′17″	69.8 80	5 7′40″	60.8 85
»	40–50	5 6	68.6 80	5 5′5″	79.6 80	5 5′22″	75.4 80	5 5′25″	79 85
»	60–70	5 10	46 79.2	5 8′25″	51.4 80	5 8′45″	50.8 80	5 8′8″	54 85
»	120–130	5 7′55″	61 80	5 7′15″	61.8 80	5 7′22″	61.2 80	5 8′23″	52.8 85
»	140–150	5 10	22 35	5 10	23.4 38.4	5 10	20.4 34.6	— —	— —
4. Šlapanice 85	10–20	4′10″	80	2′53″	80	3′53″	80	5′ 5′6″	84 85
»	40–50	5 9′10″	53.8 80	5 8′47″	53 80	5 10	45.2 76.4	5 10	43.2 76.2
»	80–90	5 10	43 68.2	5 10	40 69.8	5 10	39.8 68.3	5 10	33.2 61.2
»	130–140	5 10	48.6 77	5 9′35″	48.4 80	5 10	45.5 78.4	5 10	35.4 65.6
5. Ivanovice	10–30	5 7′12″	63.4 80	5 7′26″	60.2 80	5 8′19″	56 80	5 10	35.2 74
»	44–60	5 9	55.2 80	5 8′58″	53 80	5 9′35″	50 80	5 10	37.8 71
»	60–75	5 10	46.4 79	5 9′13″	51.6 80	5 8′50″	51.6 80	5 10	46.6 81.8

TABLE II (*continued*).

Origin	Depth in cm.	*a* Air-dried soil		*b* dried at 50°C.		*c* dried at 100°C.		*d* boiled in water for 1 minute	
		Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.
5. Ivanovice	80–	5	47.2	5	48.6	5	49	5	35.4
		10	75	9′28″	80	9′25″	80	10	69
6. Hrušovany-Sanov . .	20–30	5	66	5	78.3	5	67.6	5	66.8
		7′50″	80	5,12″	80	7	80	7′13″	85
» . .	90–100	5	15.4	5	13	5	13.6	5	4.6
		10	23.6	10	22.8	10	22.4	10	11.4
Hrabetice	10–20	5	23.4	5	21.4	5	17.2	5	12
		10	31.8	10	30.3	10	23.2	10	20
7. Hustopeč.	5–15	5	79	4′15″	—	5	75.4	5	75
		5′5″	80	—	80	5′30″	80	8′58″	85
»	20–30	3′50″	80	3′23″	80	5	78.6	5	82
						5′8″	80	5′15″	85
»	35–45	5	47.6	5	46	5	41.2	5	33
		10	72	10	74.8	10	68.8	10	63.6
»	80–90	5	43.6	5	47	5	43.4	5	31
		10	71.5	10	78.2	10	73.6	10	59.2
8. Olomouc	20–30	5	17.3	5	12.5	5	6.6	5	6.6
		10	23.8	10	17.7	10	11	10	11
»	50–60	5	6.6	5	4	5	2.4	5	0.4
		10	7.0	10	3.8	10	1.8	10	1
» Upper Ortstein	60–65	5	59.8	5	62	5	56	—	—
		7′30″	80	7′10″	80	8′2″	80	—	—
» Lower Orstein	75–80	5	11.6	5	7.2	5	7.6	5	2.4
		10	14.7	10	7.8	10	10	10	3.9
9. Hodonín	10–20	5	10	5	7.8	5	4.8	5	4.7
		10	12	10	9.8	10	6.4	10	7
»	35–45	5	4.8	5	3	5	2.2	5	0.4
		10	4.3	10	2.6	10	1	10	0
»	80–90	5	4.6	5	2.2	5	1.4	5	1.4
		10	3.4	10	1	10	0.2	10	0.5
»	250–	5	32.5	5	30.2	5	34.4	5	18.8
		10	54.8	10	54.8	10	57.8	10	39
10. Hrušovany	10–20	5	36.8	5	34.6	5	30.8	5	26
		10	50.8	10	50	10	44	10	39
»	30–40	5	67	5	66.8	5	62.6	5	27
		6′30″	80	6′22″	80	6′45″	80	10	54.5
»	70–80	5	54.4	5	54	5	56	5	40
		9	80	8′22″	80	7′59″	80	10	72
»	150–160	5	42.8	5	46.8	5	51	5	36
		10	68.2	10	75.6	9′20″	80	10	63.2
11. Poštorná	10–20	5	21.2	5	19.5	5	17.2	5	12.2
		10	30	10	28.6	10	25	10	20.0
»	30–40	5	20.4	5	16.7	5	16.3	5	8.7
		10	29.2	10	25.2	10	26.2	10	17.2

TABLE II (*continued*).

Origin	Depth in cm.	*a* Air-dried soil		*b* dried at 50° C.		*c* dried at 100°C.		*d* boiled in water for 1 minute	
		Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.	Time in Min.	O_2 in cc.
11. Poštorná	60–70	5	12.2	5	8.8	5	6.2	5	3.7
		10	16	10	12.3	10	9.6	10	7.8
»	250–260	5	10.4	5	7.3	5	7.2	5	1
		10	12.4	10	8.3	10	8.8	10	2.2
12. Val Mezérici	10–20	5	28.6	5	22.2	5	18	5	18.7
		10	38.8	10	32.6	10	26.6	10	29.2
»	30–40	5	36.8	5	30.2	5	25.4	5	24
		10	50.8	10	43.4	10	36.9	10	38.8
»	60–70	5	33.0	5	32.4	5	28.8	5	22.3
		10	46.8	10	46.8	10	42	10	37
»	120–130	5	14	5	10.8	5	14.1	5	6
		10	20	10	16.7	10	20.5	10	12.4
13. Radomín.	8–13	5	37	5	34.2	5	26	5	33
		10	52.2	10	51.8	10	37.8	10	49.4
»	30–40	5	2.5	5	3	5	1.2	5	0.8
		10	2.2	10	2.6	10	0.4	10	—
»	80–90	5	2.2	5	2.2	5	—	5	2.8
		10	1.0	10	1.2	10	—	10	1.8
14. Tichá	5–15	5	44.6	5	43.6	5	35.2	5	31
		10	69.8	10	65.6	10	53.3	10	53.6
»	20–30	5	25	5	20.8	5	18.6	5	15.2
		10	36.2	10	32.5	10	28.7	10	28
»	70–80	—	—	5	76.4	5	66	5 11″	56
		5	80	5′21″	80	6′35″	80	8′	85
»	150–160	5	22.8	5	22.8	5	18.5	5	6.4
		10	33.6	10	36	10	27.3	10	14.5
II. — FOREST SOIL.									
15. Adamov	0–3	5	52.4	5	47.4	5	20.4	5	35.6
		10	78.3	10	74.6	10	34.4	10	53
»	3–17	5	13.4	5	9	5	4.8	5	1
		10	17.6	10	12.8	10	7	10	3
»	17–34	5	20.4	5	16.2	5	13.6	5	4
		10	30.2	10	27	10	22	10	8.6
»	34–49	5	47.8	5	44	5	38	5	34
		10	71.6	10	70.4	10	60.6	10	60
»	49–74	5	47.4	5	48	5	38.2	5	34.2
		10	72.2	10	72.8	10	59.6	10	58.2

The soils cannot be compared by the speed constant of FAITELOWITZ (19) because no suitable H_2O_2 concentration was found for the soil, in which there was molecular reaction (determined in milk and blood. High concentrations render the catalase inactive in both). For this reason the soils are compared according to the number of cc. of oxygen set free in equal time.

Between the quantity of the liberated oxygen and the hygroscopicity of the different soils there was no marked connection (20). In Brest-Hulín, for instance, the least hygroscopicity was found in the lowest layers, but they set free the greatest quantity of oxygen. At Tichà, the hygroscopicity, owing to the clay soil and iron, increases with the depth, the catalase also reached its maximum at a depth of 70 to 80 cm., on the other hand the upper layers come after the soil vegetable matter as regards catalase. In the Adamover forest zone the minimum hygroscopicity is at a depth of 17-34 cm. and increases regularly on either side, the maximum being at a lower level. The minimum catalase is in the leached layer below the forest litter. The dynamic force of the soil constituents appears to be in relation with the catalase.

The iron and varying lime content in this Adamof type is given in Table III.

TABLE III.

Origin	Depth in cm.	Fe_2O_3 %	Liberated O_2 in cc. in 10′	mg. CaO in 100 gm. Soil	pH reaction	
					variable	constant
Adamov . . .	0–3	1.947	78	176	5.4	5.9
» . . .	3–17	1.608	17	38	4.5	6.3
» . . .	17–34	2.114	30	82	6.1	6.9
» . . .	34–49	2.110	71	168	6.3	7.1
» . . .	49–74	3.362	72	290	6.3	7.1

As may be seen from Table III, the lime and iron content, the hygroscopicity and the variable and constant reactions are related to the catalytic force (lime was not found in the soil in the form of carbonate).

It is interesting to observe how the upper bed rock layer in the Olomouc section, becoming softer, differs from the lower. The upper layer is strongly catalytic whereas the lower is only slightly catalytic. As regards hygroscopicity there is only a comparatively slight difference.

No close relation was found between the calcium carbonate and catalase. In Hulin, for instance, the greatest catalytic power is found at a depth of from 300-310 cm., and here also the greatest quantity of lime was found. In Slapanice No. 85 the greatest lime content is at a depth of from 130-140 cm., the catalytic power here, however, takes the third place. The minimum catalase was found at 80-90 cm., though this zone is nearly as rich in carbonate as the vegetable mould. Though there appears no definite relation between the calcium carbonate content and the catalase, yet a certain tendancy thereto can be observed here. The soils showing the greatest catalytic force (Hustopeč vegetable mould, subsoil No. 1, Slapanice 85 vegetable mould) are richer in lime than soil of the lowest catalytic force (Radomin UG1,2, Hodonin UG1,2) (This result agrees with von KOENIG's).

If the soil catalase is partly of bacterial origin, then there must be a certain correlation between soil catalase and soil reaction. The degree of the constant and variable reaction of the soils examined is given in Table I (30 gms. of soil were shaken for 1 hour in 100 cc. of water, or with KCL, and the pH filtrate determined by MICHAELIS' colorimetric method).

Though neither the degree of variable, nor that of constant reaction always corresponds with the catalytic force of the soil, yet we find that the soil with the highest catalase showed the highest constant (pH Hustopeč A. UG 1., Slapanice 84 A.). On the other hand the soils with the lowest catalase (Radomin UG 1,2, Hodonin UG 1,2) showed less or very little pH. This rather marked tendency is also related to the calcium carbonate content.

A further test was made in order to discover how the hydrogen-peroxide catalase changes after partial sterilisation of the soil by heating (22). The soil was dried at 50° and 100° C. until constant weight was obtained. The catalytic force of the soil thus dried is as shown in Table II, columns *b*, *c*.

From this Table it is evident that in many types, when dried at 50° C., the catalytic force increases (Hulin, Slapanice 84 UG., Slapanice 85, somewhat also in the case of Radomin, Hrušovany-Sanov A., partially in that of Ivanovice and Hustopeč), while in other types it fell. A small majority show a slight decrease in catalytic force.

The catalytic force decreased after the partial sterilisation of the soil at 100° C. Only a few exceptions were found in subsoils at a great depth.

Tests were also made to discover how this soil force changes on boiling (23). The soil was boiled in water for 1 minute, and immediately after cooling hydrogen peroxide was added. The concentration was such that a quantity of H_2O_2 equal to that used in the other tests was used in the treatment, so that the results could be compared. In this way the values given in Table II, column *d* were obtained.

Boiling generally, diminished the catalytic force of all soils. This sterilisation greatly resembles in its effect the of results dry heating at 100° C. If a comparison is made of the differences obtained by subtracting the volume of the liberated oxygen before and after sterilisation of the soil, the data in Table IV result.

From the Table IV it is evident that from partial sterilisation of soil by dry heat at 100° C, most of the upper layers, or those next to them, suffer (Hustopeč 35-45 and Poštorná 60-70 are exceptions). This is in harmony with the atmospheric pressure which similarly decreases in the sections. As other authors have already shown, no relation between the numbers of organisms can be expected, for different species have a different capacity for liberating molecular oxygen from the hydrogen peroxide (certain staphylococci and sarcinae exert the greatest influence).

If we observe the difference in catalytic force between air-dried and boiled soils, the proportions are similar to those already mentioned (Hustopeč 35-45, Tichà 150-160 and Hodonin 200, for instance, are exceptions).

Nostitz (24) thinks that the catalase at greater depths decreases like the soil fertility and the humus and nitrogen content.

How the soil catalase changes on heating to a dull, red heat may be seen from the following examples, Table V.

If these figures are compared with those in Table II, column *a*, a great decrease is found in the liberated oxygen. Comparatively the greatest catalytic force is retained after heating to a red theat, by those types having a higher lime content, namely Hulin at 300 cm. and Slapanice at 140 cm. This is probably due to the chemical and mineral composition of the soil components (25).

TABLE IV.

Origin	Depth in cm.	Difference in the amount of exygen liberated from the soil before and after sterilisation			
		By drying at 100° C.		By boiling in water	
		after 5'	after 10'	after 5'	after 10'
I. — AGRICULTURAL SOILS.					
1. Hulín	10–20	—	13.8	—	6.7
»	30–40	—	9.8	—	3.2
»	60–70	—	5.1	—	0
»	90–100	—	2.0	—	3.7
»	120–130	—	1.8	—	6.8
»	300–310	—	—	—	—
2. Brešt-Hulín	10–20	4.4	4.4	6.6	5.7
»	20–30	6.6	6.4	22.0	10.1
»	40–50	9.6	—	—	—
3. Šlapanice 84.	20–30	2.5	—	11.5	—
»	40–50	—6.8	—	—10.4	—
»	60–70	—4.8	—	—8.0	—
»	120–130	—0.2	—	8.2	—
»	140–150	1.6	0.4	—	—
4. Šlapanice 85.	10–20	—	—	—	2.8
»	40–50	8.6	—	1.7	2.2
»	80–90	3.2	—0.1	—0.6	—0.8
»	130–140	3.1	—1.4	—	—
5. Ivanovice	10–30	7.4	—	28.2	—
»	44–60	5.2	—	17.4	—
»	60–75	—5.2	—	—0.2	—
»	80–	1.8	—	11.8	6.0
6. Hrušovany-Sanov	20–30	1.6	—	—0.8	—
»	90–100	1.8	1.2	10.8	12.2
Hrabetice	10–20	6.8	8.6	11.4	11.8
7. Huštopec	5–15	4.4	—	4.0	—
»	20–30	—	—	—	—
»	35–45	6.4	3.2	14.6	8.4
»	80–90	0.2	—2.1	12.6	12.3
8. Olomouc.	20–30	10.6	12.8	10.6	12.8
»	50–60	4.2	5.2	6.2	6.0
» Upper Ortstein	60–65	3.8	—	—	—

TABLE IV (*continued*).

Origin	Depth in cm.	Difference in the amount of oxygen liberated from the soil before and after sterilisation			
		By drying at 100° C.		By boiling in water	
		after 5′	after 10′	after 5′	after 10′
8. Olomouc Lower Ortstein . .	75–80	4	4.7	9.2	10.8
9. Hodonín.	10–20	5.2	5.6	5.3	5
»	35–45	2.6	3.3	4.4	4.3
»	80–90	3.2	3.2	3.2	2.9
»	250–	— 1.9	— 3.0	13.7	15.8
10. Hrušovany	10–20	6.8	6.8	10.8	11.8
»	30–40	4.4	—	40.0	—
»	70–80	— 1.6	—	14.4	—
»	150–160	— 8.2	—	6.8	5.0
11. Poštorná	10–20	4.0	5.0	9.2	10.2
»	30–40	4.1	3.6	11.7	12
»	60–70	6.0	6.4	8.5	8.2
»	250–260	3.2	3.6	9.4	10.2
12. Val Mezirici	10–20	10.6	12.2	9.9	9.6
»	30–40	11.4	14.5	12.8	11.8
»	60–70	4.2	4.8	10.7	9.8
»	120–130	— 0.1	— 0.5	8	7.6
13. Radomin	8–13	11	14.4	4	2.8
»	30–40	1.3	1.8	1.7	2.2
»	80–90	2.2	1	— 0.6	— 0.8
14. Tichà	5–15	9.4	16.5	13.6	16.2
»	20–30	6.4	7.5	9.8	8.2
»	70–30	—	—	—	—
»	150–160	4.3	6.3	18.4	19.1
II. — FOREST SOILS.					
15. Adamov	0–3	32	43.9	16.8	25.3
»	3–17	8.6	10.6	12.4	14.6
»	17–34	6.8	8.2	16.4	21.6
»	34–49	9.8	11.0	13.8	11.6
»	49–74	9.2	12.6	13.2	14.0

TABLE V.

Origin	Depth in cm.	Time	O_2 in cc.
Hulín.	10–20	5 10	3.3 3.2
»	30–40	5 10	2.5 1.4
»	300–310	5 10	28.8 48.2
Tichà	5–15	5 10	2.5 1.4
»	20–30	5 10	2.8 1.7
Šlapanice 84	140–150	5 10	32.5 45.2

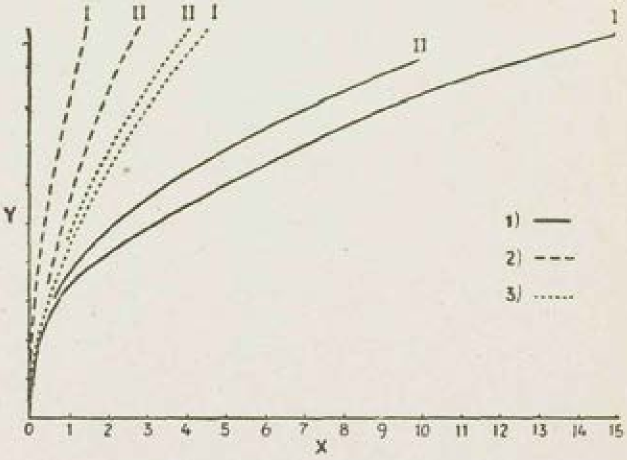

FIG. 57. — Intensity of oxygen liberation.
Y = cc. oxygen; X = Time in minutes

1) ——— at 17° C.
2) . . . . . at 37° C.
3) - - - - at 60° C.

