One fact is proved abundantly by a study of the flora of the serpentine barrens, and that is that the chemical character of the soil derived from a disintegration of the serpentine plays an unimportant part in the distribution of the plants mentioned. The distribution of such species is due rather to the physical conditions of the soil, especially with reference to water conductivity and water storage capacity (edaphic conditions). The variation in the character of the plant associations described above is in the main due to the character of the soil. If the soil is present as a well-marked surface layer, then tree associations are found; if on the other hand the rock is exposed, herbaceous associations are the rule. The surface layers of serpentine rock are broken by weathering into angular fragments, which, lying loosely together, permit the percolation of the rain water down into the seams of the underlying rock. Such exposures, therefore, support plants that have adapted themselves to living in dry situations and have structural arrangements which prevent a rapid loss of water.

JOHN W. HARSHBERGER.
UNIVERSITY OF PENNSYLVANIA.

THE AMOUNTS OF READILY WATER SOLUBLE SALTS FOUND IN SOILS UNDER FIELD CONDITIONS.

IN the investigations of the Division of Soil Management, in the Bureau of Soils, relating to the influence of soil moisture in crop production it has been found essential to take into consideration not only the varying amounts of available moisture in the soil but also the readily water soluble salts which this moisture carries in solution.

The sensitive and rapid methods which have been devised or adapted for this work enable us to determine the K, Ca, Mg, NO_3, HPO_4, SO_4, Cl, HCO_3 and SiO_2 in the soil with an accuracy of duplication ranging usually from one to five parts per million of the dry weight of the soil examined and with rapidity such that eight men are able to complete the nine sets of determinations on twenty samples daily between 9 A.M. and 4 P.M.

As these methods are now used in our soil investigations, those for the K, Cl and HCO_3 have been devised and adapted under the direction of Dr. F. K. Cameron; that for NO_3 by A. R. Whitson of Wisconsin and the writer; that for HPO_4 and SiO_2 by Dr. Oswald Schreiner; those for Ca and Mg by Dr. Schreiner and W. S. Ferris, and that for SO_4 by J. O. Belz. The clear soil solutions for examination are obtained by using the effective filter devised by Dr. Lyman Briggs.

After extended observations it has been found that to recover the maximum amount of the readily water soluble salts which are present in the soil it is necessary to first render the sample water free by drying at a temperature of 110° to 120° C., as soils are dried for moisture determinations. Mr. J. O. Belz and the writer found, for example, that after ten times washing 50 grams of a coarse, clean sand containing 4.125 mg. of potassium nitrate, that the same sample oven dried after having been ten times washed in 100 c.c. of distilled water yielded when worked in the disulphonic acid a large additional amount of nitrates. Our actual figures are given below, where from 50 grams of sand we recovered:

By 1st washing of three minutes	....	3.12100 mg.
" 2d " " " "	....	.32840 "
" 3d " " " "	....	.04515 "
" 4th " " " "	....	.01736 "
" 5th " " " "	....	.01380 "
" 6th " " " "	....	.01280 "
" 7th " " " "	....	.01109 "
" 8th " " " "	....	.01100 "
" 9th " " " "	....	.01100 "
" 10th " " " "	....	.01101 "
After drying	.....	.76290 "
Total recovered	.....	4.34551 "
Amount present	.....	4.12500 "

These observations were made in February, 1902. Later in the season, in September, we made an examination of thirty-two samples of soil, representing eight soil types, determining the amounts of NO_3, SO_4, HPO_4, HCO_3, Cl and SiO_3 which could be recovered by washing 100 grams three minutes in 500 c.c. of distilled water as they came fresh from the field, and again by washing in the same manner 100 grams of the water free sample direct from the oven.

As an average of the thirty-two determinations of NO_3, SO_4, HPO_4 and SiO_3 made by Mr. Belz, and of the Cl and HCO_3 made by Mr. A. T. Strahorn, it was found that from the oven dried samples we received 68.85 per cent. more NO_3, 62.38 per cent. more HCO_3, 62.42 per cent. more HPO_4, 244.32 per cent. more SO_4 and 287.9 per cent. more SiO_3 than from the fresh field sample, but about the same amount of chlorine in each set of determinations.

This year, early in June, Dr. Schreiner and Mr. Ferris, of this Division, have shown by a less extended series of observations that the oven-dried samples yielded 54.15 per cent. more calcium and 109.03 per cent. more magnesia.

We were led to make these observations on account of the great difficulty in determining the true amount of nitrates in soil samples, on account of the rapid changes in nitrates which occur after a soil sample has been taken, the work being done to ascertain whether it would be admissible to render the samples water free to stop such action, and were surprised to find that we could recover from the oven-dried samples more readily water soluble salts of nearly every sort determined than we could recover from the fresh sample. The reasons for this increased amount are discussed in a section of the report of our results for 1902 not yet published. In this discussion we assigned several causes, but regard the physical conditions produced by the drying as the chief one. It appears to be demonstrated that the strength of the soil solutions in the water films surrounding the soil grains increases as the surface of the soil grain is approached, in an undetermined ratio; and when a moist field sample is put into distilled water and shaken for three minutes the films of water which the soil grains and granules possess under the field conditions move about in the solution with the soil grains, and during the three minutes of agitation, which we have adopted as our practicable limit, only a portion of the salts diffuse out into the surrounding water; but when the soil sample is rendered water free the readily water soluble salts are deposited on the surface of the soil grains and the surface of the soil granules, so that when the distilled water is dashed upon them they go into solution; during the vigorous agitation, they are carried bodily away from the soil grains much more completely during the three minutes than is possible by the slower process of diffusion which must occur in the case of the moist sample, and on this account we recover a larger per cent. of the readily water-soluble salts which the soils carry.

