LETTERS TO THE EDITORS

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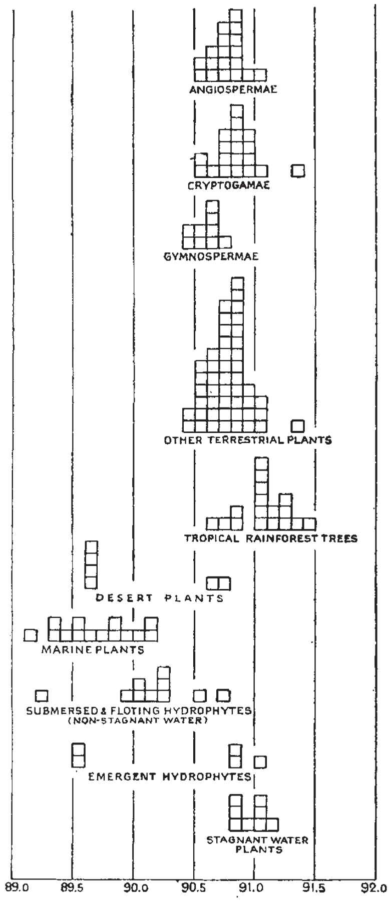
Variations in the Relative Abundance of the Carbon Isotopes in Plants

THROUGH the investigations of A. O. Nier and co-workers[1], it is known that the isotopic composition of carbon in living matter and related materials is different from that in carbonates.

About a hundred plants, representing most of the major plant groups, have been investigated (see diagram). It was found that generally the isotope ratio did not vary with the systematic position of a plant. The only exceptions to this rule are the gymnosperms; though it is possible, but improbable, that this effect is caused by an unfavourable selection of plant specimens.

On the other hand, various biotopes show interesting regularities in the distribution of isotope ratios. If the samples investigated are referred to our standard sample used in earlier investigations[2], tropical rain-forest plants and hydrophytes from stagnant water give values of the isotope ratio around 91. Marine plants and other hydrophytes in non-stagnant water generally give values in the interval 89·0–90·4. Desert plants also give values lower than those characteristic of tropical rain-forests.

The high values observed in tropical rain-forests are by no means observed only there; on the contrary, they can be found in plants from other biotopes representing quite different conditions.



Ratio carbon-12/carbon-13

Various hypotheses have been postulated in order to explain the results, and they can easily be described in terms of the 'local carbon dioxide cycle', well known to botanists and geochemists. It is assumed that there is a difference in the rate of assimilation of the light and the heavy carbon dioxide molecules. This difference is accentuated by the cycle: 'local air' – plant – soil – 'local air', which works as an isotope enrichment process, assuming there is an exchange between the 'local' air and the 'main' atmospheric air. At places where this cycle is intense the isotope effect is large; where it is almost absent, for example, in deserts or very windy places, the isotope effect will be small.

In the case of aquatic plants, the carbon dioxide cycle can develop in stagnant water, and the largest enrichments are also observed there.

These results are also of some interest in connexion with the carbon-14 method for age determinations. The observed effects will be accentuated because the difference in rates of assimilation will be much larger.

Full details of this work will be published in *Acta Geochimica et Cosmochimica*.

FRANS E. WICKMAN

Department of Mineralogy,
Swedish Museum of Natural History,
Stockholm 50. Jan. 10.

[1] Nier, A. O., and Gulbransen, E. A., *J. Amer. Chem. Soc.*, **61**, 697 (1939). Murphey, B. F., and Nier, A. O. *Phys. Rev.*, **59**, 771 (1941).

[2] Wickman, F. E., Blix, R., and von Ubisch, H., *J. Geol.*, **59**, 142 (1951). Wickman, F. E., and von Ubisch, H., *Acta Geochim. and Cosmochim.*, **1**, 119 (1951). von Eckermann, H., von Ubisch, H., and Wickman, F. E., *ibid.* (in the press).

Anal and Oral Water Intake by Crustacea

IN the majority of small and transparent Crustacea, water can be seen with a microscope to be pumped into the alimentary canal by rhythmic antiperistaltic movements of the rectum repeated at intervals of one to a few seconds. This anal drinking is continuous in small species and in the young of larger species; it occurs in intermittent series of gulps in the adults of larger species.

In prawns it is clear that the intermittent anal intake of water acts as an enema, for it occurs only at the time of defæcation, which is preceded by one or two dozen rapid rectal gulps of water. The continuous anal intake of water by smaller Crustacea acts likewise as an enema, being continuous because of the more frequent defæcations, due to the higher metabolism and therefore greater food requirements of small animals. The water acts as an enema as in man, stretching the gut-wall muscles until they contract.

In prawns the rectal swallowing of water initiates and maintains intestinal antiperistalsis; at other times the intestine wall is still. This antiperistalsis moves the swallowed water forwards towards the thorax. A second function of anal drinking is thus to stretch the walls of the intestine until they contract antiperistaltically. This may be compared with the initiation and maintenance of the heart-beat in molluscs by hydrostatic pressure, and with Starling's 'law of the heart' in mammals.

In the past it has been thought that the rectal swallowing of water by Crustacea is respiratory[1]. This opinion was apparently strengthened by experiments[2] showing that a deficiency of dissolved oxygen in the water increases the rate of rectal swallowing move-