I = Hulin mould at 10 cm.; II = Ticha mould at 5 cm.

The extent of the action of oxygen liberation at temperatures of 17°, 37° and 60° C. may be illustrated by graphs (Fig.57).

From the foregoing diagram it is seen that with an increase of temperature during the reaction the quantity of oxygen liberated is greater at the same $H_2 O_2$ concentration (See Hulin 10-20 cm., Ticha 5-15 cm.).

How the quantity of oxygen liberated under the influence of a different hydrogen-peroxide concentration varies, may be seen from the following diagram (Fig. 58).

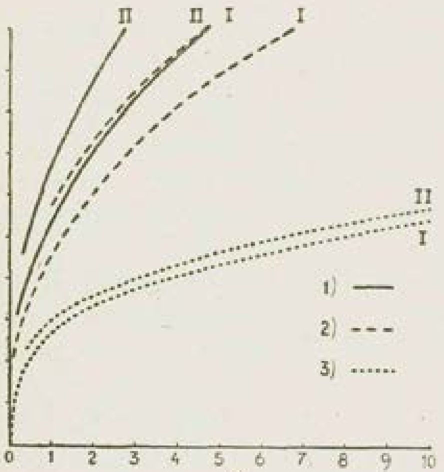

FIG. 58. — *Variation in the quantity of oxygen liberated under the influence of hydrogen-peroxide concentration.*

Y = cc. Oxygen; X = Time in minutes
1) ——— 20 % H_2O_2
2) – – – – 10 % »
3) . . . . . 1 % »
I = Hulin vegetable mould at 10 cm.; II = Ticha vegetable mould at 5 cm.

A higher concentration at the same temperature is accompanied by an increase in the quantity of oxygen liberated.

From all these results it is clear that the catalytic force of soils cannot be brought into close relation with any one of the characteristic soil properties mentioned. No general close connection was found between the physical composition, hygroscopicity, calcium carbonate content or degree of reaction, either constant or variable. This may perhaps be understood up to a certain point. If this property of the soil depends on the humus content, then it must be greatest in the vegetable mould and upper layers. As, however, it is influenced by various oxides (iron, manganese) in the subsoil it must increase with the depth. As lime also and a whole series of other elements in the soil come into play, it is clear that the hydrogen-peroxide catalase cannot be brought into correlation with any single property of the soil.

The concluding results obtained can therefore only be considered as certain tendencies, which become evident on studying the analysis data, and in no way as definite functions.

SUMMARY.

The object of this investigation was to determine the hydrogen-peroxide catalase in types of marsh soil, and to find out how it changes after partial sterilisation at a temperature of from 50°-

100° C, after boiling, or finally, after heating to a red heat, and how various temperatures and H_2O_2 concentrations during the reaction show their influence, and to bring them into relation with:

(1) the physical composition;
(2) the hygroscopicity (27);
(3) the carbonate content;
(4) the constant and variable soil reaction.

The results of the investigation are as follows:

(1) In the subsoils treated, the hydrogen-peroxide catalase increased with the depth, as likewise the hygroscopicity and constant and variable pH concentration.

(2) The soils having the greatest catalytic force showed a higher constant pH and at the same time a higher calcium carbonate content. On the contrary, soils with the lowest catalase showed a lower constant pH reaction.

(3) After drying the soils at 50° C. the catalytic power altered irregularly. In some soils it increased, in others it diminished. After drying the soils at 100° C, also after boiling in water for a minute, the catalytic power of the great majority of the soils diminished. After heating the soils to a dull red heat the catalytic power diminished in all cases, but irregularly.

(4) With an increased H_2O_2 concentration the quantity of oxygen liberated also increased.

(5) With a higher temperature during the reaction the quantity of oxygen liberated also increased.

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(1) Wolf: Die chemischen Forschungen, 1847.
(2) *Landw. Jahrbuecher* 21, 1892.
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Von L. Bohnson and A. C. Robertson: Die katalyt. Zersetzung von Wasserstoffsuperoxyd durch Ferrisalze. II. *Journ. Physic. Chem.* 25, 19, c. 1921.

(9) CAMERON and Bell (Oxydasen) Woods (Peroxydasen) See under 6).

(10) Die Tschernosem-erden ragen durch eine ausserordentlich hohe katalytische Kraft hervor. Nach PAPA KALANTARINIAN (5 g Erde + 400 cc 3 % H^oO^o ergeben nach 30° z. B .455 cc O). See under 7, S. 62.

(11) PAPA KALANTARIAN führt an, dass Chloroform sehr ungleich auf verschiedene Boeden wirkte. Bei einigen Boeden setzte es die katalytische Kraft nur sehr undeutlich herab, bei manchen erhoehte sie sogar diese.

(12) Versuche eine Beziehung zwischen der chemischen Zusammenstzung des Humus und der katalytischen Kraft des Bodens zu finden. See SMOLÍK, IVth Soil Science Congress, Rome, 1924.

(13) The catalase of soils, *Porto Rico Agric. Exp. Station Circular* 9, 1909.

(14) H. GROSSMANN, *Landw. Versuchstat.*, 1908.

(15) *Comptes rendus hebd. d. séances d. l'acad. des sciences*, p. 1842, 1924.

(16) GERTRUD WOKER (1914) haelt die Peroxydase, Katalase, und die Reduktase fuer Enzyne von Aldehydcharakter. Ihr widerspricht A. BACH (1924) der verschiedene Enzyme (auch Katalase) herstellte, aber die Eigenschaften von Aldehyden nicht vorfand.

(17) SMOLIK, Ueber Menge und Charakter der Matière noire in den maehrischen Boeden, 1924.

(18) Bodenkunde III.

(19) *Milchwirtschaftliches Zentralblatt*, 1910.

(20) Einige Veraenderungen der Katalase des Bodens bei Veraenderungen der gesammten Bodenoberflaeche sind angefuehrt: in SMOLIK, Beitrag zu den diskolloiden Veraenderungen des Bodens, Zemedel. Archiv, 1924.

(21) Es handelt sich hier um ein saures Profil. Der Austauschkalk wurde bestimmt durch Extraction mit n-KCl.

(22) PAPA KALANTARIAN vollzog die Sterilisation bei 2 Atm. Ueberdruck bei einer Temperatur von 133°, um nicht nur die Bakterien sondern auch die Enzyme zu vernichten. See No. 7.

(23) Siehe unter 15.

(24) *Landw. Jahrbuecher* 47, 1914.

(25) Interessant ist, dass die Schwarzerden — nach PAPA KALANTARIAN — durch Gluehen annähernd gleich leiden. Der Autor meint, dass man daraus auf eine annarhernd gleiche mineralogische Zusammensetzung der Schwarzerden schliessen koenne.

(26) Die Angaben von cc Sauerstoff sind nicht reduziert auf Atmosphaerendruck.

(27) $H^{\cdot}$ koagulieren die Bodenkolloide. Nach AARNIO kann man daher eine Beziehung zwischen den $H^{\cdot}$ im Boden und der Hygroskopicitaet suchen. Bei dem Adamover Profil sehen wir tatsaechlich, dass in den Untergruenden, wo die aktuelle Aciditaet am geringsten ist (pH am groessten) die Hygroscopicitaet steigt.

THE HELP OF GRAPHS IN KOPECKY'S SCALE FOR SOIL CLASSIFICATION BY MECHANICAL ANALYSIS.

By Eng. Jar. SPIRHANZL,
Prague, Czechoslovakia.

The soil cleansing apparatus of Prof. KOPECKY, as experience shows, is now increasing in importance, especially amongst agricultural scientists. Its success is naturally greatly enhanced by its easy manipulation, automatic working and the short time occupied by the analyses. This apparatus has been largely introduced into the Chechoslovakian Republic and used also in connection with maps, with excellent results.

As further experience shows, however, the examination of the character of the soil type by the process of mechanical analysis, for which investigation a special classification scale was drawn up by Prof. KOPECKY (1), is often attended with certain difficulties. Especially in mechanical analyses and in laboratory work at the Technical High School, the analyst students have always had to search in the scale in order to get together the right description according to the analytical data. This led me to draw up a simple scheme (graph), by means of which the description of the soil type desired could immediately be ascertained.

This plan is based on Prof. KOPECKY's classification scale, which takes into consideration chiefly two kinds of particles, viz., I. particles with a diameter of less than 0.01 mm. (the finest particles which may be held in suspension) and II. particles with diameter of from 0.01-0.05. In the diagram the data for the percentage content of particles of category I. in the soil type are shown in the vertical figures and the similar percentages of particles of category II. are shown in the horizontal figures.

If, therefore, following the analysis data, the corresponding figures of category I. be found in one column and those of category II. in the other, *the intersection of these lines shows the description as per classification* of the soil type under examination. For instance:

I. 55 %, II. 35 % . . . " Clay-loamy Soil "
I. 8 %, II. 35 % . . . " Slightly Loamy Sand " etc.

As, in the scale, for the outside space I. 0-10 %, and II. over

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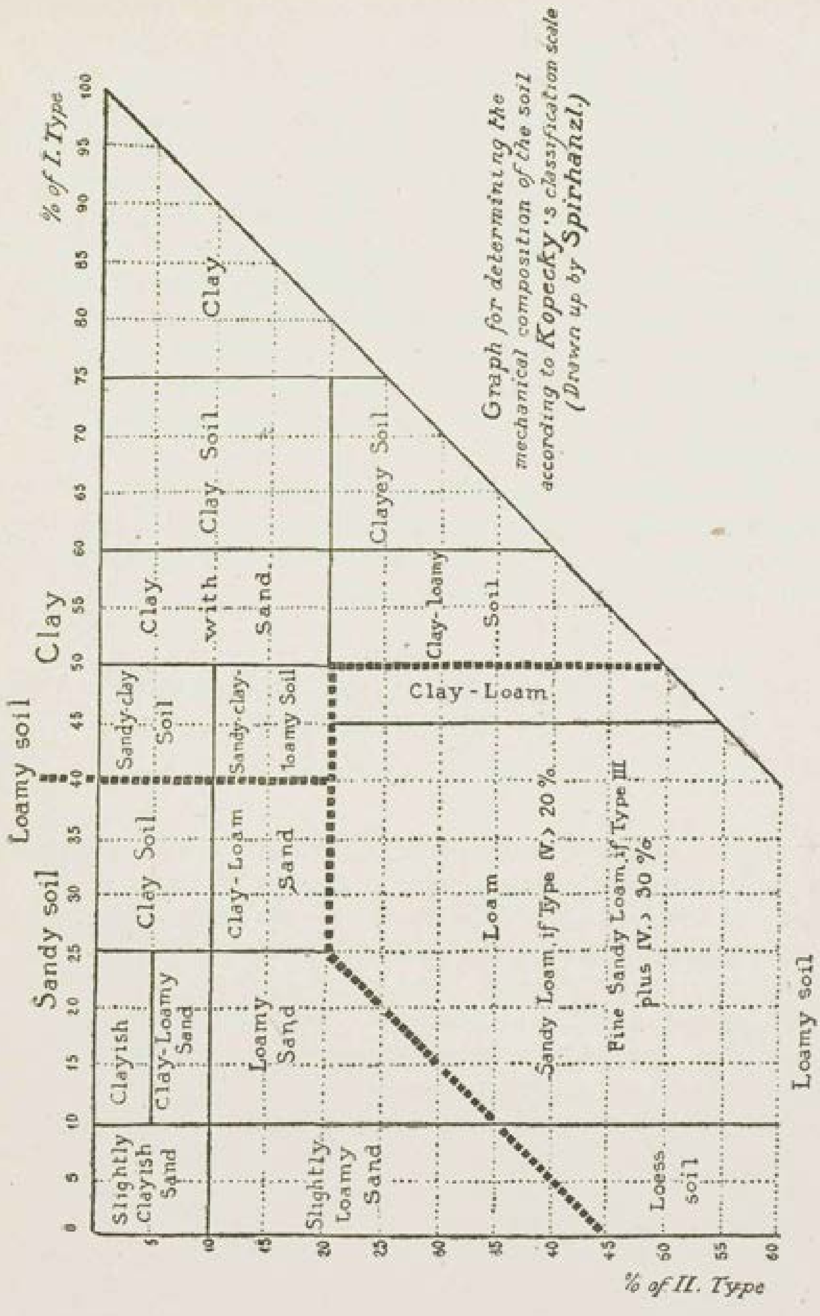
(1) " *Soil Type Classification* " - Prague, 1913, 22.



Graph for determining the mechanical composition of the soil according to **Kopecky**'s classification scale (Drawn up by **Spirhanzl**)

45 %, no allowance has been made, we have supplied Prof. KOPECKY's deficiency by inserting the corresponding " Loess Soil ".

On the plan, the gradual change from sand to clay may very easily be followed. In addition, the individual character of the separate soil types, through their position in the common space is brought out very clearly, and a reference to the neighbouring group will also allow of the properties of each group being determined, and further, from the position of the point of contact in the single group space, by reference to the neighbouring spaces the properties of the soil type can be determined. If, for instance, the point of contact I. 20 % and II. 27 % lies near the " Loamy Sand " group, it is clear that the analysed loam will be very sandy,. . . and so on. Also, in the plan, the chief groups, Sand, Loam and Clay Soils, are enclosed by thick lines.

The simplicity of application of this diagram has been so far appreciated that it is already in general use for practical soil science dt the Technical High Schools in Bohemia and the work of the stuaents is thereby considerably lightened.

THE INFLUENCE OF NEUTRAL SALTS ON SOIL REACTION.

By O. ARRHENIUS,
Stockholm.

It has long been known that neutral salts modify soil acidity. At first these modifications were measured by titration, but recently KAPPEN (5, 9), among others, has investigated the removal of the actual acidity by the addition of salts.

As very few systematic determinations of the reaction of different salts and soils had been made with this object, the author began these investigations some years ago. After the first series of tests had been made, it became evident that the colorimetric method did not give sufficiently exact results. The investigations therefore had to be made by the electrometric method *, but were delayed by the fact that the author hitherto had no suitable instruments at his disposal.

For the proposed tests, an acid and an alkaline loam soil, a sandy soil and an undecomposed sphagnum peat were used.

* The pH determinations were kindly made by Miss S. HEINZE.

The tests were made in the following manner. 10 gm. of dried soil were mixed with 100 cc. of salt solution. The following concentrations were used: 0; 0.00003; 0.0001; 0.0003; 0.001; 0.003; 0.01; 0.03; 0.1; 0.3; 1.0; in addition, a still higher degree of concentration was used, being, for the various salts, as follows:

KCl	KNO_3	$NaCl$	$NaNO_3$	Na_2SO_4	NH_4Cl
3.00	2.16	5.40	5.53	1.71	4.94
NH_4NO_3	$(NH_4)_2SO_4$	$CaCl_2$	$Ca(NO_3)_2$		
5.07	5.19	3.47	5.53		
$MgCl_2$	$MgSO_4$				
5.08	4.15-n				

The samples were shaken by hand several times, and allowed to stand over night in closed vessels and the next day the determinations were made by the quinhydronelectrode (BIILMANN, 4) on the soil deposits.

The results of these determinations are given in Table I (see page 26-27).

(In these Tables "concentration" means concentration of salts solution, "pH", hydrogen concentration).

As the acidity modifications through titration were also of interest, the titration curves of the different soils were determined.

TABLE II.

Titration of the different soils.

		1	2	4	6	8	10
cc. of Acid . . .	0	2	4	6	8	10	
Alkali Loam.	7.92	7.50	7.35	6.90	6.65	6.36	5.80
Acid »	5.05	4.64	4.30	3.95	3.60	3.18	3.10
Sandy Soil.	5.16	4.48	3.94	3.43	3.00	2.71	2.56
Peat	5.26	5.22	5.20	5.00	4.90	4.76	4.68

10 gms. of dry soil were mixed with various quantities of sulphuric acid and then diluted to 100 cc.

As however in this investigation only the question of acidification was dealt with, only the acid sections of the titration curves

TABLE I.

