obtained with a purified organic matter extracted from the *B* horizon of a Tasmanian ground-water podzol. Part of the acidity of this preparation (indicated by the dotted line) was due to free hydrochloric acid. Other experiments have shown that the presence of neutral salt in such systems does not alter the displacement of the end-point in the presence of copper.

Although Martin and Reeve[2] doubted whether chelates were found in any of their organic matter systems, the curves which they obtained with purified podzol humus (ref. 2, Fig. 6) appear to be compatible with the present interpretation. Their other evidence resulted from application of the test of Gregor *et al.*[5]; this test has proved unreliable in application to citric acid systems.

Accumulated evidence leading to the conclusion that transition metals can be chelated by soil organic matter need not be summarized here. However the present evidence appears to provide the first indication of the identity of the binding sites, namely carboxyl and phenolic or hydroxylic groups. Amino- or imino-acids could give titration curves showing the relationship described for hydroxy acids but the amount of copper chelated in these experiments exceeds that which could be bound even by the whole of the nitrogen present. Published figures on the OH content of organic matter are, on the other hand, compatible with the amount of copper bound.

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R. S. Beckwith

Commonwealth Scientific and Industrial Research Organization,
Division of Soils,
Cunningham Laboratory,
Brisbane.

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Nitrogen Fixation in a Uganda Swamp Soil

Information about the swamp-soils of Uganda is important since their agricultural potentialities are largely unknown and the swamps cover a large part of the surface of the country. Work on the relationship between the nitrogen status of some tropical soils and the water regime applied to them has given particularly interesting results with a sandy soil from a papyrus swamp at Namulonge, near Kampala.

400-gm. samples of soil were placed in 18 shallow jars of thick glass giving a soil layer about 5 cm. deep. Distilled water was added to each preparation to give three groups with (1) soil at saturation capacity, (2) soil completely water-logged to the surface and (3) soil flooded under a layer of water 2 cm. deep. Each group was divided into two sets (triplicates) where (*a*) moisture status was maintained by restoration of water loss after daily weighing and (*b*) water was allowed to evaporate until the soil became completely air-dry as shown by constancy of weight of the preparation. The latter samples then received distilled water in the original quantity so that a drying and wetting cycle occurred. The experiment ran for nine weeks, the jars being placed on an open flat roof under a stretched polythene sheet excluding dust and insects but not obstructing ventilation. Temperature in the preparations varied between 19° C. (8 a.m.) and 36° C. (in full sunlight).

Kjeldahl nitrogen determinations were carried out separately (i) on supernatant liquid when it was present and (ii) on the soil plus organisms homogenized by hand grinding. Combined results are given in Table 1. Nitrate-nitrogen determinations by the phenoldisulphonic acid method failed because of the presence of organic matter. Ammonium-nitrogen was also determined but did not exceed 3 per cent of the Kjeldahl value.

Table 1. Triplicate Groups of Kjeldahl-Nitrogen Values for Namulonge Swamp Soil in P.P.M. on an Oven-Dry Basis (105° C.)

	Outset	Water status maintained: Saturated	Water status maintained: Water-logged	Water status maintained: Flooded	Alternately wetted and dried*: Saturated	Alternately wetted and dried*: Water-logged	Alternately wetted and dried*: Flooded
	600	435	585	585	585 (4)	870 (5)	1190 (3)
	710	575	730	540	560 (5)	585 (5)	1090 (4)
	560	440	595	565	565 (4)	540 (4)	905 (3)
Mean	623	483	637	563	570	665	1062

* Figures in parentheses show the number of wet/dry cycles undergone by the preparation.

Considerable increase in nitrogen occurred only where preparations were alternately flooded under 2 cm. of water and allowed to dry out. The effect is probably related to that observed by Birch and Friend[1] in which the rate of soil respiration corresponds to cyclic wetting and drying but the influence of the layer of water remains to be explained. The control of the depth and duration of such a layer clearly may be of much importance in crop-production on soils of this type.

In every preparation a luxuriant growth of blue-green algae occurred either as a gelatinous sheet on the surface of the soil or as lobed floating masses in the water layer. *Anabaena* spp. were identified as part of the complex in every case and the nitrogen-fixing properties of *Anabaena* are well known, but the problem remains why they were ineffective in the majority of the preparations.

Preliminary experiments have shown that minute inocula from the jars initiates good growth of blue-green algae (*Anabaena* predominating) in a nitrogen-free liquid medium[3]. The growth is continued if such cultures are allowed to dry out and particles of the residue transferred to fresh medium.

The situation in this type of swamp soil seems to be similar to that described for the rice-growing soils of parts of India[2] and the use of some Uganda swamps for agricultural purposes may involve methods similar to the Indian.

E. A. Calder

Department of Botany,
Makerere College,
University College of East Africa,
P.O. Box 262, Kampala,
Uganda.
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