Iron and the Origin of Life

IN a series of papers[1] published during the last few years, W. D. Francis, assistant Government botanist in the Botanic Museum and Herbarium, Botanic Garden, Brisbane, offers theoretical reasons and experimental evidence for a connexion between iron compounds and the origin of life. In 1925, he suggested that oxidation of ferrous compounds in soils and waters, or of native or meteoric iron, could provide energy for primitive organisms in a manner analogous to that whereby the oxidation of ferrous carbonate has been shown to provide energy for *Spirophyllum*.

In order to test the validity of such theories, Francis carried out series of experiments in which iron wires were suspended in dilute nutrient media, containing, for example, ammonium sulphate, potassium chloride, magnesium sulphate, potassium phosphate and calcium nitrate. The solution and the iron wires were, it is said, rigorously sterilised before the experiments began, and were protected from contamination as long as they lasted. After the lapse of several days, the ferruginous material on the wire was found to contain microscopic "protein" bodies of "irregular and crystalline shapes". If the atmosphere was freed from carbon dioxide, these particles did not appear, but the presence or absence of light had no effect. The protein was identified as "chromatin" after "the application of seventeen different micro-chemical tests".

Francis concluded that the particles observed were closely related to the iron bacteria *Leptothrix* and *Gallionella*. He considers that "the iron bacterium *Leptothrix* is derived from inorganic material through the operation of four fundamental factors: (1) the arrangement of iron atoms in ferrous hydroxide, (2) the processes of aggregation and crystallisation of ferrous hydroxide, (3) the chemical affinities of ferrous hydroxide for the groups of compounds containing the protein elements, (4) the ability of ferrous hydroxide to function in oxidation-reduction processes".

These conclusions can scarcely be regarded as substantiated until similar experiments leading to confirmatory results have been carried out in other laboratories throughout the world. In the meantime, it is permissible to make certain comments. *If* the precautions regarding sterility were really adequate, and *if* the colour tests, as used, prove the presence of protein, the work may be of significance. But besides this, it should not be forgotten that traces of silicon in the iron used might during corrosion give rise to a stainable colourless product insoluble in acids and swelling up in alkali. It is known that carbon dioxide enormously accelerates the corrosion of iron in air. Colloidal silica may thus be misleading investigators just as it did fifty years ago, and the spontaneously generated *Leptothrix* now described from Australia may have the same short-lived fame as the celebrated *Bathybius* of Huxley's day.

[1] Francis, W. D., *Proc. Roy. Soc. Queensland*, **37**, 98 (1926). *Bot. Archiv* (German translation), **15**, 377 (1926). *Proc. Roy. Soc. Queensland*, **44**, 23 (1933). Also three papers privately published, 1933, 1934 and 1935.

Recent Rumanian Work on the Absorption and Movement of Mineral Elements in Plants

DURING the last few years, under the able leadership of Prof. Deleano, much valuable information has been added to our knowledge of the absorption and movement of mineral elements in plants.

A note directing attention to new evidence for the negative migration of mineral elements, particularly in connexion with the work of Bossie on wheat, was published in NATURE last year[1]. Since then, further papers dealing with the work of Prof. Deleano and his colleagues have been received, and it is with these that the present note is concerned.

In 1931, Deleano and Andreesco[2,3], studying the accumulation of mineral and organic substances during the course of development of the leaves of *Salix fragilis*, showed that the total vegetative activity of the leaves can be divided into three periods: (1) At the commencement of vegetative activity mineral and organic substances accumulate in the leaf; this is called the period of growth. (2) The quantities of mineral and organic substances are then maintained constant for a considerable time, during which the leaves transform them into more elaborated forms; this is the period of assimilation proper, or, as Deleano calls it, "constant protoplasm", because the total quantity of nitrogen in the leaves remains unchanged. (3) Towards the end of this period the mineral and organic substances begin to be eliminated from the leaves to other parts of the plant or to the soil; thus giving the third, or period of negative migration. At the onset of this period, it is suggested that the permeability of the cells increases and assimilatory activity declines, resulting in the loss of soluble materials; protein nitrogen decreases in quantity, being converted into more soluble forms such as amino acids and ammonia nitrogen, in which form it is eliminated; fifty per cent of the total nitrogen is lost in this way.

The duration of the three periods in the case of *Salix fragilis* is: period of growth, 25 per cent of the growing season; period of constant protoplasm, 50 per cent; and period of negative migration, 25 per cent.

Analyses of *Aesculus Hippocastanum* material by Deleano and Bordeiano[4] gave substantially similar results, except that the duration of the three periods was in this case 75, 12, and 13 per cent, respectively, of the total vegetative period.

During the third period it was found that non-combined water content commenced to decrease in quantity some time before elimination of the mineral substances was evident; suggesting that the migration of the latter may be independent of the movement of water. In all the investigations the results are expressed in absolute quantities per hundred leaves, etc., a method now generally used in this kind of work, so that a more correct impression of the movement of the substances in question is being obtained than would be the case if results were expressed on a dry-weight basis.