Concentration	KCl		KNO_3		K_2SO_4		NaCl		$NaNO_3$		Na_2SO_4		NH_4Cl		NH_4N
	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH
Alkali Loa Soils															
0,00000	7.93	0.00	7.92	0.000	7.92	0.00	—	—	—	—	7.92	0.000	7.92	0.00	7.92
0,00003	7.92	0	7.92	0	7.90	0.0	7.90	0	7.94	0	7.92	0	7.92	0	7.90
0,0001	7.92	0	7.92	0	7.90	0	7.90	0	7.94	0	7.92	0	7.92	0	7.90
0,0003	7.87	0.01	7.92	0	7.90	0	7.85	0.015	7.94	0	7.92	0	7.92	0	7.81
0,001	7.82	0.02	7.79	0.05	7.83	0.02	7.85	0.015	7.87	0.01	7.86	0.01	7.75	0.0	7.75
0,003	7.68	0.06	—	—	7.75	0.04	7.80	0.03	7.87	0.01	7.90	0	7.69	0.0	7.68
0,01	7.54	0.09	7.53	0.095	7.64	0.07	7.75	0.04	7.75	0.04	7.79	0.03	7.55	0.0	7.50
0,03	7.30	0.21	7.40	1.155	7.45	0.13	7.68	0.06	7.67	0.06	7.75	0.04	7.42	0.1	6.39
0,1	7.28	0.22	7.31	0.205	7.39	0.16	7.58	0.08	7.56	0.085	7.71	0.05	7.29	0.2	7.25
0,3	7.29	0.22	7.30	0.21	7.39	0.16	7.50	0.10	7.50	0.10	7.68	0.06	7.18	0.2	7.18
1,0	7.29	0.22	7.30	0.21	7.84	0.02	7.45	0.13	7.46	0.135	7.65	0.065	7.00	0.3	7.07
1	7.22	0.25	7.25	0.235	—	—	6.81	0.41	6.10	0.92	7.76	0.04	6.30	0.8	6.64
Acid Loa Soils															
0,00000	5.05	0.00	—	—	—	—	—	—	—	—	5.05	0.000	5.05	0.0	—
0,00003	5.05	0	—	—	5.05	0	—	—	—	—	5.05	0	5.00	0.0	5.05
0,0001	5.06	0	5.06	0	—	—	—	—	—	—	5.10	0.01	5.00	0.0	5.05
0,0003	5.06	0	5.06	0	5.05	0	—	—	—	—	5.05	0	5.00	0.0	5.05
0,001	4.86	0.04	4.86	0.04	4.93	0.03	5.06	0	5.06	0	4.96	0.03	4.90	0.0	4.90
0,003	4.64	0.10	4.58	0.12	4.76	0.07	4.96	0.03	5.00	0.01	4.92	0.03	4.75	0.0	4.75
0,01	4.47	0.15	4.45	0.16	4.56	0.13	4.77	0.06	4.77	0.06	4.85	0.04	4.53	0.1	4.55
0,03	4.20	0.25	4.25	0.23	4.40	0.17	4.61	0.11	4.58	0.12	4.77	0.07	4.35	0.1	4.35
0,1	4.10	0.31	4.10	0.31	4.32	0.19	4.47	0.11	4.50	0.14	4.65	0.10	4.10	0.3	4.10
0,3	4.05	0.34	4.05	0.34	4.30	0.22	4.29	0.22	4.25	0.22	4.53	0.13	4.04	0.3	3.94
1,0	3.90	0.43	3.90	0.43	4.42	0.16	4.11	0.30	4.09	0.30	4.75	0.07	3.96	0.4	3.96
1	3.90	0.43	3.90	0.43	—	—	3.79	0.48	3.92	0.41	4.75	0.07	3.74	0.5	3.86
San Soils															
0,00000	5.13	0.00	—	—	—	—	5.13	0.000	—	—	—	—	5.13	0.0	—
0,00003	5.07	0.01	5.15	0	5.15	0	5.14	0	5.12	0	5.12	0	5.13	0	5.10
0,0001	5.10	0.01	5.10	0.01	5.15	0	5.14	0	5.12	0	5.12	0	5.12	0	5.07
0,0003	5.07	0.01	5.05	0.01	5.15	0	5.16	0	5.14	0	5.12	0	5.10	0.0	5.07
0,001	4.99	0.01	4.99	0.01	5.04	0.01	5.14	0	5.10	0.01	5.10	0.01	5.00	0.0	5.07
0,003	4.90	0.04	4.96	0.02	4.94	0.03	5.00	0.01	5.00	0.01	5.04	0.01	4.90	0.0	4.90
0,01	4.74	0.06	4.70	0.07	4.80	0.05	4.90	0.04	4.91	0.04	4.96	0.02	4.74	0.0	4.74
0,03	4.57	0.08	4.57	0.08	4.70	0.07	4.77	0.06	4.86	0.04	4.90	0.04	4.59	0.0	4.61
0,1	4.41	0.11	4.41	0.11	4.59	0.08	4.65	0.07	4.65	0.07	4.82	0.05	4.47	0.1	4.45
0,3	4.30	0.13	4.32	0.13	4.42	0.08	4.64	0.10	4.46	0.10	4.72	0.06	4.27	0.1	4.30
1,0	4.26	0.14	4.26	0.14	4.74	0.06	4.27	0.14	4.31	0.13	5.00	0.01	4.15	0.1	4.16
1	4.16	0.16	4.22	0.15	—	—	4.20	0.15	4.11	0.16	5.20	0.01	—	—	3.99
Pe															
0,00000	5.23	0.00	—	—	—	—	—	—	—	—	—	—	5.26	0.0	—
0,00003	—	—	—	—	—	—	—	—	5.26	—	—	—	—	—	—
0,0001	—	—	5.26	0.000	—	—	—	—	5.26	0.000	—	—	—	—	—
0,0003	5.26	0.00	5.26	0.000	—	—	—	—	5.26	0.000	5.26	0.000	—	—	—
0,001	5.25	0.00	5.25	0.000	5.26	0.00	—	—	5.26	0.000	5.20	0.18	5.26	0.0	—
0,003	5.26	0.00	5.20	0.18	5.30	0	5.26	0.000	5.26	0	5.20	0.18	5.26	0	5.26
0,01	5.19	0.21	5.19	0.21	5.30	0	5.16	0.24	5.26	0	5.20	0.18	5.08	0.3	5.08
0,03	5.16	0.24	5.18	0.22	5.26	0	5.10	0.31	5.21	0.17	5.20	0.18	5.08	0.0	5.08
0,1	5.10	0.31	5.10	0.31	5.26	0	5.04	0.37	5.15	0.25	5.18	0.22	4.98	0.4	4.98
0,3	5.07	0.34	5.08	0.32	5.16	0.24	4.94	0.53	5.04	0.37	5.10	0.31	4.88	0.	4.87
1,0	5.00	0.41	5.00	0.41	5.35	0.20	4.84	0.70	4.94	0.52	5.15	0.26	4.78	0.	4.84
1	4.81	0.70	4.98	0.44	—	—	4.65	1.05	4.86	0.66	5.15	0.26	4.60	1.1	4.80

TABLE I.

	NH_4Cl		NH_4NO_3		$(NH_4)_2SO_4$		$CaCl_2$		$Ca(NO_3)^2$		$MgCl_2$		$MgSO_4$		$FeCl_3$	
c.	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH	ac.	pH	ac.
Alkali Loa oils																
00	7.92	0.0	7.92	0	—	—	7.92	0	—	—	7.94	0	—	—	7.92	0
	7.92	0	7.90	0	7.90	0	7.90	0	7.90	0	7.92	0	7.90	0	7.92	0
	7.92	0	7.90	0	7.90	0	7.85	0.015	7.90	0	7.92	0	7.90	0	7.84	0.015
	7.92	0	7.81	0.03	7.90	0	7.81	0.03	7.85	0.01	7.84	0.015	7.90	0	7.84	0.015
1	7.75	0.04	7.75	0.04	7.85	0.015	7.73	0.05	7.76	0.03	7.80	0.03	7.80	0.03	7.50	0.10
	7.69	0.05	7.68	0.06	7.70	0.05	7.65	0.06	7.64	0.07	7.69	0.06	7.60	0.08	7.19	0.26
3	7.55	0.09	7.50	0.10	7.60	0.08	7.38	0.07	7.40	0.16	7.52	0.09	7.50	0.10	5.74	1.08
4	7.42	0.14	6.39	0.16	7.50	0.10	7.20	0.26	7.24	0.24	7.35	0.18	7.41	0.15	2.98	—
5	7.29	0.2	7.25	0.23	7.35	0.18	7.00	0.37	7.00	0.37	7.25	0.24	7.34	0.19	—	—
6	7.18	0.27	7.18	0.28	7.35	0.18	6.82	0.44	6.87	0.44	7.20	0.26	7.30	0.21	—	—
65	7.00	0.3	7.07	0.33	7.27	0.23	6.58	0.65	6.20	0.84	7.04	0.35	7.24	0.26	—	—
4	6.30	0.8	6.64	0.60	6.73	0.55	6.10	0.93	—	—	6.10	0.93	6.54	0.68	—	—
Acid Loa oils																
000	5.05	0.0	—	—	—	—	5.05	0	—	—	5.05	0	—	—	5.05	0
	5.00	0.0	5.05	0	5.05	0	5.05	0	5.05	0	5.05	0	—	—	5.05	0
1	5.00	0.0	5.05	0	5.05	0	4.96	0.02	5.05	0	5.05	0	—	—	4.98	0.01
	5.00	0.0	5.05	0	5.05	0	5.00	0.015	5.10	0.01	5.05	0	—	—	4.86	0.05
3	4.90	0.0	4.90	0.04	5.00	0.01	4.78	0.06	4.81	0.03	5.05	0	5.00	0.01	4.67	0.08
3	4.75	0.0	4.75	0.07	4.75	0.07	4.59	0.11	4.56	0.13	4.77	0.06	4.82	0.05	3.98	0.09
4	4.53	0.1	4.55	0.13	4.64	0.10	4.46	0.15	4.47	0.15	4.57	0.13	4.65	0.09	2.98	1.10
7	4.35	0.1	4.35	0.19	4.46	0.13	4.28	0.21	4.28	0.21	4.47	0.15	4.54	0.13	—	—
0	4.10	0.3	4.10	0.31	4.36	0.19	4.10	0.31	4.14	0.28	4.31	0.20	4.45	0.16	—	—
3	4.04	0.3	3.94	0.35	4.36	0.19	4.04	0.35	4.04	0.35	4.14	0.29	4.37	0.19	—	—
7	3.96	0.4	3.96	0.40	4.46	0.15	3.90	0.43	3.96	0.40	3.97	0.39	4.28	0.21	—	—
7	3.74	0.5	3.86	0.43	4.29	0.21	3.67	0.55	3.58	0.60	3.46	0.69	4.09	0.31	—	—
San Soils																
–	5.13	0.0	—	—	—	—	5.15	0	—	—	5.15	0	—	—	—	—
	5.13	0	5.10	0	5.12	0	5.15	0	5.15	0	5.15	0	5.15	0	5.05	0.01
	5.12	0	5.07	0.01	5.10	0	5.15	0	5.15	0	5.15	0	5.15	0	5.15	0
	5.10	0.0	5.07	0.01	5.04	0.01	5.09	0	5.09	0	5.09	0	5.10	0	4.98	0.02
1	5.00	0.0	5.07	0.01	4.96	0.92	4.93	0.03	4.90	0.03	4.98	0.02	4.98	0.2	4.50	0.10
1	4.90	0.0	4.90	0.04	4.90	0.04	4.72	0.06	4.53	0.06	4.81	0.05	4.85	0.05	3.67	0.30
2	4.74	0.0	4.74	0.06	4.70	0.06	4.53	0.09	4.53	0.09	4.65	0.07	4.70	0.07	2.84	0.69
4	4.59	0.0	4.61	0.08	4.61	0.08	4.33	0.13	4.33	0.13	4.48	0.10	4.58	0.08	—	—
5	4.47	0.1	4.45	0.10	4.57	0.08	4.17	0.15	4.19	0.15	4.33	0.13	4.46	0.10	—	—
6	4.27	0.1	4.30	0.13	4.50	0.09	4.09	0.17	4.07	0.17	4.17	0.16	4.40	0.11	—	—
1	4.15	0.1	4.16	0.16	4.57	0.08	3.93	0.20	3.93	0.20	4.10	0.17	4.36	0.12	—	—
1	—	—	3.99	0.19	4.36	0.12	3.70	0.29	3.70	0.29	3.57	0.34	3.98	0.20	—	—
Pe																
–	5.26	0.0	—	—	—	—	5.26	0	—	—	—	—	—	—	5.26	0
–	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.30	0.10
–	—	—	—	—	—	—	5.26	0	—	—	—	—	—	—	5.26	0
00	—	—	—	—	—	—	5.26	0	5.26	0	—	—	—	—	5.26	0
8	5.26	0.0	—	—	5.26	0	5.26	0	5.25	0	5.26	0	—	—	5.16	0.24
8	5.26	0	5.26	0	5.20	0.18	5.16	0.25	5.22	0.10	5.21	0.18	5.21	0.10	5.16	0.24
8	5.08	0.3	5.08	0.31	5.14	0.27	5.07	0.33	5.07	0.33	5.08	0.31	5.14	0.27	4.74	0.89
8	5.08	0.6	5.08	0.31	5.14	0.27	4.99	0.43	5.00	0.40	4.97	0.47	5.05	0.36	4.18	—
2	4.98	0.4	4.98	0.44	5.12	0.29	4.77	0.83	4.80	0.77	4.81	0.75	4.92	0.58	2.87	—
1	4.88	0.6	4.87	0.65	5.05	0.33	4.55	1.24	4.55	1.24	4.68	1.00	4.81	0.74	—	—
6	4.78	0.8	4.84	0.70	5.05	0.33	4.31	1.64	4.37	1.55	4.44	1.43	4.72	0.92	—	—
5	4.60	1.1	4.80	0.78	4.83	0.71	3.77	—	3.90	—	3.78	—	4.33	1.60	—	—

were determined (1). From the curves thus obtained (Fig. 59), the quantity of liberated acid was estimated by a graph. These values are shown in the Table I under « ac. »

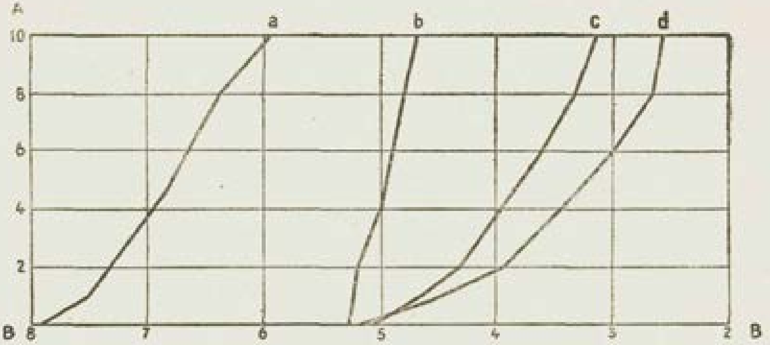


FIG. 59. — Acid set free.

A = H_2SO_4 per gm. of dry soil; B = pH.; *a* = alkaline loam.; *b* = peat soil; *c* = acid loam; *d* = sand.

The origin of the acidification is usually attributed to the so-called potential acidity (7). This might be represented by the following equation:

$$HBd + CaCl_2 = HCl + CaBd$$

provided the salt added be $CaCl_2$ and the acid soil substance, Bd. Through the formation of salts there should be an increase of acidity. The acidity however does not depend on the quantity of acid available, but on the H-ion concentration. But this does not vary according to the equation. FREUNDLICH (6) points out that it is very probable that, as stated by ROTHMUND, the basic variation may be explained by the formation of a strong solution, that is, the phenomenon may be defined as a separation of the salts present into two solvents. If this explanation is sound, it will be still more difficult to explain the potential acidity as a phenomenon of adsorption. If the potential acidity really existed, the phenomena could be estimated by the FREUNDLICH formula. As previously mentioned (3), however, the author has shown that this is not the case if the hydrogen-ion concentration be calculated on this formula, without taking into consideration the buffer-action of the soil.

It might be said that it is the quantity of acid formed, and not the hydrogen-ion concentration, which depends on the concentration of the salt solution. Were the increase in acidity a variable phenomenon, the logarithmic values, represented by a graph, would form a straight line. From Figs. 60 and 61, however, it will be seen that this is not the case; the lines are curved, and this is also the case with Daikuhara's values (5).

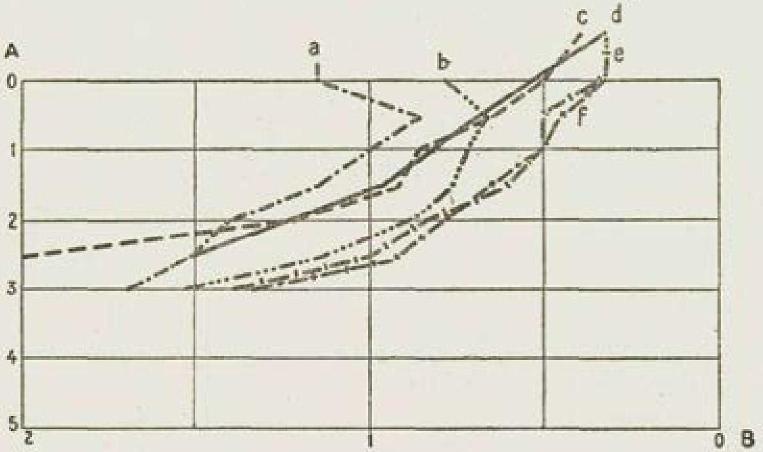


Fig. 60. — Liberated Acidity and Salt Concentration in Acid Loam Soils.
A = Log. Concentration; B = Log. "Liberated" Acid.
a = Na_2SO_4; *b* = K_2SO_4; *c* = $NaNO_3$; *d* = $NaCl$; *e* = KCl; *f* = KNO_3.

Another arguement against the explanation of the phenomena as variable is that alkaline loam, also according to Ramann an adsorbent saturated soil, in some cases, both in actual and titration acidity, has undergone greater changes than acid loam. In other instances the contrary is the case. There is therefore no rule that the adsorbent unsaturated soil can take up more cations from the salt solutions than the adsorbent saturated soil.

Hence it appears as though the definition of increased acidity as a variable phenomenon is not tenable. How then can the matter be explained? One way of explaining it is by assuming that neutral salts exert an influence. If a dilute acid solution be mixed with a stronger neutral salt solution it gives rise to an increased acidity. (In some cases also a decreased acidity may be the result.)

This is accounted for by the fact that the hydrogen-ions are stimulated, or that the OH-ions are expelled, whereby an apparent increase in acidity takes place.

