tor 1. The potency of this preparation of factor 1 as measured by such gains in weight is given in Table I.

TABLE I
WEIGHT INCREASE OF RATS FED CRYSTALLINE FACTOR 1 FOR 14 DAYS

Daily intake of factor 1 Micrograms	Average daily gain in weight Grams
25.0	3.4
20.0	3.4
10.0	3.4
5.0	2.5
2.5	2.4

An independent check of the potency of crystalline factor 1 was made by Mrs. M. K. Dimick at the Biological Laboratory of the Vitab Products, Inc., with similar results. In this experiment, rats which had ceased to grow on the factor 1-deficient diet,[1] gained an average of 3 grams daily when fed 10 micrograms of crystalline factor 1 daily; and when 5 micrograms were fed daily, the rats made an average daily gain of 2 grams. The factor 1-deficient diets were similar in composition,[1] the only difference being in the factor 2 concentrate, a liver filtrate being used by Mrs. Dimick, and a rice bran filtrate, in the laboratory of the Poultry Division.

This work was greatly facilitated by a financial grant from Eli Lilly and Co.; by crude factor 1 concentrates made for us by Eli Lilly and Co., and the Vitab Products, Inc.; and by materials and personnel from the WPA (project No. 8261).

SAMUEL LEPKOVSKY

POULTRY DIVISION,
UNIVERSITY OF CALIFORNIA

ANEURIN AND THE ROOTING OF CUTTINGS[1]

WITH the increase of our knowledge concerning the principles of plant growth and development, it has been possible to solve some interesting practical problems by a purely scientific approach. Thus the discoveries, in rapid succession, of the growth hormone (auxin), of its chemical nature, of the identity of the growth hormone with one of the hormones of root formation and of the growth hormone activity of indole derivatives have led to a number of practical applications, particularly in the rooting of cuttings.[2] It soon became clear, however, that root initiation and subsequent root growth are conditioned by a complex set of factors of which auxin, although of great importance, is but one. Sugar and biotin were soon recognized as additional factors in root formation (Went and Thimann[3]). An independent line of research has led to the recognition of aneurin (vitamin B_1) as a hormone of root growth.[4] Under normal conditions the extremely small amounts of aneurin which are required for root growth (as judged by the amounts required by roots *in vitro*) are supplied by other parts of the plant. Without aneurin, or derivatives of it, no root growth is possible. This consideration has led us to expect that under certain conditions aneurin should be the limiting factor for root development on cuttings. That this is actually the case is shown by the following experiments: etiolated pea stems were treated basally for ca 20 hours with indole acetic acid (20–200 mgs per liter), and were then transferred to bottles containing 5 cc of 2 per cent. sucrose solution. At different times after the auxin treatment, aneurin, over a wide range of concentrations, was added to the sugar solutions for different periods of time. With the exception of the highest concentrations (100–20 mgs per liter) applied soon after the auxin treatment, all the aneurin treatments caused a marked increase in the number and size of the visible roots. Concentrations of 1 mg per liter or lower, applied 5 to 9 days after the auxin treatment, gave the most vigorous response, which amounted to several hundred per cent. more visible roots than in the non-aneurin treated controls. Histological investigations show that 5 days after the above auxin treatment large numbers of root primordia have been formed. The number of these primordia which grow out is, as shown by the above experiments, limited by the available aneurin. That it is not root initiation which is primarily affected by aneurin is shown by the fact that aneurin without previous auxin treatment is without influence upon the root formation of these cuttings.

A number of other experiments were carried out under practical nursery conditions. Leafy lemon cuttings were treated overnight with indole acetic acid (200 mgs per liter) and were then allowed to stand for one week in sand in a propagating frame. The bases of these cuttings were then placed for 24 hours either in water or in an aneurin solution (1 mg per liter). Thirteen days later the control cuttings, after-treated with water, had 8.1 roots apiece, while the aneurin-treated plants had 16.3 roots each. These roots were in addition much longer than those of the water after-treated cuttings. The controls which were not treated with indole acetic acid had only 0.3 roots per cutting. Still more striking was an experiment with leafy Camellia cuttings, which are notably slow in rooting. After repeated indole acetic acid treatment (200 mgs per liter for 20 hours each time), 30 out of 200 cuttings

[1] Report of work carried out under the auspices of the Works Progress Administration, Official Project Number 165-03-6999, Work Project Number 6330-6989.

[2] These discoveries are sometimes erroneously attributed to the investigators of the Boyce Thompson Institute.

[3] F. W. Went and K. V. Thimann, "Phytohormones," New York, 1937.

