In all these stages the nucleus and nucleolus are clearly visible, and in dividing cells the chromosomes appear as dark, rope-like structures. These observations have been repeated on the spermatids of the mouse. The Golgi apparatus appears as a dense black crescent resting on a definite clear area closely applied to the nucleus. Apart from the acrosome, which was not visible, the cytological picture is similar to that figured by Gresson[8] in Kolatchew preparations.

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[1] Zernike, F., *Z. tech. Phys.*, **165**, 454 (1935).
[2] Linfoot, E. H., *Nature*, **155**, 76 (1945).
[3] Cox, A., *Nature*, **155**, 425 (1945).
[4] Burch, C. R., and Stock, J. P., *J. Sci. Instr.*, **19**, 71 (1942).
[5] Bosshard, E., *Rev. Brass.*, **55**, 131 (1944).
[6] Richards, O. W., *Nature*, **154**, 672 (1944).
[7] Hibbard, H., *Quart. Rev. Biol.*, **20**, 1 (1945).
[8] Gresson, R. A. R., *Proc. Roy. Soc. Edin.*, B, **61**, 197 (1942).

Manganese Toxicity Affecting Crops on Acid Soils

THE recent letter from Wallace, Hewitt and Nicholas[1] on the effects of soil acidity on the growing plant prompts us to bring forward some cases of presumed manganese toxicity which have occurred on arable soils in several different parts of England.

As the result of sand culture experiments, Wallace, Hewitt and Nicholas came to the conclusion that the characteristic 'field acidity' leaf symptoms of runner beans and cauliflowers are due to toxicity of manganese, though a low level of calcium supply may aggravate its effects. The aluminium treatments in the experiment had no effect on symptoms. During the past five years we have investigated some twenty-five cases of damage to field crops which have proved on analysis to be associated with a very high concentration of manganese in the leaves of the plant. Examination of the soil has always revealed a low *p*H value and a high concentration of exchangeable manganese.

Soil and plant analyses for eleven cases in which both sets of data are available are given in the accompanying table. Each pair of contrasted samples comes from the same field. The affected soils are characterized by a low *p*H (below 5·0 in eight cases) and high exchangeable manganese content.

While the exchangeable manganese of normal arable soils of *p*H values 6·0–6·5 averages 15 p.p.m. and constitutes but a small fraction of the total reducible manganese, the toxic soils contain between 13 and 41 per cent of their total reducible manganese in the exchangeable form. In contrasted pairs of soils the affected soil contains as a rule much more exchangeable manganese than the healthy soil. The readily reducible manganese content, determined by extracting soils with a salt solution containing hydroquinone, is either higher in the healthy soil than in the comparable affected soil or else of the same order. The total reducible manganese extractable by an acid sulphite solution may be regarded as a measure of the total manganese capable of entering into the oxidation-reduction cycle of the soil. Most of the contrasted soils contain the same amount of this form.

In green leaves the total manganese normally varies from 30 to 500 p.p.m. of the oven-dry material, but on these acid soils it may reach several thousand p.p.m. Calcium, on the other hand, is normal and there is no indication of deficiency, except in case No. 11 (Ashridge), where the potato plants are on the verge of calcium deficiency.

Comparing soil and plant analyses, pairs of samples which show big differences in exchangeable soil manganese show also big differences in leaf manganese. With No. 6 the differences between the pair of soils and between the pair of plants are both small. At Ashridge (No. 11) the 'healthy' plants were by no means free from symptoms, and manganese is still high in both leaves and soil.

This evidence seems to confirm the view of Wallace, Hewitt and Nicholas that in acid soils manganese toxicity is an important factor in causing injury to plant growth. Calcium deficiency may, of course, occur on acid soils, but in only one of these cases of excess manganese is there indication, in the leaf analyses, of this deficiency. Lacking any figures for aluminium and remembering Wallace, Hewitt and Nicholas's failure to observe any effect of aluminium on the plant, it seems reasonable to attribute the injury to the crops, largely at any rate, to manganese toxicity. Soil analysis shows that it is the high concentration of the exchangeable form of manganese which is responsible for the high concentration in the leaves and thus for the damage to the plant.