Exactly the same phenomenon takes place if quartz, permutit, cotton or similar substances be treated with neutral salt solutions. It would be very useful to explain the soil phenomenon from the same point of view.

From the Tables it will be seen that the chlorides exercise the greatest influence, and the nitrates come next ; the sulphates have the weakest influence. The same order will be found in ACKERLOEF's works (8).

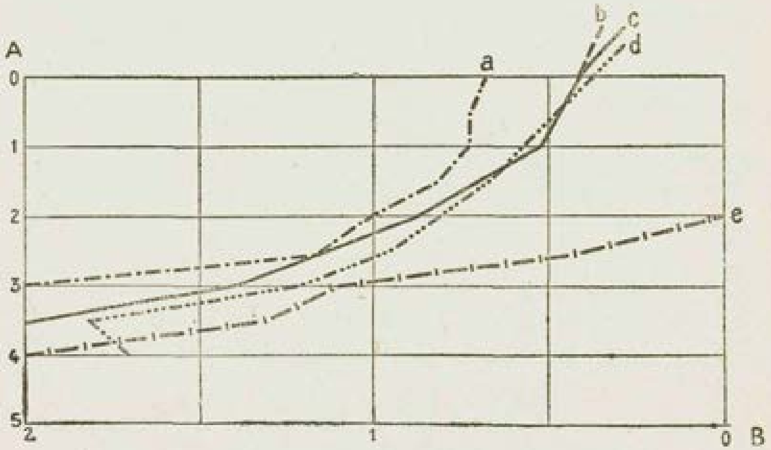


FIG. 61. — Liberated acidity and salt concentration in acid loam soils.
A = Log. concentration ; B = "Liberated" acid.
a = $(NH_4)_2 SO_4$; *b* = $NH_4 HO_3$; *c* = $NH_4 Cl$; *d* = $Ca Cl_2$; *e* = $Fe Cl_2$.

Among the cations, Fe has the strongest influence, then come the Ca, Mg, K, NH_4 and Na series. These facts justify us in regarding the phenomenon as brought about under the influence of neutral salts.

The greater the buffer reaction of the substances treated, the stronger is the modification of their acidity.

By explaining the influence of the salt solutions in this way, the question of soil acidity will be simplified ; the same kind of acidity exists before and after the addition of the salts, there is therefore no new acidity, which moreover would be very difficult to define.

⁂

The extent to which soil acidity is affected by the addition of artificial fertilisers is of great interest as regards manuring. In certain cases even, mineral fertilising may be a failure, for it gives rise to too strong acidity, which, after the investigations on soil reactions made in recent years (2), may be easily understood.

Large quantities of manure are generally added to sugarbeets. In order to give a clear idea of this question, a summary of the frequency of various additions of potash and Chili nitrate made to the soil in an agricultural district in the south of Sweden are here given:

TABLE III.

Frequency of manuring to soil under sugarbeet.

Amount added	0	100	200	300	400	500	750 kg. ha.
40 % potash	221	109	234	24	18	—	2
Chili nitrate	27	26	163	205	165	8	4

Supposing an addition of 200 potash and 400 kg. Chili nitrate per ha. be made, this, assuming that the water content of the soil be 15 % and the weight of one ha. 3,000,000 kg., corresponds to a 0.0045 % of potash solution and a 0.009 % of nitrate solution. For pure salts (this has no practical application) the concentrations would be: a 0.0011-n NO_3 solution and a 0.0006-n KCl solution. From Table 1 it will be seen that these concentrations correspond to the following acidity modifications:

	$NaNO_3$	KCl
Alkaline Loam Soil	0.2	0.3
Acid " "	0	0.1
Sandy	0	0.1
Peat	0	0.1

As will be seen, the modifications are very slight after these additions of fertiliser. It must also be borne in mind that a very low water content has been allowed for here. But with the addition of 1000 kg. or more per ha. very considerable modifications may take place, as will easily be calculated from Table 1.

⁂

During the last decades a series of methods for determining soil acidity have been elaborated (see especially 1), in which the determinations were made on soil precipitates or filtrates plus concentrated soil solutions. Chloride of potash especially has been used in these determinations. During the last few years, especially in Germany (9), the pH determinations have been made on KCl extracts instead of water, and indeed the KCl method is that principally used there. The author has made enquiries of several investigators as to the preference shown for the KCl method and has generally received the following answers:

1. By the KCl process a clear solution is obtained, but with water turbid extracts are often obtained.

2. By the addition of KCl the maximum results in the soil reaction changes caused by manuring are obtained.

3. By the KCl process constant pH values result.

4. From the values obtained with KCl, information may also be gathered as to the soil's need of lime.

5. By this process (according to KAPPEN, 7) much more important potential acidity is measured.

These points will now be examined:

1. Clearer and better solutions are certainly obtained by the addition of KCl. But the same also happens when acids are added. The objection to the last method for pH determinations is generally understood, but the addition of KCl has also an acidifying effect and should likewise therefore be rejected. What it is desired to ascertain through the pH determination is the actual acidity present in the soil, and this mostly for physiological purposes. By the addition of KCl this acidity is modified; therefore by the KCl method something quite different from that desired is measured. Unfortunately it is also impossible to transmute the values obtained with the KCl solution by means of a correcting factor into the " water values. "

2. It has been shown that the salt concentrations in the soil obtained by rather abundant manuring are 1/1000 of those which are generally used in these methods (7 % or 1-n KCl). The maximum values, therefore, are never reached, nor even approached.

3. That the values obtained electrometrically after the addition of KCl are more constant than those obtained in soil suspensions in water, is erroneous. By the use of indicators errors with regards to the salts are greatly increased, and especially with methyl-red quite erroneous results are obtained.

4. That the " lime requirement " of the soil can be measured

by the addition of KCl solution seems very improbable. On the one hand we know that as regards soil reaction different plants have quite different tendencies, on the other hand, from tests made, it appears possible to mistake the quantity of lime necessary to convert a soil to a pH unity by determining the titration curve of the soil. If the pH values which are obtained from the three acid soils, are compared before and after the KCl treatment the following is found :

	pH		
	before	After	Difference
	treatment in KCl		
Peat	5.25	4.84	0.41
Acid Loam	5.05	3.90	1.15
Sand.	5.13	4.16	0.97

According to this it must be concluded that the sand and loam soil have about the same need of lime and the peat much less. From the titration curve it will be seen however that the peat has a much greater lime requirement than the other soils, which is in accordance with the experience of farmers.

5) As shown above, it appears very improbable that potential acidity exists. But it has never been proved that this fact is of any physiological or physico-chemical importance. On the other hand it is clearly shown what a great influence soil reaction has on agriculture. It appears to be more important to establish an extremely weighty factor, than to turn one's attention to questions not yet clearly defined and, as it appears, wrongly explained.

⁂

Neutral salt solutions exercise an acidifying influence. It appears as though this influence may be regarded as a neutral salt influence. Ordinary artificial fertilisers exert very little influence in the matter of modifying reactions, on the contrary large additions may even have an unfavourable effect on soil reaction.

Apparently the estimation of soil reactions in salt solutions is an unsatisfactory method.

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Abstracts and Literature.

The Aeration of Soils as Influenced by Barometric Pressure Changes.

Bouyoucos, G. J. and McCool, M. M. (Michigan Agricultural Experiment Station). *Soil Science*, Vol. XVIII, No. 1, pp. 53-63, figs. 7, Baltimore M., 1924.

In the investigation of this problem, the barographs were buried in the earth and the graphs thus obtained were compared with those obtained in the open air. It was found that at a depth of 10 feet the barometric pressure was the same as in the open air, this being the case in all soil types, including even heavy clay. It must be concluded therefore that the air in the soil has free communication with the outside air as far as the impermeable strata.

Calculations then showed that the greater the variations in pressure and the deeper the impermeable strata, the more extensive is the aeration of the soil and the deeper the penetration of the air therein. When on the other hand these factors are slight, the air penetrates to a lesser extent. Considering the whole earth, it must be concluded that the influence of barometric pressure on soil aeration is considerable, especially in the torrid zones; certainly this influence is greater than is generally supposed.

A. F.

Remarks and Observations on Imbibitional Soil Moisture.

FISHER, E. A. *Journal of Agric. Science* 14, Part 2, pp. 204-220, 1924.

In previous papers (*Roy. Soc. Proc.* 103 A. 1923, pp. 139 and 164) the author has shown that the evaporation curves of water from wool, sand and kaolin, ball clay, etc., form four straight intersecting lines. The factors determining the shape of the curves depend on the vapour pressure of the water present, the temperature of the drying mass, capillarity and the diminution of the evaporating surface. The first portion of the rate curves can be expressed by the equation $-\frac{dw}{dt} - \mathrm{A} = kw$, in which A and k are characteristic constants for each substance. Similar curves were obtained for a deep subsoil containing 55.4 % of clay, yet the section corresponding to the above-mentioned curve sections showed a considerable inclination, for the direction of which the author deduced the equation $-\frac{dw}{dt} - A + a\,(w - n) - \left[\frac{dw}{dt} - A\right] = kw$. In this equation A, a and k are constants and n the percentage water-content at which the curvature ceased. Curves of the second kind are found only in the case of evaporation curves of materials such as clay soils, which are mixtures of colloidal and non-colloidal substances, for water in colloidal combination evaporates at an approximately constant rate, while the rate of evaporation of the capillary "interstitional" water quickly decreases.

In this paper the manner in which the "imbibitional" water is retained by the soil colloids, as compared with the retention of interstitional or capillary water.

If the critical moisture content, at which the evaporation speed ceases to be constant, be compared with the moisture equivalent determined by the BRIGGS and McLANE method (*U. S. Dept. of Agric., Bur. of Soils, Bul.* 45, 1907), i. e. that in which the percentage of water in the soil, which remains after the elimination of the water from the capillaries by centrifuging, it will be found that in the absence of colloidal substances, as for instance quartz sand, the moisture equivalent is less than the critical moisture content (the contrary is the case with substances containing colloids). This can only be explained by the fact that the water retained by the clay, or organic matter, as well as by the coating of colloids on the particles of soil, acts differently from the moisture retained in the capillaries. According to the tests by PROCTER and his collaborators (*Journal Americ. Chem. Soc.* 40, 886, 1918) the force which causes the entrance of water into a gelatine gel and thus determines the expansion, is the osmotic pressure of the excess of crystalloid-ions inside over that outside the gel; this excess is a consequence of the DONAN equilibrium (*Zeitschr. f. Elektrochem.* 17, 572, 1911). The opposing force, limiting expansion, is the cohesion of the colloidal particles. A gelatin gel expanding through the absorption of water acts as a perfectly elastic body and obeys HOOKE's law: $e - CV$ ($V =$ vol. increase in cc. of 1 mgm. equivalent weight gelatine, $C =$ constant corresponding to the modulus of elasticity and e the osmotic force producing the expansion). In conformity with this law the author found, in his investigations with a saturated wool fabric, which was centrifuged at various speeds, that the moisture content, i. e. the degree of expansion, is a linear function of the centrifugal force used. The tests made by other investigators, for instance those by **Briggs** and **McLane** on the moisture content of soils after centrifuging at a varying number of revolutions, also led to the same results. If xylol be used instead of water, the former causing no expansion of cotton, wool, soil, etc, much less xylol than water is retained after centrifuging. This also proved to be the case with soils, as will be shown by a comparison of the moisture and xylol equivalents in the following Table :

Moisture equivalents and xylol equivalents of various materials.

Material	Moisture equivalent (*ME*)		Xylol equivalent (*XE*)		*ME-XE*	Max. imbibitional water = 1-38 *ME*	Percentage imbibitional water retained after centrifuging
	Dry wt. basis (1)	Volume basis	Dry wt. basis	Volume basis (2)			
Kaolin.	41.2 40.8 } 41	106.6	33.0	99.4	7.2	47.1	4.9
Ball clay. . . .	47.2 45.5 } 46.3	120.4	20.2	60.9	59.5	166.2	35.8
Silty soil. . . .	23.5 22.6 } 23.0	59.8	8.2	24.7	35.1	82.5	42.5
Clay subsoil . .	51.6 47.8 } 49.7	129.2	13.8	41.6	87.6	178.3	49.1

(1) Calculation on basis of real specific gravity of soil = 2.60.

(2) Calculation on basis of real specific gravity of soil = 2.60 and specific gravity of xylol = 0.863.

The differences between the moisture equivalents and the xylol equivalents probably furnish a standard for the imbibitional water absorbed by the colloids, as distinct from the interstitial liquid. In kaolin, possessing, as is known, but few or no colloidal properties, the moisture and xylol equivalents on a volume basis are almost the same. This indicates that water, like xylol, is retained interstitially, and that little or no water is held by imbibition. In the other three tests the imbibition and consequent expansion is considerable, and much greater with the clay subsoil than with the ball clay.

Berju.

Capillary Distribution of Moisture in Soil Columns of small Cross Section.

McLaunglin, W. W. (Bureau of Public Roads). *United States Department of Agriculture. Department Bulletin* No. 1221, p. 22, Fig. 7. Washington, D. C., 1924.

The author carried out experiments for the purpose of ascertaining the distribution of capillary moisture in vertical, horizontal and inclined soil columns. Different kind of soils were used, distributed evenly and uniformly into 32-38 mm. pipes. Capillary moisture did not decrease or increase in relation to proximity to the water level. The highest percentage of moisture was not found close to the water level, but at some distance from it. The chart recording the percentage of moisture present in the soil columns shows an irregular curve, the ends of which, corresponding to the top of the column, form almost a straight line.

In all the experiments carried out, except in a test on the silty sand of Idaho, the quantity of water found in the lower half of the pipes was greater than the average content of the entire soil column. A moderate content of water was present from the half of the soil to $^2/_3$ of its height while the greatest quantity existed at a height varying from $^1/_7$ to $^1/_5$ of the immersed portions of the column. In all the soil columns the same percentage of moisture existed at a distance of a few inches from the level of the water. The different methods of cultivating the soil and of aeration caused no alteration in the moisture content.

In the horizontal soil columns, with a vertical line of 100 m/m to the horizontal surface, it is observed that the highest degree of moisture is generally, though not necessarily, present at the further end of the pipe, in close proximity to the water. A moderate percentage exists at a distance from the water equal to half the length of the pipe ; its distribution alters when the water reaches the outer end. In columns that are inclined towards the base, the highest percentage is present at the top of the pipe when the force of gravity and capillarity act simultaneously. The total quantity of moisture contained is a good deal less than the capillary saturation. If the flow towards the base is stopped by an impervious layer, the content of moisture above this is equal to that observed in a vertical soil column with the water level at the surface of this layer.

A. F.

The Theory of the Mechanical Analysis of Sediments by means of the Automatic Balance.

FISHER, R. A., and ODEN, Prof. SVEN. *Proceedings of the Royal Society of Edinburgh*, Vol. XLIV, Part 2, pp. 99-115. Edinburgh, 1924.

In 1916, in a paper on the size of the particles in deep-sea deposits, Odén showed that the distribution by mass of a suspension into classes of particles of different size could be inferred from a study of the course of sedimentation of such a suspension from a state of uniform dispersion in water.

In the article now published, the authors have set forth, in a more complete form than has hitherto been attempted, the theory of the derivation of the distribution curve and the statistical methods appropriate for its deduction from the physical data.

A summary of the conclusions drawn is as follows :

(1) A simplified mathematical statement of the theory of sedimentation through a stationary fluid, leads to the formula indicated by Odén,

and shows that the characteristic distribution of the sediment may be obtained:

(*a*) from the variation of density with depth;
(*b*) from the rate of change of density at a given depth;
(*c*) from the variation of hydrostatic pressure with depth;
(*d*) from the rate of change of hydrostatic pressure at a given depth.

The last relationship affords the theoretical basis of the sedimentation method.

(2) Schloesing's sedimentation is incomplete, and leads to errors.

(3) Statistical problems arise in the reduction of sedimentation data derived from the automatic balance, and data from two duplicate experiments are utilised to examine into the experimental errors actually present.

(4) Two types of fluid motion appear to influence results:

(*a*) A vertical circulation set up by the initial disturbance of the fluid. This may be remedied by using fluids of higher viscosity.

(*b*) Convection currents of unspecified type will become important in prolonged experiments, where the finer particles are being studied. Great experimental refinement may be necessary to avoid these; their effect should be reduced by maintaining the temperature of the water as close as possible to its temperature of maximum density.

W. S. G.

Investigations on the Rate of Outflow of Granular Substances.

SCHULTZ ZUR OVEN, G. Untersuchungen über das Ausfliessen von Körnungen.

LANGHANS, in his investigations on the angle of inclination (*Kolloid Zeitschrift*, Vol. XXVIII, 3), found that each powder or granular substance has a characteristic angle of inclination, and recommends the determination of this angle for the identification of food-stuffs, powders, etc. According to LANGHANS the angle of inclination depends on the specific gravity, friction coefficient and size of grain of the substance. According to BOUSSINESQ (*Beibl. z. d. Annalen*, Vol. 6, 1919), the flow of the sand through an hour-glass, with a suitable size of grain, depends on the form and dimensions of the vessel, not on the height of the sand itself. For a number of substances: kaolin, sand, loam, loess, chalk, clay, slate, corundum, glass, I have accurately tested the flow through suitable vessels, in order to determine the importance, as affecting the outflow of the particles, of the specific gravity, size of grain, form and nature of the surface of the particles, and the shape of the vessels. For the tables, illustrations, graphs and full text, see my Dissertation, Giessen, 1912.

The following is a summary of the results:

(1) The specific weight has no decisive influence on the outflow of dry particles.

(2) The speed of the outflow does not depend on the height of the material in the vessel.