There is still another physical condition which makes it possible to recover a large amount of readily water soluble salts by washing the oven-dried sample. In the first place the soil granules are more completely broken down by the pestling to which the samples are subjected after being oven-dried, so that the deposited salts are more freely exposed to the water when it is put upon the samples, and are dissolved more quickly on this account. Further than this, while soil samples are drying in the oven the capillary action which is set up in the interior of the soil granules brings out upon their surface a considerable quantity of the salts, which in the moist condition are retained in the interior of the granules where the diffusion outward would be necessarily slower than if the granular condition did not exist and the salts were all in the water film surrounding the surface of the compound grain. This capillary action therefore which takes place during the time of drying, brings soluble salts where the water comes quickly in contact with them, even though the pestling does not completely break down the granular structure, which, as a matter of fact, it never does.

Large as are the amounts of readily water-soluble salts which we are recovering from our field samples, observations which we cite indicate that the amounts actually present are an undertermined amount greater than those we have found. As an example of the amounts of readily water-soluble salts which field soils carry, and as an illustration of the rapidity of securing results and the character of the results, the following table is given,

TABLE SHOWING THE AMOUNTS OF READILY WATER SOLUBLE SALTS FOUND IN THE JANESVILLE LOAM, NEAR JANESVILLE, WISCONSIN, MAY 1, 1903.

	K.	Ca.	Mg.	No_3.	HPO_4.	SO_4.	HCO_3.	Cl.	SiO_2.
				In parts per million of dry soil.					
				Surface Foot.					
Nothing added	28.72	138.00	42.28	36.32	37.60	222.50	64.00	2.00	35.11
5 tons per acre stable manure	27.70	120.00	43.90	28.56	43.00	240.00	40,00	2.00	62.86
10 " " " " "	26.80	127.50	38.90	34.56	82.00	187.50	60.00	2.00	55.72
15 " " " " "	18.08	135.00	39.36	32.64	27.80	210.00	54.00	2.00	41.75
300 pounds guano	26.20	114.00	38.44	25.96	26.20	215.00	28.00	6.00	27.94
				Second Foot.					
Nothing added	48.80	96.00	34.24	46.88	18.40	178.00	6.00	2.00	68.14
5 tons per acre stable manure	24.16	100.00	36.42	24.24	19.00	185.00	12.00	2.00	68.75
10 " " " " "	31.52	66.00	36.04	28,56	34.80	162.50	22.00	2.00	63.78
15 " " " " "	27.84	86.00	32.64	28.00	24.40	200.00	22.00	2.00	28.13
300 pounds guano	28.72	94.00	34.24	23.44	8.60	200.00	24.00	2.00	36.43
				Third Foot.					
Nothing added	13.36	56.25	33.94	45.44	29.40	215.00	6.00	2.00	36.28
5 tons per acre stable manure	41.92	57.00	30.58	26.72	31.60	182.50	22.00	2.00	35.10
10 " " " " "	15.76	60.00	27.40	28.00	34.00	162.50	22.00	2.00	72.94
15 " " " " "	25.68	72.00	30.84	25.96	9.80	197.50	42.00	2.00	47.03
300 pounds guano	34.88	61.00	33.64	13.52	34.40	187.50	22.00	2.00	42.68
				Fourth Foot.					
Nothing added	27.84	53.00	33.28	42.72	17.20	195.00	12.00	2.00	26.38
5 tons per acre stable manure	26.01	51.00	26.34	30.88	72.40	190.00	14.00	2.00	39.27
10 " " " " "	29.12	57.00	26.74	26.40	56.40	160.00	12.00	2.00	87.53
15 " " " " "	28.40	58.00	25.18	25.04	28.40	167.50	12.00	2.00	56.34
300 pounds guano	18.56	55.00	30.58	20.16	80.60	215.00	14.00	2.00	25.80

illustrating a single day's work on a set of samples taken from the surface four feet.

It is not, of course, affirmed that the amounts of the different ingredients found in the soils examined are actually in solution in the soil moisture as the sample comes from the field, although in my judgment the observations indicate that this is likely to be the case for most of the ingredients at least, but observations sufficiently demonstrative have not yet been made to warrant such a statement as fact. The five sets of determinations in each group are, in a way, made on duplicate field samples; that is, they are taken at the same time from the same field but from alternating plots, one of which, as the table indicates, has received no treatment, the others having received the amounts of stable manure indicated, or the amount of guano. These samples were taken early in the spring, only a few days after the application of the stable manure and fertilizers.

Observations similiar to these are being carried through the growing season on eight types of soil in four different states, the samples being taken simultaneously in the four different localities. All of the different fields are under the same crop conditions, so that any differences in yield may be determined for comparison with the amounts of soil moisture and the amounts of readily water-soluble salts which the soils upon which the crops are growing are found to contain. F. H. KING.

BUREAU OF SOILS.
July 30, 1903.

CURRENT NOTES ON METEOROLOGY.

PRELIMINARY METEOROLOGICAL OBSERVATIONS FROM THE 'DISCOVERY' EXPEDITION.

DR. H. R. MILL, in *Symons's Meteorological Magazine* for May, publishes some preliminary results of the meteorological observations taken on the British Antarctic Expedition near Mt. Erebus. The *Discovery* was in winter quarters in a sheltered position twenty-one miles from Mt. Erebus, in lat. 77° 49′ S., long. 166° E. Among the observations three facts are of special interest by reason of their bearing upon the theory of the general circulation of the atmosphere, which is just now much in debate. Lieut. Royds, in charge of the meteorological observations, reports that