In a later series of papers[5], similar work on *Populus pyramidalis* and *Robinia pseudacacia*[6]; *Juglans regia*, *Quercus Robur* and *Zea Mais*[7]; *Triticum vulgare*[8]; *Nicotiana Tabacum*[9]; is recorded by Deleano's colleagues. In all cases the three periods of vegetative growth are recognisable, although the duration of the individual periods, and the percentages of materials eliminated during Period (3), naturally show differences in each plant. For example, in *Nicotiana* there are two well-marked phases of development; during the first, maximum accumulation of organic and mineral substances coincides with maturity of the main axis and its members, that is, leaves and fruits; then negative migration sets in. But this is arrested by the development of the axillary shoots, and a second period of absorption and assimilation follows, succeeded still later by a second negative migration.

The work of Deleano and his colleagues shows quite clearly that in annual plants the direction of the negative migration in the third period of vegetative activity is from the leaves and stem back into the soil, very little if any being retained in the roots. In biennials, during the second year, the roots act merely as regulators allowing the passage of considerable quantities of mineral substances, so that throughout the whole period during which the aerial portions show the three stages of development, and movement of materials already outlined, the initial content of mineral and total nitrogenous substance in the root itself remains unchanged.

In perennials it is shown that during any one vegetative (leafy) season, nitrogenous and other materials decrease in the stem during the first period of growth of the leaves, accumulate again to their initial value and then remain constant during the second period of protoplasmic stability in the leaves, and remain constant also during the period of negative migration from the leaves. That is, there is no evidence of a further accumulation of these substances in the stem while they are being passed out of the leaves at the end of their vegetative activity. The natural conclusion is, therefore, that in perennials as well as annuals and biennials, most of the substances migrating out of the leaves are returned to the soil, and not stored in either the stem or the root; and that this state of affairs cannot be shown when results are expressed on a dry-weight basis, but only when they are recorded in absolute quantities per hundred plants or parts of plants.

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[1] NATURE, **136**, 268 (1935).
[2] Deleano, N. T., and Andreesco, M., *Bul. Soc. Sci. Cluj. Roumanie*, **6**, 209–220 (1931).
[3] Deleano, N. T., and Andreesco, M., *Sonderabdruck Bietrage Biol. Pflan.*, **19**, Hft. 3 (1932).
[4] Deleano, N. T., and Bordeiano, C., *Acad. Roma mem. Sect. Stiint Ser.* (III), **9**, Mem. 10 (1934).
[5] Series Title: "Contributiuni la Studiul Rolului si Functiunii Substantelor Minerali si Organici in Viata Plantei".
[6] No. 2, Polovrageano, I., *Univ. de Bucharest Fac. Farm.*, May 1933.
[7] No. 3, Trandafiresco, E., ibid., June 1934.
[8] No. 4, Bossie, V. G., *Lab. Chim. Anal. Fac. de Farm.*, 1934.
[9] No. 5, Vladesco, I. D., *Univ. de Bucharest Lab. de Chim. Anal.*, 1934.

Developments in Cathode Ray Oscillographs

AT a meeting of the Wireless Section of the Institution of Electrical Engineers held on March 4, two papers dealing with cathode ray oscillograph tubes were presented, experimental demonstrations being given in each case.

The first paper, by Dr. L. Levy and Mr. D. W. West, was entitled "Fluorescent Screens for Cathode-Ray Tubes for Television and other Purposes". This paper contains an account of investigations carried out with various materials employed for the screens in cathode ray tubes. The fluorescent and phosphorescent phenomena displayed by a variety of materials are described in detail, and the results of photometric measurements of the illumination of screens of these materials under different conditions of excitation are given. The results show that it has been possible to obtain a zinc sulphide giving approximately white fluorescence, while a mixture of zinc sulphide and zinc cadmium sulphide giving a brilliant white fluorescence of high intensity has also been prepared. The intense fluorescence of these materials is usually accompanied by considerable phosphorescence, which renders them unsuitable for many practical purposes. The authors have made the discovery, however, that the phosphorescence of zinc sulphide can be prevented by adding a minute trace of nickel—about one part in two million—at the expense of only a very slight reduction of fluorescence.

The second paper, entitled "The Comparative Performance of Gas-Focused and Electron-Lens-Focused Oscillographs at Very High Frequencies", was read by Mr. L. S. Piggott. This paper describes an experimental investigation of the relative properties of the gas-focused cathode ray tube and that employing an electron-lens system for focusing purposes, at various frequencies up to 1,400 megacycles per second (wavelength about 21 cm.). It appears from the results that the latter type of tube is likely to prove a most useful instrument at very high radio frequencies.

A third paper, "A Cathode-Ray Oscillograph for the Direct Measurement of High-Voltage Transients", by A. K. Nuttall, was published in the February number of the *Journal of the Institution of Electrical Engineers*. This paper describes a high-speed continuously evacuated cathode ray oscillograph for the recording of high voltage transients, a distinctive feature of the instrument being that impulses of 100 kv. can be applied to the deflecting plates without the use of a potential-divider. The possibilities of the instrument are illustrated by the results of a brief investigation of the characteristics of a sphere-gap when sparking over on the application of a steep-fronted wave.