(3) It is however dependent on the shape of the vessel, on the size of

the grain of the same material, on the shape of the particles and the nature of their surface; for speed of the outflow of the different fractions of the same substance there is an optimum. AUTHOR.

A Note on Soil Shrinkage.

FISHER, E. A. *Journal of Agric. Science,* 14. 126-132, 1924.

A critical review of W. B. HAINE's theory on the progress of soil shrinkage after the drying of the soil (*Journal of Agric. Science* 13, 296). From the results of this investigation the importance of the critical water content, i. e. the water content at which rapid evaporation ceases to be constant, and the divergence between the lower part of the moisture curve and the corresponding part of the vapour pressure curve, can for the first time be accurately defined. BERJU.

Method for Determining the Permeability of Colloid-Dispersing Substances under the Influence of Electrolytes.

SCHULTZ ZUR OVEN, G. Methodisches zur Untersuchung der Durchlaessigkeit Kolloiddisperser Substanzen unter der Einwirkung von Elektrolyten.

The apparatus used by HISSINK for determining the permeability of the soil under the influence of various salt solutions (*Int. Mittl. für Bodenkunde* Vol. 6, 1916) does not sufficiently prevent the escape of the colloid-dispersing particles. In the method used by the writer, both the utility of a porcelain filter and also that of DE HAEN's membrane filter were tested, and it was found that a certain type of membrane filter does not allow the dispersing particles to pass through, so that it is possible to work on a large scale with these " ultra " filters (1). Reference should here be made to a work by W. WENSE, the expert in filtration technique (*Zeitschrift für angewandte Chemie* 1923, No. 47-8, pt. 310), in which the difficulties and inconveniences often arising in the filtration of highly dispersive suspensions are mentioned, and effective measures of precaution and practical hints given.

The use of a high suction pressure increases the rate of filtration, but even then a slackening of speed very soon takes place. The use of tubes over the membrane gives but slight results and of short duration; the use of a broad, soft brush, with which from time to time the " obstructing layers " may be removed from the membrane, and perhaps also particles blocking the pores, proved to be more effective; but even then the advantage gained is not great. On the other hand, the cleaning of the pores by driving a current of air and water through them was quite effective. The advantage gained through the water current was, however, due to the increased volume of water passing over the membrane, partly negatived as regards the total duration of filtration. The greatest rate was attained by a regular alternation between filtration and air-current. The conven-

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(1) More detailed information may be had from the writer's dissertation (Giessen, 1921).

iently placed taps on the apparatus made possible very accurate and effective working.

The local conditions of soils are due to the varying dispersion of the soil colloids. Granulation, i. e., the formation of the larger soil particles is largely dependent on the nature of the electrolyte with which coagulation is effected. In suspensions of colloidal soil particles, as well as in Berlin-blue sol, the rate of filtration proved to be dependent on :

(1) The degree of dispersion. — With increasing sedimentation the speed decreased; the hydrostatic level played a subordinate part in this connection.

(2) The electric chargeability of the dispersed particles. — It was important first to determine the chargeability of the dispersum before commencing the test, or, as is easily possible with Berlin blue, to produce a clearly defined electric material. The differences in the series of tests with positive and negative electric material are very great, as will be seen from the graphs and the sedimentation determinations made on the interruption of the experiment.

There are no essential differences between sol and gel as regards the influence of the electrolyte.

The variation in dispersion brought about in the sol does not cease in the gel, so that here it is a case of a merging of the series of phenomena into one another, it being assumed that the optimum of the structural change had not yet been reached in the sol.

A structural change in colloidal systems is adopted in agriculture when, for instance, it is necessary to lime a soil. Here the absence or presence of soil acidity, as tests with acid and neutral loess have shown, plays a prominent part. The degree of soil dispersion is heightened by potash ions, for calcium ions are supplanted by them and the soil cakes over. This interchange of bases is reversible.

(3) The influence of the electrolyte concentration. Until expansion takes place the size of the coagulated particles is largely dependent on the electrolytic concentration, but this influence appears to be of secondary importance.

(4) The nature of the electrolytes. Both cations and anions come into action during the coagulation; the cations appear to have the greatest influence. The diminishing influence of the electrolytes on the dispersion phase is dependent on the chargeability of the dispersum and very particularly on the atomicity of the electrolytes. AUTHOR.

Investigations on Alkali Soil and Colloidal Phenomena.

JOFFE, J. S. and McLEAN, H. C. (New Jersey Experiment Station). *Soil Science*, Vol. XVII, No. 5, pp. 395-409, figs. 2. Baltimore, Md., 1924.

The work hitherto done on soil alkalis had a purely practical scope and and was based on empiricism. Only in recent times in Russia has a series of investigations to discover the origin of soil alkalis and reaction been begun. Such knowledge is necessary before undertaking any scientific treatment. An important feature of the recent investigations is the estimation of the colloidal nature of some phenomena inherent in soil alkalis. The following conclusions may be drawn from the authors' investigations. The positive and negative absorption of the soil and soil solution system is of great importance for the washing out of the soluble substances. A negative absorption is desirable in alkaline soils. The coagulation of the colloids increases the surface tension of the extract and modifies the physical conditions of alkaline soils, which modifications show themselves by the capillary ascent of the water and the soil's permeability to water. In the investigations on the effects of alum and sulphuric acid on the coagulation of the alkali soil colloids, the authors have observed that the combined effect of both such substances is greater than that of either of them separately. At pH 4.7, coagulation is almost instantaneous, which indicates that this is probably the isoelectrical point. The alkaline soil colloids are charged negatively and then precipitated from the colloids with a positive charge, or by electrolytes with high-power cations. The dispersal phase which affects the surface, influences evaporation; the vapour pressure of the extracts undergoes little alteration from the various treatments.

In normal soils, the colloids serve to retain various constituents and therefore delay washing out; in alkaline soils, this colloidal property reduces the permeability and aeration of the soil and increases its power of retaining substances, thus bringing about the accumulation of the salts after dessication.

A. F.

Soil Climatic Conditions and Clay Silicates.

GANSSEN, R. (Gans.) Die Klimatischen Bodenbedingungen der Tonerdesilikatgesteine. *Mitteilungen, aus den Laboratorien der Preussischen Geologischen Landesanstalt* part 4, pp. 32. Berlin, 1922. (Published by the Preussischen Geologischen Landesanstalt, Berlin, No. 4, Invalidenstrasse 44).

In this work the author discusses the decomposition of clay silicates. Three kinds of weathering are described:

(1) the weathering of clay;
(2) the weathering of laterite;
(3) weathering by hydration.

The author describes in detail the methods for determining the various types of decomposition, and then discusses the chemical processes which take place in connection therewith.

(1) The weathering of clay in moist, cool and temperate zones:

$$\underbrace{2\,(6\,SiO_2\,.\,Al_2O_3\,.\,K_2O)}_{\text{(potash feldspar)}} + x\,H_2O = \underbrace{4-6\,SiO_2\,.\,Al_2O_3\,.\,K_2O\,.\,m\,H_2O}_{\text{(zeolitic silicate)}} + \underbrace{2\,SiO_2\,.\,Al_2O_3\,.\,2\,H_2O}_{\text{(kaolin silicate)}} + \underbrace{3-6\,SiO_2\,.\,K_2O\,.\,n\,H_2O}_{\substack{\text{(soluble potash silicate,}\\ \text{eliminated in partly clear,}\\ \text{partly colloidal solution).}}}$$

(2) The lateritic or clay-lateritic decomposition in semi-moist, torrid, and temperate zones :

(*a*) purely lateritic decompositions :

$$\underbrace{6\,\mathrm{SiO_2\,.\,Al_2O_3\,K_2O}}_{\text{(feldspar)}} + x\,\mathrm{H_2O} = \text{(primary process)}\ \underbrace{6\,\mathrm{SiO_2\,.\,Al_2O_3\,.\,K_2O\,.}\,m\,\mathrm{H_2O}}_{\text{(zeolitic silicate)}} + y\,\mathrm{H_2O}$$

$$= \text{(secondary process)}\ \underbrace{\mathrm{Al_2O_3\,.\,3\,H_2O}}_{\text{(hydrargillite)}} - \underbrace{6\,\mathrm{SiO_2\,.\,K_2O\,.}\,n\,\mathrm{H_2O}}_{\substack{\text{(soluble silicate,}\\ \text{eliminated)}}}$$

(*b*) clay lateritic decomposition :

$$\underset{\text{(feldspar)}}{6\,\mathrm{SiO_2\,.\,Al_2O_3\,.\,K_2O} + x\,\mathrm{H_2O}} = \left\{\begin{array}{ccc} \textit{primary process} & & \textit{(secondary process)} \\ 4\text{-}6\,\mathrm{SiO_2\,.\,Al_2O_3\,.\,K_2O\,.}\,n\,\mathrm{H_2O} & \longleftrightarrow & \mathrm{Al_2O_3\,.\,3H_2O}\ \text{(Hydrargillite)} \\ \text{(zeolitic silicate)} & & 4\text{-}6\,\mathrm{SiO_2\,.\,K_2O\,.}\,n\,\mathrm{H_2O}\ \text{(soluble silicates liberated).} \\ & + y\,\mathrm{H_2O} = & \\ + 2\,\mathrm{SiO_2\,.\,Al_2O_3\,.\,2\,H_2O} & \longleftrightarrow & + 2\,\mathrm{SiO_2\,.\,Al_2O_3\,.\,2\,H_2O}\ \text{(kaolin silicate, unchanged in secondary process).} \\ \text{(kaolin silicate, unchanged by further influence of water).} & & \end{array}\right.$$

(3) Decomposition by hydration in arid and semi-arid zones :

$$\underbrace{6\,\mathrm{SiO_2\,.\,Al_2O_3\,.\,K_2O}}_{\text{(feldspar)}} + x\,\mathrm{H_2O} = \underbrace{6\,\mathrm{SiO_2\,.\,Al_2O_3\,.\,K_2O\,.}\,n\,\mathrm{H_2O}}_{\text{(zeolitic silicate)}}.$$

In addition to the factors of heat, precipitation and evaporation, the effect is discussed of the composition of the underlying rock on the type of decomposition, and the reaction of the resulting soil.

H. HALLER.

Soil Reaction in Relation to Calcium Adsorption.

SWANSON, C. O. (Kansas Agricultural College). *Journal of Agricultural Research*, Vol. XXVI, No. 3, pp. 83-123, figs. 7, tab. 23. Washington, D. C., 1923.

The author observes that acid soil reaction is not determined by organic substances. Indeed, the pH values are the same before and after soil burning ; further, a certain quantity of oxalic acid may be added to the soil without changing H-ion concentration. The addition of a slightly ionized acid, on the contrary, heightens OH-ion concentration, probably through the formation of salts of a weak acid with a strong base.

The cause of acid soil reaction should be looked for instead in chemical phenomena connected with the climatic factors which lead to soil formation. There is more probability of its acidity when the yearly rainfall is in excess of evaporation, whereas when the contrary is the case there is a tendency to alkalinity. The cause of the acidity is to be looked for, therefore, in the carrying off of the bases and especially of calcium, which takes place in the decomposition of the silicates. Under such conditions vegetation languishes since calcium is necessary to plant growth and development. The addition of calcium in the form of Ca $(OH)_2$ to such soils tends to reestablish the former conditions. In these processes it is a question of adsorption more than of chemical combination.

It may therefore be concluded that the presence of aluminium silicate brought about by the influence of climatic factors causes the adsorption of the calcium of Ca $(OH)_2$ and $CaCO_3$. The washing out and treating with acids, which may be considered as an exaggeration of climatic factors, increases the soil's power of adsorption. The latter is therefore dependent on the aluminium silicates which are formed in such processes and may be considered as a phenomenon of base substitution. The adsorptive power of aluminium silicates is greater for calcium than potassium. A. F.

On the Measurement of the Hydrogen-ion Concentrations in Soil by means of the Quinhydrone Electrode.

BIILMANN, EINAR. *Journal of Agricultural Science*, 14, 232-39, 1914. (Compare CHRISTENSEN and HARALD, *Intern. Mitteilungen für Bodenkunde*, 14, p. 2. 1924).

Hydrogen-ion Concentration in Soil and Lime Requirement.

JONES, J. S. (Oregon Experimental Station). *Soil Science*, Vol. XVIII, No. 1, pp. 65-74, bibliography. Baltimore, Md., 1924.

Crops are possible within certain limits of hydrogen-ion concentration, beyond which, however, the soil must be improved in order to bring it to the necessary concentration. Such investigations, however, though important, are generally neglected in the examination of soil. The author has made this determination on many soils, using the colorimetric method, which has given results in accord with the electrometric method, and has compared the values thus obtained with the lime requirement of soils.

Generally, if the hydrogen-ion concentration varies considerably in the same soil type, with the exception of two or three samples, which represent perhaps the extreme types, there is a remarkable uniformity in all the others. Alfalfa and clover crops may succeed well within rather wide limits of hydrogen-ion concentration. There is no relation therefore between this and lime requirement. A. F.

Investigations on Soil Minerals and their position in the Speier Stratum and Soils of the Kusel Beds as shown on the Geological Map (1 : 100,000).

(Untersuchungen ueber Gesteine und ihre Lagerung auf Blatt Speyer und Böden auf Blatt Kusel der geologischen Karte 1 : 100 000). *Geognostische Jahreshefte*, 35th Year, Munich, 1923.

In the previous Palatinate number of the Bavarian Geological and Agricultural Institute an important place is assigned to soil science investigations. OTTO M. REIS writes at length on the stratification and geological character of the various alluvial, loess, tertiary, coloured sandstone, shell-lime and lower red sandstone soils, while H. NIKLAS and A. HOCK treat of the soil reaction and need of lime of the Speier beds. H. NIKLAS shows, from the results of investigations, that the soil reaction is more or less influenced by the geological structure, while OTTO M. REIS is of opinion that soil acidity is not so much caused by the formation, as by the important factor of the presence or absence of a forest growth, or the fact that it was a forest soil in a not distant past. Indeed, a soil becomes acid not in consequence of its petrological character, but through the influence of the plants which cover it, or the agricultural uses to which it has been put.

In comparing the different methods for testing soil reaction and its need of lime, many interesting facts come to light. Thus, as NIKLAS says, the need of lime does not depend on the existing quantity of lime, but on the buffer action of the soil, and what reaction it causes. The alluvial and loess-loam soils show the least hydrogen-ion concentration. Bunter sandstone and lower red sandstone, on the other hand, prove, in all the tests, to be acid. From the total acidity estimated by titration with $^1/_{10}$ N. alkaline soda solution, the quantity of lime necessary to neutralise the acidity was estimated, and thus the lime requirement of the field was determined. The titration of the soil acidity by DAIKUHARA's method gave no reliable values, for the iron, and especially the aluminium hydroxide, formed colloidal compounds with the acid, which escaped titration. Neutral soils require a particularly searching test as regards their lime requirement. In CHRISTENSEN's azotobacter test, the five-days' treatment is decidedly preferable to the three-days' treatment, as was shown by the tests.

While the upper red sandstone soils in the Speier beds tested by NIKLAS are really all acid, there are, in the lower red sandstone of the Lautertal, between Olsbruecken and Wolfstein (Kusel beds), according to OTTO M. REIS, also alkaline soils near those which are acid. But the $CaCO_3$ content, determined by PASSON's method, was negative everywhere, and only once was a trace found of $CaCO_3$. In spite of this, the percentage of CaO content can be estimated at 0.41 %. These results show how carefully PASSON's lime test should be used. The only acid soil among the samples with 0.05 % CaO was taken from forest land.

Field crops, as is well-known, except on soil of the most marked lime formation, imply no surety against acidity, especially when physiologically acid artificial fertilisers are used.

HERM. FISCHER.

Importance of Hydrogen-ion Concentration in Physico-Chemical Studies of Hevea Soils.

BRADFIELD, R. (Agricultural Experiment Station, University of Missouri). *Soil Science*, Vol. XVII, No. 5, pp. 411-422, Fig. 6, bibliography. Baltimore, Md., 1924.

The author in this article discusses the flocculation of clay and the effect of hydrogen-ion concentration upon the absorption and exchange of bases. The importance of this in a physico-chemical study of soils is pointed out and its practical results. A. F.

Changes in the Chemical Composition of Soils in Cylinders after long continued Treatment.

Blair, A. W. and Prince, A. L. (New Jersey Agricultural Experiment Station). *Soil Science*, Vol. XVIII, No. 1, pp. 31-32. bibliography. Baltimore, Md., 1924.

The chemical composition of the soil continually changes, but our methods of investigation are not sufficiently delicate to follow such changes unless the determinations are made continuously over a long period of years.

The authors have investigated the problem with the cylinder method, already described in Bulletins Nos. 221 and 288 of the New Jersey Agricultural Experiment Station. The investigations covered a period of 25 years, various fertilising treatments being applied and both the soil and the crop analysed.

Phosphoric anhydride. — The quantity present in the soil, plus that carried away by the crop, is rather less than that generally present in the soil plus that added by fertilising. Supposing the fertiliser contains 100 lb. per acre, the loss is 13 lb. per acre. By doubling the addition of phosphoric anhydride, a larger crop is obtained, but the loss is three times greater. It must be concluded that the phosphoric anhydride is carried away by drainage water. When this fertiliser is applied in large quantities it may accumulate in the soil, which may be injurious.

Potash. There is generally a loss, notwithstanding applications of potash. Soils containing 2.6 % at the outset only contained 2 % at the end of the test. The loss was caused through the crops and the drainage water; the more abundant the fertilising in general, the greater is the loss under both these heads.