[4] J. Bonner, SCIENCE, 85: 183, 1937; W. Robbins and M. Bartley, SCIENCE, 85: 246, 1937.

had still failed to root. Twelve of these were then treated with water, another 12 with aneurin (1 mg per liter) for 24 hours. One week later a total of three short and poor roots had developed on the water-treated set. Those treated with aneurin, on the other hand, all rooted vigorously and formed a total of 67 sizable roots.

It is also known that certain "essential" amino acids exert a beneficial effect upon the growth of some roots.[5] It can therefore be predicted that cuttings may be found in which root development is limited by these substances.

The above experiments are a logical outcome of the series of discoveries concerning the plant growth hormones. They demonstrate clearly that aneurin, the root growth hormone, if it is applied at the appropriate time after roots have been initiated by auxin, greatly increases the root development of cuttings, and may hence become as important in nursery practice as are the auxins themselves.

F. W. WENT
JAMES BONNER
G. C. WARNER

WILLIAM G. KERCKHOFF LABORATORIES
OF THE BIOLOGICAL SCIENCES,
CALIFORNIA INSTITUTE OF TECHNOLOGY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

QUANTITY COLLECTING OF PLANKTONIC DIATOMS[1]

IN the contribution to SCIENCE of December 4, 1937, by Dr. G. L. Clarke concerning the collecting of marine plankton diatoms I notice several surprising assertions which were not entirely acceptable on available evidence. Perhaps a word of dissent is in order. For the sake of brevity only brief reference to particular items will be attempted.

1. Small size of plankton diatoms is not always (if ever) detrimental to collecting them. Bigelow,[2] Trask[3] and other American and European observers have commented on the ease of obtaining large quantities at particular times and places.

2. It is not always necessary to "strain very large volumes of water." For example, in the 12,000,000 cells per liter population found by Trask near Grays Harbor, Washington, thirty liters would have yielded a large quantity. This could have been obtained with far less trouble by dipping and "straining" that amount than would be involved in operation of "six tow nets" at once.

3. It seems to be assumed that if diatoms are taken from sea water all specimens are uniformly representative in chemical composition. This assumption is not tenable. At the Scripps Institution of Oceanography it has been found that some larger population near the surface of the sea show nearly 50 per cent. in decadent condition.[4] There are other reasons why the physical or the functional conditions of a particular population should be noted before it is assumed to be representative, although chemical analysis of a number of populations may offset this deficiency in general observation for certain purposes.

4. It is true that "purity of the catch" is requisite for reliable "chemical analysis," but *that* is a common characteristic of plankton diatom populations showing excessive abundance, *i.e.*, above a million cells per liter. In a population as low as 200,000 cells per liter considerable numbers of several other kinds of organisms may be encountered. Some of these have dimensions similar to those of the diatoms and would not be excluded by the ingenious reversed cone device. For full satisfaction concerning "purity" a dense population should be found in which natural exclusion of other organisms is practically complete.

5. As a general statement, the assertion that 200,000 cells per liter "approaches the maximum richness observed for diatom flowerings" is not acceptable. In addition to the reports from European and other North Atlantic waters, there are a number of instances in which millions of cells per liter have been found in Pacific waters from the Gulf of Panama to the region of Juneau, Alaska.[5] The Gulf of Santa Catalina is not one of the most productive regions, but at the Scripps Institution of Oceanography in certain years whole weeks (mss. records) have been noticed in which the abundance remained above a million cells per liter in daily catches.

W. E. ALLEN

SCRIPPS INSTITUTION OF OCEANOGRAPHY,
LA JOLLA, CALIF.

THE PREPARATION OF ABSOLUTE ETHER

"THE customary method of preparing absolute ether consists in shaking the ether repeatedly with water to remove alcohol and finally drying with sodium."[1] The

[5] P. White, *Plant Physiol.*, 12: 793, 1937; J. Bonner and F. Addicott, *Bot. Gaz.*, 99: 144, 1937.

[1] Contributions from the Scripps Institution of Oceanography. New Series, No. 12.

[2] H. B. Bigelow, U. S. Bur. Fish. Doc. No. 968, 1926.

[3] P. D. Trask, "Origin and Environment of Source Sediments of Petroleum," Gulf Publishing Company, 1932.

[4] W. E. Allen, *Quart. Rev. Biol.*, 9: 170, 1934.

[5] W. E. Allen, *Bull. Scripps Inst. Oceanog.*, 1: 42, Univ. Calif. Press, Berkeley, 1927; W. E. Allen, SCIENCE, 70: 418, 1929; E. E. Cupp, *Trans. Am. Micros. Soc.*, 53: 25, 1934.

[1] D. W. McArdle, "Solvents in Organic Chemistry," Van Nostrand, New York, p. 83, 1927.