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[1] *Nature*, **156**, 778 (1945).

EFFECT OF SOIL ACIDITY ON MANGANESE IN THE SOIL AND IN THE LEAVES OF THE PLANT.

Crop and place		*p*H	Analysis of air-dry soil			Analysis of oven-dry leaf material	
			Exchangeable Mn (p.p.m.)	Readily reducible Mn (p.p.m.)	Total reducible Mn (p.p.m.)	Mn (p.p.m.)	CaO (%)
1. Kale. Abbot's Langley, Herts.	*A*	5·6	160	260	880	5900	4·8
	H	6·0	75	265	875	430	6·0
2. Kale. Stretton Sugwas, Hereford	*A*	4·7	182	560	980	5070	5·8
	H	6·3	16	560	1080	163	5·8
3. Swede. Holsworthy, Devon	*A*	4·6	88			2700	4·2
	H	4·7	50			—	—
4. Lettuce. Ware, Herts.	*A*	5·0	120	142	570	1670	2·4
	H	5·5	48	298	580	360	1·5
5. Sugar beet. Scotter, Lincs.	*A*	5·6	113	300	670	2160	2·2
	H	6·4	14	460	560	113	2·6
6. Sugar beet. N. Burlingham, Norfolk	*A*	4·6	50	230	390	2690	2·5
	H	5·0	46	235	420	1490	2·6
7. Sugar beet. Earleston, Berwick	*A*	4·6	88	112	480	1250	2·0
	H	5·6	24	290	505	—	—
8. Sugar beet. Upton, Pembroke	*A*	4·6	270	250	895	2290	2·0
	H	5·2	120	230	900	—	—
9. Potato. Harpenden, Herts.	*A*	4·6	480	520		11300	3·4
10. Potato. Coven, Staffs.	*A*	4·6	112	110	270	4320	5·9
	H	5·4	32	142	310	610	4·6
11. Potato. Ashridge, Herts.	*A*	4·6	222	618	1870	7050	1·1
	H	5·0	130	800	1750	3430	1·5

A = affected; *H* = healthy.

Formation of Aggregations of *Glaucoma pyriformis* Kahl by Means of Phenanthraquinone and Other Substances

PHENANTHRAQUINONE has been shown by Powell[1] to be an inhibitor of the growth of Twort carcinoma and by Jones[2] as a potent inhibitor of root growth. In the course of similar work on the growth of cultures of *Glaucoma pyriformis*, it was observed that if a few drops of phenanthraquinone solution were added to a culture in a watch-glass, the individuals collected into aggregations which are clearly discernible, against a dark background, as circumscribed, whitish areas.

An aggregation seemed to start by the random meeting of a few individuals which remained in close proximity to one another. There is the possibility that, when started, an aggregation had become a field of attraction to individuals outside.

Adjacent to the floor of the watch-glass the individuals of an aggregation were crowded together, merely jostling one another, while above these was a zone of freely swimming, active individuals. An uppermost zone usually contained fewer, relatively inactive organisms.

There is no doubt that by the collective efforts of the individuals within an aggregation, mutual protection against the lethal action of the phenanthraquinone was obtained. Those which failed to enter an aggregation were soon killed. If aggregations were broken by stirring, they could reform; but in the meantime large numbers again succumbed to the phenanthraquinone. After a period of time, undisturbed aggregations could once more disperse without fatality but reformed on addition of more phenanthraquinone.

Aggregations were produced with a number of quinones tried and were also formed spontaneously in some old cultures. The use of 'selective' enzyme inhibitors produced no conclusive results, although with sodium arsenite the individuals swam backwards, an effect due, no doubt, to the monovalent cation[3,4,5].

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[1] Powell, *Nature*, **153**, 345 (1944).
[2] Jones, *Nature*, **154**, 828 (1944).
[3] Jennings, "Behaviour of the Lower Organisms" (New York, 1906).
[4] Mast and Nadler, *J. Morph.*, **43**, 105 (1926).
[5] Merton, *Pflüg. Arch. ges. Physiol.*, **198**, 1 (1923).