Lime. In the cylinders in which lime was not added, a decrease of the latter was observed; the loss was greater in that in which sulphate of ammonia only, without lime or farmyard manure, was used. With few exceptions, the cylinders in which lime was added showed an increase of the latter.

Magnesium. It was not applied as a fertiliser, but only added as a lime impurity and with farmyard manure. A decrease of from 2.24 % to 1.5 % was noticed.

Reaction. The soils in all the cylinders where lime was not added became acid. The lime requirement is reckoned at from 1400 to 2800 lbs. per acre; the pH value varied from 4.9 to 6.2 %. The cylinders in which lime had been added, on the other hand, showed no need of lime; their pH was from 6.5 to 7.3. The continued use of acid phosphates did not cause acidity.

Among the cylinders where lime had not been added, the greatest need of this was observed in that treated with sulphate of ammonia only; the soil became so toxic that not a single plant reached maturity.

A. F.

Comparison of the Soil Solution by Displacement Method and the Water Extract of Alkali Soils.

HIBBARD, P. L. (University of California, Agricultural Experiment Station). *Soil Science*, Vol. XVI, No. 6, pp. 465-471, bibliography. Baltimore, Md., 1923.

Two methods in use for the analysis of the soluble elements of soil are :— the " Solution ", obtained by the displacement method, and the " Extract ", obtained by mixing with the soil a quantity of distilled water almost entirely free from CO^2, equal to five times its weight, after which the Pasteur filter is used. Experiments carried out by the author indicate that the water extract does not represent the actual conditions in the soil, as the figures recorded for carbonate, bicarbonate and phosphate are higher than those actually existing. The data registered for chlorine, sodium and nitrate are approximately correct ; sulphate and potassium show an excess, while the data given for calcium and magnesia may be either too high or too low. The geo-chemical classification shows that the water extracts contain a relatively higher proportion of sodium salts, whereas calcium and magnesium salts are less abundant than in the real solution. The latter makes the soil appear more suitable for the growth of plants than does the water extract method. A. F.

The Rapid Determination of Available Phosphate in Soil by the Coeruleo-Molybdate Reaction of Denigès.

ATKINS, W. R. G. *Journal of Agric. Science* 14, Part 2, 192-197, 1924.

In determining the P_2O_5 in saturated soil extracts, 10 gm. of air-dried soil, which had been passed through a 100-mesh sieve, were shaken with 50 cc. of water, 10 cc. of the extract being centrifuged until clear, and 5 cc. of this extract was made up to 100 cc. and reduced by the following reagents : (Reagent A) 100 cc. 10% ammonium molybdate + 300 cc. 50 per cent by volume, H_2SO_4. (Reagent B) 0.1 gm. tin after the addition of one drop of a 4 % copper sulphate solution, was dissolved by 2 cc. pure HCl, and after solution of the Sn the whole was made up to 10 cc. For every 100 cc. of the extract prepared as above, 2 cc. of reagent A and 5 drops of reagent B (which must be freshly prepared every day) were added. With a similar quantity of these reagents a control solution was prepared containing 0.05 or in some cases 0.5 mg. of P_2O_5. After the addition of the reagents the solution assumed a blue colour, which attained its maximum intensity after 5 minutes. The colorimetric tests can be made in a simple manner in 100 cc. HEHNER cylinders. Faults through slightly coloured extracts, which impart a green colour to the blue solution, can be corrected by the addition of a few drops of a dilute solution of Bismark brown to the test solution. The method allows the P_2O_5 in the soil extract (1 : 5) to be determined even after considerable dilution. High phosphate contents were found in the samples taken from bog peats. In the majority of the soils examined, less than 2 parts of water-soluble P_2O_5 were contained in 1 million parts of soil. Manured soils contained

20 or more parts. A 3-4 hours' extraction gives the same P_2O_5 content in ordinary soils with a low P_2O_5 content, as a 4-7 days' extraction. In soils rich in P_2O_5 on the other hand, the solubility of the P_2O_5 appears to be retarded by lengthened extraction and may undergo reversion to an insoluble form during prolonged extraction.

BERJU.

The Determination of Nitrates in Soils.

HARPER, HORACE J. (University of Wisconsin, Madison, Wis.). *Industrial and Engineering Chemistry*. Vol. 16, No. 2, pp. 180-183. Washington, D. C.

Among the various methods proposed for the determination of nitrates in soils, that of phenoldisulphonic acid is most used because it is the simplest and quickest. It presents various difficulties however: (1) that of obtaining a perfectly clear and colourless extract, which is absolutely essential; (2) of obviating the losses in nitrate which occur, from various causes, during the determination; (3) of making an exact comparison between the sample solution of known value, and the solution under examination, avoiding the use of reagents which interfere with the process.

In these notes the Author reports an accurate analytical process for obviating this difficulty, which ensures the most exact results being obtained. To obtain a perfectly clear and colourless extract, the Author, basing on practical tests repeatedly made on different types of soil, suggests as most suitable in all cases the use of the sulphate and hydroxide of copper, which serve as excellent colorising and clarifying agents. The losses in nitrates during the determination process, as has already been observed by other experimentalists, chiefly takes place: (1) *through absorption* by certain decolorising and clarifying agents (e. g. the various kinds of decolorising carbons, aluminium hydroxide, etc.); (2) *through evaporation* when the extract obtained and which evaporates is acid; (3) through the presence of other salts in the extract, such as carbonates and chlorides, the latter only if found in the soil in quantities of more than 15 parts per million. To reduce to a minimum this loss in nitrates the Author proposes: to use copper hydroxide as a decoloriser, bring that portion of the extract which is to be evaporated to a distinctly alkaline reaction, and if necessary, set free the chlorides, precipitating with silver sulphate, and finally, when evaporation has taken place, add to the dry precipitate obtained 3 cc. of phenoldisulphonic acid in such a way that the whole of the precipitate, from the centre to the periphery, is completely saturated by the reacting agent. The presence of colorisations, which prevent an exact comparison being made between the nitrate solutions of known value serving as controls, and the solution under examination, is due either to the presence of organic substances or of insoluble salts in the precipitate, or to an irregular use of the various reacting agents.

By using copper hydroxide the colorisation due to organic substances is absolutely excluded. As to the other causes, to obviate them it suffices to follow out the process exactly.

L. M.

Iron, Aluminium and Manganese in Hawaiian Soils.

McGeorge, W. T. (Experiment Station, Hawaiian Sugar Planters' Association). *Soil Science*, Vol. XVIII, No. 1, pp. 1-2, bibliography. Baltimore, Md., 1924.

Until now, the presence of free acids in soils has been considered the cause of their poor fertility. As a matter of fact, in the Hawaiian Islands, poor vitality in the roots of the sugar-cane and pineapple, the principal local products, has been met with in the highly acid soils. This however is associated with abundant quantities of soluble salts of iron and aluminium while on the other hand it has been found that the toxicity of certain acid soils must be attributed more to the presence of soluble salts of aluminium and manganese than to hydrogen-ion concentration. The principal characteristic of the Hawaiian soils, like many others of the acid type, is the absence of easily soluble salts of lime and magnesium and of soluble phosphates. Hence there is an accumulation of acid salts of iron, aluminium, manganese and of hydrogen-ions liberated by hydrolysis.

Soluble crystalloid salts of iron, manganese and aluminium were as a matter of fact found in soils with pH values below 5.8. With more than 6.0 pH, manganese is absent from the soil solutions, and iron and aluminium are only found therein as hydrosols of the hydrates of iron and aluminium.

The solubility of manganese as found by Comber's test is due to the greater hydrogen-ion concentration, obtained by treating the soil with sulphocyanate of alcoholic potassium. The solution of normal nitrate of potassium does not liberate the aluminium from the silicates, except in soils with less than 6.0 pH. A. F.

The Electrical Conductivity of Extracts from Soils of various Types, and its Use in Detecting Infertility.

Atkins, W. R. G. *Journal of Agric. Science* 14, Part 2, 198-203, 1924.

In determining the electrical conductivity of diluted soil extracts, 10 gm. of air-dried and sifted soil extract were diluted with 50 cc. of water, shaken and tested until there was no longer any appreciable alteration of the conductivity. In alkali soils, which showed the greatest conductivity, this took place after 6-14 days in soils with a slight salt content, and much sooner in peat soils, which showed a high conductivity. Acid soils generally showed but slight conductivity, which mostly reached its maximum after a short treatment.

Though a high salt concentration in the extract is no sure sign of soil fertility, it may however be concluded from the fertility data and the results of the tests, that the fertility is generally low in the case of such soils which exhibit very slight conductivity and show but little concentration of their liberated salts. On the other hand a high electrical conductivity of the soil extract may only indicate the presence of large quantities of liberated salts, and is not always necessarily a sure indication of the fertility of the soils in question. A rapid increase of conductivity in diluted extracts indicates on the other hand an increased liberation of salts, which is partly effected by bacterial action and may therefore be taken as a useful criterion in judging fertility. Low conductivity, which persists after long continued extraction, indicates that the soil is infertile.

BERJU.

Studies on Virgin and Depleted Soils.

MILLAR, C. E. (Wisconsin Agricultural Experiment Station). *Soil Science*, Vol. XVI, No. 6, pp. 432-448, bibliography. Baltimore, Md., 1923.

The greatest degree of solubility is found in virgin soils, as measured by the freezing-point method. Results of experiments continually proved this fact, which indicates that solubility gradually diminishes and forms an important factor in the transformation from virgin to depleted soils.

Generally speaking, solubility is apparent in lesser degree in the lower layers of soil than in those at the surface ; it is also greater in the lower layers of depleted soil than in the same layers of virgin soil. This tends to show that the greater number of crop plants absorb nourishment from the surface or ploughed layers.

Cropped soils yield a greater quantity of sulphates, while virgin soils gave larger quantities of iron, aluminium, calcium and magnesium.

The proportion in which various constituent matters are given up by soils is an important factor in determining their crop producing capacity.

A. F.

The Influence of Soil Organic Matter and Accessory Substances on Plant Growth.

CLARK, N. A. (Department of Chemistry, Iowa State College, Ames, Ia.). *Industrial and Engineering Chemistry*, Vol. 16, No. 3, pp. 249-250. Washington, D. C., 1924 (1).

The influence of soil organic matter on growth has been investigated from two points of view ; its direct and its indirect influence.

Greater attention has been paid by the various investigators to its indirect influence. Its direct influence, which may be nutritive, toxic or accessory, is more difficult to investigate, but is very important.

The author cites, among those who have investigated the direct influence of soil organic matter on plants, the names of SCHREINER and SHOREY, who in 1910-1912 carried out systematic investigations and isolated a certain number of compositions in a pure state. Some of these compositions, as for instance picolin carbosilic acid, had a decidedly toxic effect on corn, when added to a nutritive solution. Others, such as histidin, were beneficial, and some had no influence.

KNUDSON and CORNELL proved that sugar can be assimilated by maize and legumes and LIVINGSTON pointed out the efficacy of small quantities of organic substance, added to nutritive solutions, on the growth of maize.

The possibility of some soil organic substances influencing the growth

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(1) See also *R.* 1924, No. 596. (*Ed.*)

of green plants has been especially laid stress on by Bottomley in England. He even went so far as to admit that the addition of small quantities of organic substances, extracted from the soil, to the mineral nutritive element is absolutely essential to the life and reproduction of green plants. He gave the name of " auximones " to these accessory substances, and considered them analogous to vitamines.

The author continues by observing that it now seems an established fact that small quantities of organic substances influence the growth of green plants, but there are still doubts as to the nature of this influence. The question should be considered from two points of view: (1) these accessory substances are analogous to vitamines; (2) these accessory substances only accelerate growth.

The first point has been thoroughly investigated in the author's laboratory. It had to be proved whether green plants can or cannot live and reproduce themselves in the absence of these substances. The tests were especially made on *Lemna major* and *Lemna minor*, acquatic plants already examined by Bottomley.

Tests were made with various nutritive solutions. In Detmer and Knop's saline solution, without the addition of any organic matter, these plants live with difficulty, whereas on adding a small quantity of organic matter they show vigorous development and normal reproduction. The mineral salts contained in the solutions were evidently not suitable for the plants in question. In other tests, the Author, by making use of the three salts first proposed by Livingston (monocalcium phosphate, potassium nitrate and magnesium sulphate) in proper concentrations, succeeded in making *Lemna major* grow normally without any addition of organic matter. The tests prove that these accessory substances cannot be considered as essential to the life of green plants, as are vitamines to that of animals. The author concludes by saying that other investigations are being made in his laboratory with a view to finding out whether these accessory substances on the other hand accelerate plant growth.

L. M.

Influence of Organic Matter upon the Development of Fungi, Actinomycetes and Bacteria in the Soil.

Waksman, S. A. and Starkey, R. L. (New Jersey Agricultural Experiment Station). *Soil Science*, Vol. XVII, No. 5, pp. 373-378. Baltimore, 1924.

It has already been noted that the addition of organic matter to soil greatly increases the number of micro-organisms. The authors have systematically studied this phenomenon, making use of various organic matters, and estimating the quantity of micro-organisms by means of the plate method. It has been shown that all organic matter used greatly increases the number of micro-organisms, but not all to the same extent. The action of dextrose is to increase especially the number of bacteria; cellulose, increases fungi; rye straw and alfalfa meal favour both bacteria and fungi; dried blood increases fungi, bacteria and actinomycetes. The addition of nitrate of sodium to the straw treated soil, increases the number of fungi, without altering that of bacteria; alfalfa increases the number of organisms more effectively than straw, and blood acts still more strongly. The number of fungi increases more in acid soils than in those where the reaction is almost neutral. The numbers of organisms reach a higher point in fertile soils than in less fertile soils. These observations confirm the work done by other investigators, according to whom bacteria thrive most on the dextrose, while fungi mostly develop on cellulose, pentose and other complex carbohydrates.

The majority of bacteria require less nitrogen than do fungi, which require it for building up their mycelia. Cellulose is not attacked by most soil bacteria but is rapidly acted upon by numerous kinds of soil fungi; for this however the presence of nitrogen is required. A. F.

Study of Microbic Flora in Soil.

MARTIN, T. L. (Brigham Young University). *Soil Science*, Vol. XVI, No.6, pp. 475-477. Baltimore, Md. 1923.

The author in his experiments used as green manure rye, oats and buckwheat harvested at three different stages of growth, and made careful observations of the effect on the various microorganisms of the soil. It was shown that non-spore-formers are in a majority in normal soil. The addition of green manures increases the number of the micro-organisms. The fresher the manure the larger the number of actinomycetes as compared with other organisms; there is also less effect on spore-forming organisms.

It would seem therefore that the actinomycetes form a special factor in the decomposition of cellulose.

It is probable that a study of the effects of the various treatments of soil and their relation to various microorganisms, will supply useful data and thus lead to better knowledge of the different soil phenomena.

A. F.

Nitrogen Fixation in Soil and Mannite Decomposition.

WAKSMAN, S. A., and KARUNAKAR, P. D. (New Jersey Agricultural Experiment Station). *Soil Science*, Vol. XVII, No. 5, pp. 379-393, figs. 3, Bibliography. Baltimore, Md., 1924.

There is a definite relation between nitrogen fixation of soil and soil productivity as well as between productivity and other bacterial activities. The presence of an excess of available carbohydrates, such as mannite will further the growth of microorganisms which will decompose the mannite and obtain the necessary nitrogen from the air. Nitrogen fixation, when an excess of an available source of energy is added to the soil, depends on the microbial flora of the soil, on chemico-physical conditions, more especially on the soil reaction and on the presence of available salts of potassium and phosphates. Next to nitrogen, phosphorus is the most important element in the nutrition of plants: none of the methods used up to the present, gives any real idea as to the quantity of available phosphorus in the soil. This can be done by the method discussed in this paper, namely by measuring the nitrogen-fixing or mannite decomposing power of the soil. A. F.

Bacillus botulinus and *Bacillus tetani* in Soil Samples.

HALL, I. C. and PETERSON, E. C. (Department of Bacteriology, University of California). The Detection of *Bacillus Botulinus* and *Bacillus Tetani* in Soil Samples by the Constricted Tube Method. *Journal of Bacteriology*, Vol. IV, No. 3, pp. 201-209, bibliography. Baltimore, Md., 1924.

The constricted tube method, employing a medium of glucose meat mash, has proved satisfactory in the detection of *B. botulinus* and *B. tetani* in soil. Seventy per cent. of arable soil samples gave toxic filtrates; 65 % contained *B. botulinus*, and 20 % *B. tetani*. These records are of considerable importance, pointing out the origin of *Bacillus botulinus* in preserved foods. A. F.

The Soil Protozoa and their Effect on Crops.

NOVIKOFF, M. (Die Bodenprotozoen u. ihre Bedeutung fuer die Bodenkultur). *Akten der von Portheim-Stiftung*. Heidelberg, 1923.

The earliest information on soil protozoa was given by EHRENBERG (1837) and GREFF; this was, however, quite forgotten and these soil organisms did not arouse attention again until the 20th century. E. J. RUSSELL and H. B. HUTCHINSON (Partial Sterilisation of Soil — *Journal of Agric. Science*, Vol. III, 1909) either quickly dried the soil samples kept at a temperature of 55°-60° C., or treated them with reagents prejudicial to organisms. By this partial sterilisation the soil was entirely freed of protozoa, but not of bacteria, which increased rapidly owing to the disappearance of their enemies.

The protozoa might therefore be considered as soil parasites and soil fertility might be increased by their destruction.

KOCH, in his works published in the *Journal of Agric. Research*, Vols. IV & V., 1915, arrived at results somewhat different from the above mentioned. The soil protozoa found by him were the following:

Flagellates:	*Euglena sp.*
	Monas guttula
	Monas vivipara
	Peranema trichophorum
Rhizopods:	*Amoeba radiata*
	Trinema euchelys
Ciliates:	*Paramaecium* sp.
	Colpoda cucullus
	Colpidium colpoda
	Nassula elegans
	Uroleptus musculus
	Vorticella sp.

