soils may be more susceptible to decomposition by grinding than the material in mineral soils. Nevertheless, taken with the finding that quantitative release of fixed ammonium from vermiculite was not achieved even with long periods of grinding, this result indicates that methods based on ball milling are not likely to be of value for the determination of fixed ammonium in soil.

This communication is published with the approval of the Director of the Illinois Agricultural Experiment Station.

P. M. McDONNELL
F. J. STEVENSON

Agronomy Department,
University of Illinois,
Urbana, Illinois.

J. M. BREMNER

Rothamsted Experimental Station,
Harpenden, Herts.
Feb. 18.

¹ Bremner, J. M., *J. Agric. Sci.* (in the press).

² Dhariwal, A. P. S., and Stevenson, F. J., *Soil Sci.*, **86**, 343 (1958).

³ Rodrigues, G., *J. Soil Sci.*, **5**, 264 (1954).

⁴ Stevenson, F. J., Dhariwal, A. P. S., and Choudhri, M. B., *Soil Sci.*, **85**, 42 (1958).

Simultaneous Decomposition Processes in Soils

It has been found¹ that following the moistening of a dry soil two independent decomposition processes occur, namely, (1) decomposition of soluble organic material without nitrification and (2) decomposition of non-soluble organic material with nitrification. Both rates of decomposition fall off rapidly, with (1) as the soluble substrate is exhausted and with (2) as physical changes, among others, occur at the surface. These changes appear to involve organic gels the surface area of which is increased by drying, possibly as a result of fragmentation or increased porosity. On first moistening, a greater surface area is exposed to solution processes (followed by (1)), and to decomposition (2) than later when, under continued moist conditions, reversible changes occur in the colloids leading to reduced surface area. Prolongation of the dry state, without the soil necessarily becoming drier, increases the magnitude of (1) and (2), which indicates that ageing, a typical colloidal phenomenon, is involved. Moreover, since the behaviour described under (1) and (2) is repetitive with successive dryings and rewettings the changes in the colloids must be reversible, indicating that elastic gels are involved.

Further evidence for this two-process decomposition has recently been obtained. When a dry soil was moistened with water, and with normal solutions of sodium, potassium, calcium and magnesium chlorides and put in the respirometer for seven days the following amounts of carbon and nitrogen were mineralized (Table 1, stage 1).

Duplicate samples which had been through the same procedure as the above were then air-dried for 9 days, remoistened with water and again put in the respirator for a week. The amounts of carbon and nitrogen mineralized during this second cycle are given in Table 1 (stage 2).

A separate experiment (unpublished) showed that the salts depressed the solubility of the organic material and this is reflected in the greater amount of carbon mineralized in the water-treated sample, particularly during stage 1, which followed a long

Table 1
(Mgm./100 gm. soil)

Treatment	Stage 1			Stage 2		
	Carbon	Nitrogen	C/N	Carbon	Nitrogen	C/N
Water	19.8	1.95	10.2	10.2	0.90	11.3
Sodium chloride	10.2	1.18	8.6	9.6	1.85	5.2
Potassium chloride	9.6	1.64	5.6	7.2	0.84	8.6
Calcium chloride	8.4	1.73	4.9	9.0	1.80	5.0
Magnesium chloride	12.0	1.69	7.1	7.8	1.67	4.7

period during which the soil was in an air-dry state. There is, however, no indication that a reduction in the amount of carbon mineralized has had a concomitant effect in reducing nitrogen mineralization. If, as mentioned earlier, the two decomposition processes are independent, there is no reason why the repression of one should affect the other. This experiment therefore confirms previous experiments¹ in which it was found that when the soluble soil-organic material was extracted and added to both sand and soil media it decomposed without nitrification. Moreover, when the solution and decomposition of this soluble material is repressed, as in the above experiment, one gets a truer idea of the carbon/nitrogen ratio of the material actually involved in nitrification processes which, as shown in Table 1, is considerably less than the generally reported value of about 10, which usually includes carbon mineralized from both nitrifying and non-nitrifying processes.

Nitrification, on moistening a soil, occurs initially under favourable conditions because the surface area exposed to decomposition and nitrification processes is greater soon after moistening than later on. Further, the newly developing microbial population is more active. The decomposition of microbial remains killed by drying must also be involved. This combination of circumstances leads to the subsequent production of considerable quantities of mineral nitrogen sometimes equivalent to that in 1 ton of sulphate of ammonia for an acre-6 in. of soil. The amount produced depends on the humus content of the soil and the logarithm of the time the soil was in an air-dry state prior to moistening. The decline in the rate of nitrification after moistening has been found to conform closely to a first-order reaction. Both the effect of drying on nitrification and the course that this afterwards follows can therefore now be fairly well predicted. This is important in relation not only to soil fertility but also to the effect of nitrate on other soil constituents. It may, for example, affect the solution of bases.

In conclusion, it is interesting to speculate on the wider application of the principle involved in the drying effect (par. 1). It seems that further use can be made of a colloidal system which is reversible with successive wettings and dryings and which exposes the maximum area to solution and decomposition processes for only a short period after each wetting.

H. F. BIRCH

East African Agriculture and
Forestry Research Organization,
P.O. Box 21,
Kikuyu,
Kenya.
March 2.

¹ Birch, H. F., *Plant and Soil* (in the press).