Glaucoma sp.
Enchelys pupa
Prorodon ovum
Condylostomum patens.

In order to separate the protozoa from the particles of soil, GODEY had already subjected a small quantity of soil to the action of the electric current and had drawn the active, i. e. non-encysted forms, to the cathode. RUSSELL and GOLDING succeeded in separating them by twice centrifuging the soil sample, suspended in water. MARTIN (*Phil. Trans. R. S., London,* Vol. 205, 1914) recommended mixing the soil with picric acid, whereby the active protozoa are brought to the surface.

KOCH however prefers the simple microscopic examination of the soil sample held in snspension in a little water. In this connection it should be observed that at 22°-24°C. the smaller infusoria develop from the cysts in 1-2 hours, the flagellates in 6-8 hours, the larger infusoria only after 40 hours, while in the well-manured, constantly moist green-house soil active forms are always to be found, which are absent in the normal, moist field soil.

These results of American investigations are diametrically opposed to those of FRANCE as regards the protozoa, who considers "that the edaphon is an indicator of soil fertility". NOVIKOFF rightly points out that the edaphon does not, like the plankton, form living communities enclosed within themselves; hence they cannot, without further explanation, be placed in the same category.

The author therefore solved the problem experimentally by investigating the free and the encysted protozoa living in the soil, as well as their oecology, their relations with bacteria and the conditions under which the cysts pass into the free state, and finally also investigated the influence of different artificial fertilisers on the soil protozoa.

Cultures of *Amoeba limax* on agar-gelatine were successfully obtained, this being of special importance in solving the problem. Later, the list of protozoa living in field soil has proved to be much greater than the works of KOCH and FRANCE led one to suppose. The following active and encysted forms were identified:

Flagellates: *Euglena viridis*
" *acus*
Monas guttula
" *vivipara*
Oicomonas
Bodo edax
" *saltans*
Astasia
Peranema
Heteronema
Rhizopods: *Amoeba limax*
" *radiosa*
" *verrucosa*

Trinema
Difflugia
Arcella vulgaris
Englypha
Centrophyxis
Mastigamoeba (1)
Ciliates : *Paramaecium anzelia*
'' *caudatum*
Colpoda cucullus
Colpidium colpoda
Nassula elegans
Uroleptus musculus
'' *dispar*
Vorticella nebulifera
'' *microstoma*
Glaukoma
Stilonichia
Urostila
Halteria
Oxytricha
Aspidisca
Chilodon
Plematricha
Urotricha factra
Pleuromema
Lacrimonia olax

All these animal forms belong to the freshwater fauna, and are therefore not edaphic. They live in the soil as it is a suitable medium for their existence, owing to the presence of minute water reservoirs.

They are but little affected by the drying of the soil. At the Moscow Agricultural Institute there were soils which had been dry for 10 years and still contained living cysts; similarly, frozen soils on thawing yielded good cultures of protozoa. Nevertheless, with regard to active forms, moisture is of the greatest importance.

In estimating the importance of the soil protozoa in agriculture, NOVIKOFF's discovery is important, namely, that the number of active protozoan forms existing in nearly all very moist soils is not great (*Colpoda cucullus, Colpidium colpoda, Uroleptus masculus, Vorticella nebulifera, Urotricha factra, Pleurotricha* and *Amoeba limax*).Though these protozoa cause wholesale destruction among the useful soil bacteria, yet, according to NOVIKOFF, this disadvantage should not be very great, for these enemies of bacteria only develop largely in saturated soils, whereas in normally moist soils they usually remain in the encysted state. It must also be considered that the injury done by the soil protozoa is compensated by their influence on the processes of soil decomposition and the formation of humus.

With reference to the question that protozoa are to be considered as

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(1) The number of the Rhizopods is much greater. (*Ed.*)

soil parasites or, as FRANCE believes, as an indication of its fertility, the author is of the opinion that the importance of the protozoa in normal soils may be compared with that of those few plants which may indeed indicate certain soil characteristics, but which have no further influence on soil fertility as far as agricultural purposes are concerned.

HERM. FISCHER.

Partial Sterilisation of Soil by Antiseptics.

MATTHEWS, A. *Journal of Agricultural Science*, 14, 1-57, 1924.

Quantitative tests were made of the antiseptic action of substances such as benzene and its homologues and derivatives, carbon disulphide, ammonia, formaldehye and chlorpicrin, on the soil protozoa, bacteria, fungi and eel-worms of the soil. Nearly all the substances quickly disappeared from the soil. The bacteria on the other hand are only reduced in number during the first few days, and then increase to a maximum, afterwards slowly returning to their normal number. In the better aerated and lighter greenhouse soils this process of increase and decrease proceeded much quicker than in field soils, and the greater the molecular weight and heat of combustion of the antiseptics, the quicker the increase generally. The increase in the number of bacteria was independent of the effect of the antiseptics on the protozoa. Both naphthalene and toluene in large quantities, caused a considerable increase in the bacteria, but the former had no influence on the number of protozoa, while the latter killed all the ciliates and amoebae. If the protozoa were killed by large doses of a suitable antiseptic, after a long period the bacteria were still further increased by a second dose. From these results the author concludes that the increase in bacteria is chiefly to be attributed to the feeding effect of the antiseptic on the bacteria and not to the destruction of the protozoa, and that the increased fertility observed by RUSSELL and HUTCHINSON is, in very large measure, a consequence of the decomposition of the soil organic matter, through the increase in bacteria. The increase in bacteria after liming or treating the soil with steam is similarly, partly caused by the decomposition of plant residues.The introduction of a CH_3 group in C_6H_6 decreases the toxic effect on the soil organisms, while a single Cl or nitrogroup increases both the toxic effect and the stability of the compounds in the soil.

BERJU.

Factors affecting the Growth of Crops on Acid Soils.

CONNER, S. D. (Purdue Experiment Station, Lafayette, Ind.). *Industrial and Engineering Chemistry*, Vol. 16, No. 2, pp. 173-175. Washington, D. C. 1924.

The author draws attention to the varying nature of soil acidity.

KAPPEN has distinguished: (1) *free* or *active acidity* (measured by the hydrogen-ion concentration); (2) *accessory acidity*, due to aluminium silicates, iron, manganese, (estimated by the action of a strong acid salt, e. g. nitrate of potassium); (3) *hydrolytic acidity*, which may be determined by deducting the accessory acidity from the total acidity (determined with lime water or by the acetate method).

The accessory acidity is most harmful to crops, as in the soil it causes the formation of hydrogen-ions, and aluminium-ions both recognised as injurious to the growth of crops. Acidity due to organic acids is only slightly injurious; it seems even that the organic substance reduces the toxicity of the other more active acidities. By Hopkins' (potassium nitrate) method the accessory acidity, which is for the most part mineral acidity, is measured. The total acidity (accessory acidity + hydrolytic or mineral acidity + organic acidity) is measured by Jones' (acetate of lime) method. By deducting the acidity obtained by Hopkins' method from that obtained by Jones' method, we have, very approximately, the amount of organic acidity. The author in his numerous tests has found that the formula $K = H^2/I - H$ gives *an excellent index for the correction of soil acidity*, both in the case of mineral and organic acidity.

The Author in giving the practical results of his tests, points out that the toxicity of acid soils is due as much to aluminium-ions as to hydrogen-ions. The results of his tests also show that some crops are more affected by aluminium-ions, others by hydrogen-ions.

In conclusion the Author, from the results of his practical tests, advises that, to correct this injurious effect on crops both phosphates and lime should be added to acid soils. L. M.

The Injurious After-Effects of Sorghum.

Brezeale, J. F. *Journal of American Society of Agronomy*, Vol. 16, No. 11, pp. 689-700. Geneva, N. Y., 1924.

The author made a study of the residual or after-effects of sorghum, which cause injury to plants of other crops that follow in rotation, and also the effect of sorghum on the physical condition of the soil.

The results of the experiments made indicate that: (*a*) The injurious after-effect of sorghum is due to the presence of a toxic substance formed during decomposition of the stubble; (*b*) this toxic body is readily volatilised or decomposed; (*c*) during the decomposition of the stubble the soil flora that generates carbon dioxide is, to a large extent, killed off; (*d*) with the cessation of the formation of carbon dioxide, a new equilibrium is established in the soil, in which the sodium zeolite exists in excess of the calcium salt and causes deflocculation of the soil.

W. S. G.

On the Mortality of Firs in the Wienerwald.

Leiningen, Prof. Dr. Wilh. Graf zu, Vienna. (Uber das Tannensterben im Wienerwalde). *Forstwirtschaftliches Centralblatt*, No. 5, pp. 173-183, Berlin, 1924.

After the dry years 1917 and 1922, the white firs of the Wienerwald were destroyed over large stretches of country, especially the older trees with shaky tops. The immediate cause of this wholesale destruction was generally considered to be the attacks of beetles and to some extent also, fungoid disease.

So far as its course may be seen at a glance, the damage followed a west to easterly direction, without it being possible however, to attribute a definite effect to the difference in rainfall, which diminishes towards the east. There was a tendency consequently to seek the cause of the damage, in part at least, in the soil, especially as the exposure to weather conditions seemed to bear little relation to the degree of mortality.

The soils of the Wienerwald very greatly in the sandstone (Flysh) zone ; they are partly marly, but mostly poor in lime, light (with subsoil of almost pure quartz sand) to very heavy ; the latter absorb large quantities of water, but dry out in summer to a great depth, becoming cracked and hard. Only the beech shows good growth on soils very poor in lime (optimum climatic conditions). The principal humus form is " Mull ", which gradually changes into humous soil. Nitrification proceeds quite regularly ; the more ornamental forest types were found to predominate (the CAJANDERS type). Some danger however lies in the fact that the fusiform roots of the white fir become stunted in heavy soils, through twisting back, and the root system of the beech also does not penetrate very deep ; both trees show their principal root development in the upper soil layers, which are very dry during the summer. On lighter soils the roots penetrate to the lower layers, so that there is no danger here as regards the summer water supply ; neither in this case is there any bending back of the roots. The analysis of the soil (by the ATTERBERG method) gave, for the heavy Wienerwald soils, a clay content which was almost as great as that of many red earths, which accounts for such a high degree of heaviness and impermeability.

From these and other considerations, such as the quantity of precipitation during the summer months, it may be safely concluded that, the mortality among firs in the Wienerwald is caused by the exceptionally low precipitation during the growth period of certain dry years ; that white firs thrive better on light soils than on heavy ones, and that the damage caused by insect pests and fungi on trees already in a very poor state must be considered as secondary only. Nevertheless, in consequence of a large increase of insects injurious to forest growths, this damage may afterwards, owing to beetles, become of primary importance. AUTHOR.

Soil Cultivation and National Farming.

SCHNEIDER, Cl. (Forestry and Farming Engineer). Bodenkultur und Binnenwirtschaft, plates 7. Helwingsche Verlagsbuchhandlung, Hanover, 1925. Price M. 2.40.

The author is investigating from the point of view of a universal synoptic scheme the statics of economic relations in world and national agriculture, to which there must be recourse on the basis of a kind of natural valuation by way of an intensive increase in soil productivity. Statistical tables and sketch diagrams show the necessity of keeping this end in view, to the attainment of which soil science indicates new and promising paths. New fields of enterprise are thus offered to technologists with the participation of capital in large scale cultivation, and new chances of employment to labour. The relations with the colonies and Turkey are carefully examined, and in connection with the scheme for intensive cultivation consideration is also given to ethics, education and art, all of which are furthered by improvements in the soil. Y.

Origin of Alkali Soils and Physical Effects of Treatment.

JOFFE, J. S. and MCLEAN, H. C. (New Jersey Agricultural Experiment Station). *Soil Science*, Vol. XVIII, No. 1, pp. 13-30, bibliography, figs. 8. Baltimore, Md., 1924.

Among the various theories on the origin of alkali soils, the authors examine that of GEDROIZ, according to whom, from the reaction of zeolitic soda with carbonate or bicarbonate of lime, zeolitic lime and carbonate of soda are formed, without the zeolitic portion entering into solution. Instead of which, it is a question of a phenomenon of adsorption. The reactions of the zeolitic portion are of a superficial character and it is clear therefore that the degree of particle dispersion is of considerable importance, especially in alkali soil, in which the colloidal content is high. According to HILGARD, the reactions between soda and lime compounds take place in the soil solution and are therefore of a purely chemical nature. DOMINICIS' theory is analogous to that of GEDROIZ: according to the former, the hydrogels, formed by a process of substitution in certain combinations of silicates and humates, change into hydrosols. The separation of the soda and the formation of sodium hydroxide take place, and the latter combines with the carbon anhydride.

In order to improve alkali soils, therefore, either the soda in the complex silicate should be substituted (GEDROIZ's theory) or the colloids should be coagulated (DOMINICIS' theory), and finally the excess of soluble salts should be washed out. These fundamental principles should therefore be followed: (1) coagulate the colloids; (2) wash out the excess of soluble salts; (3) substitute the zeolitic cations; (4) create a favourable reaction for plant growth; (5) compensate the losses of nutritive substances caused by improvement methods.

The results of the Authors' tests show that the alum treatment improves soils, but only temporarily, inasmuch as the alkalinity soon returns. If a simple washing-out could carry away the soluble salts and render the soil productive, it would be advisable to coagulate the colloids and increase permeability by the addition of alum, but this temporary remedy cannot be considered as a scientific treatment of alkali soils.

Favourable results are obtained by large additions of sulphur. The sulphuric acid hydrogen-ions formed are sufficient to substitute the cations in the zeolites and prevent the formation of carbonate of soda, and result in the formation of neutral sulphates.

Nothing conclusive can be reduced from the peat treatment tests.

A. F.

The Formation and Origin of Loess.

GANSSEN R. (Gans.). Die Enstehung und Herkunft des Loess. *Mitteilungen aus den Laboratorien der Preussischen Geologischen Landesanstalt*, Part. 4, pp. 10. Berlin, 1922. Copies may be obtained from the Preussischen Geologischen Landesanstalt, Berlin No. 4, Invalidenstrasse, 44.

The author does not consider that the explanation hitherto given of the formation of loess is satisfactory, and in continuation of the views laid down in his work on the climatic soil conditions of clay silicates, gives the following conception of the formation of loess: " Loess is a formation due to temperature, but to the temperature of the soil rather than the air. It is the product of the arid, hydration-decomposition of a fine-grained, alkaline, clay-silicate, lime material, undecomposed, deficient in clay and rich in silicic acid, the gradual formation and arid decomposition of which in the temperate zones is to be traced to the influence of wind." It is further advanced and established that, though the principal part of loess is composed of grains of from 0.01-0.05 mm., the finest particles, under 0.01 mm., also contribute to the formation of loess, and further, that deposits of every kind may also aid therein, so long as their finer parts correspond to the above-mentioned conditions as regards composition and size of grain. Finally, the coloration of loess is explained and the cooperation of the subsoil under special conditions in loess formation is discussed. H. HALLER.

On Peat.

SPIRHANZL, Eng. J. O rašebinách. Prague, Czechoslovakia, 1924.

In this book the author describes the general properties of peat, such as water capacity, hygroscopicity, power of absorption of gases, its true and apparent specific gravity, cohesion, elasticity, capillary attraction, heat conductivity, effect of heat, and its acidity.

The formation of peat-moors is then dealt with and their geographical distribution and extent in Czechoslovakia, are discussed and shown on a map.

In the last chapters the author treats of the cultivation of peat-moors, drainage, fertilisation, etc., and the means by which they may be rendered serviceable to agriculture, gardens, and in various industries of the Czechoslovakian Republic.

The appendix to the book contains a full index of the literature on this subject. L. SMOLÍK.

Desert Formation in Present and Past Times.

WALTHER, JOHANNES, Halle. Das Gesetz der Wuestenbildung in Gegenwart und Vorzeit. 4th revised edition, pp. 421, illustrations 203. Published by Quelle & Meijer. Leipzig, 1924.

The well-known work of WALTHER now in its 4th edition, has been greatly enriched by the more recent investigations of the author, and special mention should be made of the excellent illustrations.

There is scarcely a chapter in this book that does not add something to our knowledge of soil science (though the book is primarily intended for geologists and geographers), but throughout the whole the chief note is the great importance of climatic factors in the formation of the earth's surface, decomposition, transportation, deposition and formation of soil. The author, from personal observation of different types of deserts in various parts of the globe has obtained a clear idea of the character of deserts at the present time, and as a geologist, draws conclusions respecting the deserts of the past.

An equable, temperate climate with regular precipitations is termed " isonom " by WALTHER, and is contrasted with an antinomial climate, full of extremes, in which not only are there large quantities of moisture in the atmosphere owing to the extensive evaporation of a tropical sea and heavy precipitations in all zones, but where, at the same time, the increased heat of the sun quickly disperses this moisture. Many phenomena can only be explained by a heavy flooding and simultaneously an intense evaporation of the upper layers of the soil. The laterite soils have been produced by such a climate, but to-day antinomial climatic conditions do not exist on our planet. Laterite soils are, according to WALTHERS, decomposed masses contemporaneous with earlier climatic conditions. The rainy tropical climate of the present day destroys the laterite soils in the same way as it does red earth, which often dates from the diluvial period and had been deposited in the chasms and fissures already existing at that time (discoveries at Capri of diluvial fauna and paleolithic tools in a red earth of 5 m. thickness).

The lake at Thebes had no outflow in diluvial times, and in spite of heavy precipitations the Nile in Lower Egypt dried up in consequence of the intense evaporation and did not reach the sea. This is mentioned as an indication of the effect of the fundamentally different climate of that period as compared with the present time.

In the first part, " The Character of the Desert ", the effect of the sun and evaporation (separation of lime compounds from the water of the Nile, many rocks, e. g. sandstone, disintegrated and fissures formed, decomposition of salts and gypsum) and the action of the wind in transporting soil particles, which has the greatest effect where a desert land is subjected chiefly to a wind blowing constantly from the same direction.

The flora of the desert is dependent on the possibility of obtaining water, either from the soil, or as rain, and also on the sun's rays, wind-drying, mobility and salt content of the soil.

The second part of the book treats of denudation in the desert; transporting forces only effect loose material. Gravitation, wind transportation, erosion and the results of glacier ice, also abrasion in coastal districts, here come into play. Long after the wind has lost its carrying power signs of its former influence are found.

Disintegration is particularly well shown on the ancient Egyptian monuments, the exact age of which is known. In answer to the statement that WALTHER has sought to explain all desert phenomena by physical causes without reference to water and chemical decomposition, he replies that the desert phenomena are on the contrary polydynamic, the actions taking place in the desert to-day having a constant and mutual influence on one another.

The climate of Egypt has not changed during the last 4000 years. During this period disintegration of the monuments has been going on uninterruptedly and has not yet ceased. Weather-worn remains of walls, the wearing of holes in, and the effects of insolation on statues, the scaling and splitting of rocks, all give clear pictures of the changes taking place. The wearing away in arid zones is contrasted with the inroads made in moist and rainy climates, such as washing away of the earth's crust. The formation of a hard and deep crust forms a sharp contrast to the softening of rock crystals. The origin of numerous phenomena in regions with no outflow, is only partly to be attributed to erosion through running water ; the rest is due to transport action. Wind is the decisive lifting and moving force in desert denudation. Transportation may indeed take place without corrosion, but not the converse. A covering of stones protects against transportation. The author then describes in detail the various forms of desert denudation such as pot holes, amphitheatres, networks, the removal of knolls and dunes, etc.

In the third section : " Accumulation on the Desert ", a great deal of space is given to desert sand or dust, as a very important factor ; then also the chemical deposits (salt deposits of recent and early formation), and the relation of the desert to marine sediments, etc., is discussed.

In the fourth section : " The Desert in the Past ", the author alludes to a type of desert which is no longer to be seen, namely the lifeless original desert ; and further, of tropical deserts with no outflow for streams, in which the greater the number of water courses which end therein, the more arid is the desert. The cold glacial desert is also greatly affected by wind transport action. The chapters : " The Allocation of the Weather Zone " and " Change of the Sun's Rays ", also " The Diluvial Snow Period and the Desert ", are of special importance for they also have a direct bearing on soil science.

In the last chapter are discussed loams, ferretto, bauxite, red earths, loess and laterite, the last being very fully treated.

A complete index of the contents very considerably facilitates the study of this valuable work. LEININGEN.

Genesis and Geography of Russian Agricultural Land.

GLINKA, K. Genesis und Geographie der russischen Böden, pp. 78. *Pan-Russian Agricultural and Mechanical Arts Exhibition.* Petrograd, s. d.

The author, after a clear introduction in which he examines the conditions in which agricultural land is being formed, gives a brief description of the five principal soil types.

1) Laterite, found especially in the tropical zones. 2) Podsol, the name of which is derived from the Russian " sola " (ashed), on account of the white or grey colour of such soil. It is chiefly found in the forest regions with a rather cold climate ; compact, and rich in concretions,

and contains, iron, manganese and humus. 3) Steppe, the most widely diffused and most widely investigated type of which is the Chernos ("Tschernos"). 4) Marsh. 5) Solonetz, which includes soils, of which the upper part of the humus crust is looser and lighter in colour than the lower part, from which salts, generally of lime, are separated. There are different varieties of this soil, which is found also in Rumania, Hungary, Spain and the western parts of the United States, in addition to Russia.

The author then considers the varied and extensive areas of land in Russia. The *Tundra*: A zone characterised by a low temperature (mean annual from -12^0 to -17^0 C) and by low rainfall, never more than 300 mm., sometimes less than 200. Such low precipitation renders the conditions of the tundra nearly like those of desert zones, but as a consequence, there is a hypersaturation of moisture, which favours the formation of the marshy type. Bed rocks are represented especially by marine sediments (and sand), clearly stratified with marine fossils. Here and there also rock crystals are found. The surface is varied. In some places there are quite sterile patches, deprived of humus, which approximate such soil to the podsol and solonetz type. Elsewhere the surface is covered, to a depth of 30-60 cm., by a peaty layer of a dull green or light grey colour. The peat may form hillocks of as much as 5-25 m. in diameter and 3-5 m. high. In the valleys and in places exposed to marine inundations there is the salt marsh soil, with a growth of halophitic plants. The tundra zone, the extent of which is not yet fully known, gradually passes into the forest zone.

The *podsol zone* is very extensive and is characterised by low rainfall. The mean annual temperature is slightly above 0°C in European Russia and below 0°C in Asiatic Russia, where the soil is perpetually frozen. The bed rocks are composed of sediments of the glacial period. In the moraines, the stones transported by the ice are sometimes in such quantities as to form vast spaces quite unfit for cultivation. The moraine elevations generally run in definite directions and are surrounded by enormous quantities of rocks and stones. The sediments may be considered as of fluvio-glacial origin. Not far from the moraines are vast sandy surfaces, also coming from the glacier waters. The moraine deposits are then covered with silt; towards the south are sandy islands rich in limestone. There are also marine deposits in European Russia, while in Eastern Siberia are found rocks and crystalline schists.

The nature of the surface of the soil is influenced by the climate as well as by the rock composition. Thus in the North-West zone, where great moisture prevails, the formation of the soil is similar to that of the steppes, with its characteristic flora (*Stipa pennata*) and fauna (*Spermophilus*). The nature of the soil, both of the clay masses and of the surface mud, forming an alluvial layer, is connected with glacial action. The soil formation is quite superficial where the bed rocks are hard stones, as in Eastern Siberia. Here, owing to the presence of red sandstone, the characteristic colorisation of the podsol is absent.

In the *steppe* or *Chernos zone*, the temperature varies; in the plant-growth period it is about 13°; in some places however the annual mean is 5°C, while in other it falls below 0°. Atmospheric precipitations are as much as 400 mm., except in Eastern Siberia, where they are less and where the soil is perpetually frozen. As bed rocks, sand (löess) predominates, but there are also silt, clay, chalk and granite. As regards the primary vegetation of the steppe, the author excludes the possibility of its having been marsh or intensely forest, maintaining instead that it was mostly herbaceous. At present the forest is formed of oaks, conifers or aspens. The soil surface stratum is far from uniform and there are different varieties.

There is no clearly defined boundary line between the *desert steppe zone*, with chestnut coloured or brown soils, and the preceding. The temperature is slightly higher, atmospheric precipitations are lower, and the soil in some places is perpetually frozen to a depth of 2-2.5 m. The bed rocks are silt, clay, sandy silt, originating from the Caspian Sea deposits. Vegetation passes from *Stipa* and *Festuca* to *Artemisia* and *Ceratocarpus arenosus* towards the South. In some zones there are quicksands; the earth is also frequently covered with fissures of 0.5-3 cm. in width. Some regions also show a hillock formation, 40 m. in diameter and 1.5-2 m. high, surmounted by a crater-like summit whence issues mud.

In the *grey desert steppe zone* (*Solontschak soil*), the brownish colour of the preceding zone passes to grey in the valley of the Syr-Darjia and to whiteish grey in the plains of South Russia. The mean annual temperature of this zone is above 10°C, but precipitations are very slight, so that the zone is rather arid. The bed rocks are formed of sand deposits, stones and pebbles. The soils are salt, except in the low zones of Turkestan, which are sufficiently drained.

With regard to the *mountainous regions* and the *Crimea*, there is, in the neighbourhood of Jaila, a chestnut-coloured soil (with 3 % of humus). At the eastern extremity is the pass to the desert steppe. Elsewhere there are forests, with clayey soils, passing from red-brown to light-coloured The mean annual temperature in the uplands is 5°C, atmospheric precipitations 600 mm.

In the *Caucasus*, atmospheric conditions are very varied, for regions with 2000 mm. of precipitation are succeeded by those with 300. There are consequently various zones of vegetation and of soils, from that of the steppe to those of forest and lofty mountain regions.

In the *Urals*, the soil is of the podsol type in the N., and the Chernos type in the centre, and chestnut-coloured in the S.

With regard to the *Altai*, in the plain and undulating regions there are chestnut-coloured soils, with few sulphates and chlorides and with 3-4 % of humus. In the north, this rises to 8 % and there are many salts at a depth of 15-55 cm.

In *Turkestan*, two horizontal soil zones, the brown and grey, and two vertical, may be distinguished. In the lofty mountain desert zone (Pamir), with a very low temperature and extremely dry atmosphere, there is a purely surface soil only, sandy-quartz, with scanty graminaceous vegetation

The author concludes his observations by pointing out the regularity of soil distribution throughout the world; the new soil geography data render these geographical charts simpler and clearer.

A. F.

Italian Forest Soils.

I. Edlmann, L. Analisi del terreno forestale di Camaldoli. *Annali del R. Istituto superiore dorestale fazionale*, Vol. I, pp. 27-38, 1 plate, bibliography. Florence, 1924.

II. — Idem. Il terreno forestale della Verna. *Annali del R. Istituto sup. forestale nazionale*, Vol. IX, pp. 39-53, 1 plate, bibliography. Florence, 1924.

I. After a short description of the forest domain of Camaldoli, the author touches on the geological formation and the climate of that region; and after having given the results of the microscopic and chemical examination of the rocks, from the alterations of which, in great part the Camaldolian forest soil originates. Data are given respecting the analyses and the physico-chemical and chemical composition, of the samples of soil taken at various depths in a section of which the lithological basis of the lateral section is a slightly calcarerous sandstone (1.60 % CO_2) and in another plot where, on the other hand, the basal rock is a sandy limestone with 26.82 % CO_2. The data are completed by the acid determinations made on various samples by the colorimetric method.

II. The author describes briefly the geological composition of Monte Penna, which rises to a height of 1283 m. in that part of the Appenines which, between the Serra and Catenaia Alps, divides the upper basin of the Arno from that of the Tiber. He then gives the results of the microscopic examination of some thin sections of the rock (miocenic lime and sandstone), from which the soil covered by the dense Varna forest chiefly originates, and the data of the chemical analysis of two samples of rock, the lithological basis of the forest soil, from one zone covered with spruce only, and from another covered with mixed spruce and beeches. The mineral soil directly overlays the live rock, the intermediary strata of altered rock being absent, and has various gradations of colour and composition, owing to the large quantities of organic matter present near the surface. Data are given of the mechanical, physico-chemical and chemical analyses (total composition and the composition of the hydrochloric acid extract) of the samples taken at various depths from lateral sections of the two zones mentioned. The result of the acidity determination made by the colorimetric method is given for each sample. The author observes that the Varna soil furnishes acqueous extracts with an acid reaction, both under the spruce wood and under the mixed plantation.

Author.

Additional Information on some Soil Types in Java and Sumatra.

LOOS, H. Bijdrage tot de Kennis van einige Bodensoorten van Java en Sumatra, 8vo, pp. 216, XV plates. Veenman & Zonen, Wageningen, 1924.

This work has been carried out under the direction of Prof. van BAREN at the Agricultural High School at Wageningen, Holland, and is divided into 5 sections and 2 appendices.

In the introduction, the author explains how his duties as Agricultural Adviser in the Dutch Indies led him to study the soil, and during his leave of absence in Holland, to pursue these studies further. In the first section of the work is described the investigations carried out on soil minerals, and in the second part the methods of investigation themselves are discussed. The author gives some valuable information on the determination of the optical properties of the soil-forming minerals. In the third section is given a description of 35 different minerals and some organisms, which were found in 6 different kinds of soil of a very heavy type, from the agricultural centres of Java and Sumatra. This section is illustrated by 14 tables and 153 photo-micrographs.

In the fourth part of the work is discussed the method which should be adopted in arranging the results of mineral investigations in order to draw definite conclusions therefrom ; it is suggested that comparisons be made of the quantitative mineral determinations, by means of the magnetic process, basing on the specific weight or the optical qualities. The author prefers the last-named method, and has discovered a quantitative optical method, in which he makes use af a NEBELTAU microscope. The quantitative value can be determined by comparing a large number of samples by this optical method.

In the last section, the 6 soil sections examined are described, and the minerals found therein are again discussed, and in conclusion a general survey of the minerals is given, and the probable bedrock for each mineral is added. The appendix includes a further description of the minerals found, on the basis of recent literature on the subject, with critical notes by the author, a full bibliography being given. X.

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General Notices.

The "International Reports on Soil Science", which were originated in 1911 by resolution of the II International Soil Science Conference at Stockholm, came to an end in 1924. The Reports which are still available may be obtained from the Publishers, F. Wunder, Berlin, NW., 23, Cuxhavenstrasse, 2.

The IV International Conference at Rome in May 1924 decided to publish the review in a new form as the organ of the recently established "International Society of Soil Science", starting in 1925 and beginning with this issue, as a part of *The International Review of the Science and Practice of Agriculture*, published by the International Agricultural Institute in Rome. It is hoped that the review in this new form will continue to be useful to soil science.

As general editor I must ask indulgence, if in this first number the summary of soil science literature is somewhat incomplete, but the new organisation should soon make good this deficiency. All communications regarding this publication should be addressed to the under-signed

The Editor: Prof. Dr. F. SCHUCHT,
Berlin-Wilmersdorf, Güntzelstrasse 59.

The International Society of Soil Science. — The International Society of Soil Science was founded on the last day of the fourth International Soil Science Conference held in Rome, on Monday, May 19th, 1924. It is hoped to give detailed information respecting the Society in the next number of the Review, especially as to the composition of the Executive Committees, of the International Commissions and of the National Sections formed in the different countries. If possible, the statutes and the list of members will also be published in that number. Brief notices only are given here.

In accordance with par. 2 of the Statutes the object of the Society is the encouragement and promotion of soil science in general by means of:

(*a*) the organization of Congresses and Conferences;

(*b*) the formation of Sections and Commissions;

(*c*) the publication of a review;

(*d*) the establishment of a central office for soil science literature and documentation at the International Institute of Agriculture in Rome.

For particular countries separate sections may be formed within the Society, for the study of soil science in general or of special branches of the subject. Every section with more than 15 members has the right to representation on the General Committee by one of its members.

Constitution of the Society:

(*a*) the Executive Committee;
(*b*) the General Committee;
(*c*) the Commissions.

The following persons constitute the Honorary Committee of the Society:

Prof. Dr. E. Ramann; Prof. Dr. L. Cayeux; Prof. Dr. C. Glinka; Prof. Dr. Jozef Kopecký; Prof. Dr. G. Murgoci; Sir John Russell; Prof. Dr. Winogradsky.

The following persons were appointed at Rome to form the Executive Committee:

President: Prof. Dr. Jacob G. Lipman.

Acting President: Dr. D. J. Hissink.

Vice-Presidents: Prof. Dr. G. de Angelis d'Ossat, Dr. Benjamin Frosterus.

Editor of the Review: Prof. Dr. F. Schucht.

Representative of the International Institute of Agriculture in Rome: Eng. Fr. Bilbao y Sevilla, Spanish Delegate to the Permanent Committee, International Institute of Agriculture.

General Secretary: Dr. D. J. Hissink;

Librarian: Dr. G. Borghesani.

The following were elected to form the General Committee:

Prof. André, Prof. Aso, Dr. Christensen, Prof. Hesselman, Dr. Miklazewski, Prof. Novarese and the presidents of the six International Commissions:

(1) for the study of soil physics, Dr. Novák;
(2) for the study of soil chemistry, Prof. Dr. von Sigmond;
(3) for the study of soil bacteriology, Prof. Dr. Stoklasa;
(4) for the study of soil fertility, Prof. Dr. Mitscherlich;
(5) for nomenclature, classification, and soil mapping, Prof. Marbut;
(6) for the application of soil science to agricultural technology, Dr. Girsberger.

Any individual or body corporate interested in soil science, is eligible for ordinary membership.

Members of the society are entitled to receive the Review free of charge on payment of the annual subscription.

It was decided in Rome to fix the contribution for the year 1924, which is to be regarded as a foundation subscription, at 2 American dollars. The subscription for 1925 will be fixed by the Executive Committee, according to the statutes. It has been suggested that this should be fl. 6.50 (Dutch guilders) with an entrance fee for new members of fl. 2.50. New members are asked to communicate with the General Secretary, enclosing their annual subscription and giving full particulars respecting name, title, institution, address, etc. Every member is asked to send the annual subscription for

1925 to the General Secretary, together with the entrance fee, before the 1st of July.

In accordance with par. 12 of the Statutes the Executive Committee shall summon a Congress at least every five years, by arrangement with the International Institute of Agriculture at Rome. It was decided in Rome to hold the first Congress of the New Society in the United States of America.

The International Commissions and the National Sections have the right under the rules of the Society to determine their own constitution. It is clear however that only members of the Society can be members of the Commissions or Sections.

The Presidents of the Commissions or Sections are asked to inform the General Secretary as to the composition of the Committees and other particulars relative to their Commissions before the 1st of July 1925.

About 300 members have paid the foundation subscription of 2 dollars up to the 1st of January 1925. Every member is asked to do whatever may be possible to make the new Society known among persons interested.

Groningen, Jan. 1st, 1925.

Dr. D. J. HISSINK,
Acting First President and General Secretary,
The International Society of Soil Science,
Herman Colleniusstraat 25, Groningen (Holland).