SCIENCE

VOL. 96 FRIDAY, DECEMBER 18, 1942 No. 2503

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

THE ORGANIZATION OF BIOLOGY AND AGRICULTURE

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OVER and over again as I endeavor to facilitate the contributions of biology and agriculture toward winning the war, I encounter the unorganized and incoherent condition of our group of sciences. I have come to believe that this lack of organization, and the lack of unified objectives that goes with it, is of itself partly responsible for the comparatively ineffective application of biology and agriculture to the needs of a total war.

To assist in clarifying our functions and our responsibilities, I have constructed an organization chart (Fig. 1). In its conception the chart is entirely abstract. Its contact with the present situation comes through the numbered references in the appropriate boxes to the national technical societies in whose hands to a large extent lies the professional guidance of those arts and sciences by which man produces his food and the organic raw materials which he uses in his civilization.

To point out that the products of the soil constitute the most fundamental and the only really essential factors in man's existence is to state a truism to which there is no occasion to call your attention. The chart is presented, rather, to emphasize the complexity of the problem of organization which is faced by biology, using that term in its widest sense including its applications.

The outstanding feature of biology and agriculture, and it must immediately occur upon any consideration of these fields, is the number and diversity of the organizations included in the group. Whereas chemists of all sorts support one strong chemical society,

Koch-McMeekin Nessler reagent[4] was used in this work, although others would probably be just as satisfactory. Since Beer's law was not found to be valid over a wide range, a curve had to be prepared from readings based upon standard solutions of ammonium sulfate. Either fresh or dry material was found to be satisfactory for analysis, but the use of fresh material saved considerable time in sample preparation. A leaf punch which cuts out exactly one sq. cm of leaf tissue can be used, thus saving the time required to dry, grind and weigh the sample. Ten sq. cm of leaf tissue of most fruit trees is equivalent roughly to 100 mg of the dry material, and the area basis is just as satisfactory as a dry-weight basis for comparing samples.

The procedure adopted is as follows: Transfer 100 mg of dry material or 10 cm^2 of fresh material to a 50 ml Erlenmeyer flask. Add 2 ml of concentrated sulfuric acid and heat gently over a flame until the sample is broken down and partially dissolved. If nitrates are present, continue digestion for about a minute after dense fumes have been given off to allow for complete reduction of the nitrates by the organic matter. Allow to cool and add 0.5 ml of 30 per cent. hydrogen peroxide. Heat gently—the solution should become clear and colorless. Continue the heating until dense fumes are given off—usually the solution becomes darker at this stage. Allow to cool and add 5 drops more of 30 per cent. hydrogen peroxide and heat as before. If the solution is not completely clear and colorless on further heating, add 5 drops more of hydrogen peroxide and heat again—repeat this procedure if necessary. No more than 5 drops of hydrogen peroxide should be added at one time after the first addition, because a large excess of peroxide in the absence of organic matter will oxidize some of the ammonia. When the solution is perfectly clear and colorless on continued heating, cool, dilute with water and transfer with washings to a 100 ml volumetric flask and make to volume. Transfer a 10 ml aliquot to a 50 ml volumetric flask. Add 2 ml of 2.5 N NaOH to partially neutralize the excess acid and 1 ml of 10 per cent. sodium silicate to prevent turbidity. Make to volume and mix well. Transfer a 5 ml aliquot to a colorimeter tube and add 4 drops of Nessler's reagent—mixing thoroughly after the addition of each drop. If the mixing is not thorough, additional drops of reagent will be required to obtain the maximum color. Allow to stand for several minutes before taking a reading on the colorimeter. A blue filter (Wratten No. 49) was used in this work.

Typical comparisons between the rapid and the Kjeldahl methods and recoveries of nitrate nitrogen added to apple leaf tissues are shown in Table 1.

[4] F. C. Koch and T. L. McMeekin, *Jour. Am. Chem. Soc.*, 46: 2066–2069, 1924.

TABLE 1

REPRESENTATIVE ANALYSES OF APPLE LEAF TISSUE AND RECOVERY OF ADDED NITRATE NITROGEN. EXPRESSED AS PERCENTAGE OF DRY MATTER

Sample No.	Kjeldahl method	Rapid method	1 per cent. N added as $NaNO_3$	Recovery of added NO_3
61	2.73	2.73		
	2.73	2.71		
111	.70	.75		
	.69	.74		
216	1.77	1.81		
	1.80	1.81		
291	2.22	2.23		
	2.28	2.26		
315	1.37	1.40	2.40	101 per cent.
	1.39	1.40	2.40	101 " "
		1.37	2.41	102 " "
215	1.88	1.89	2.89	100 " "
	1.89	1.91	2.86	97 " "
		1.86	2.88	99 " "

The time required to determine nitrogen by this method in routine analysis was found to be about 10 minutes per sample, making it possible for two analysts to complete at least 48 samples a day. Furthermore, the cost of reagents is only about one twelfth that of the Kjeldahl procedure. Numerous nitrogen determinations made on replicate samples of leaves of apple, pear, peach, cherry, apricot, grape and corn gave Kjeldahl accuracy. The solution obtained from the peroxide-digested material can be used not only for the determination of nitrogen, but also for phosphorus, potassium, calcium and magnesium. Rapid colorimetric methods for the determination of these elements have been worked out and are now being prepared for publication.

Since leaf analysis offers the most promising means of diagnosing nutritional deficiencies and unbalance within the tissue of the plant, and since it eliminates most of the uncertainty in determining the actual fertilizer needs of crop plants, it is hoped that by the adoption of faster methods, leaf analysis, as a tool in increasing crop production, may come to be more widely used.

R. C. LINDNER
C. P. HARLEY

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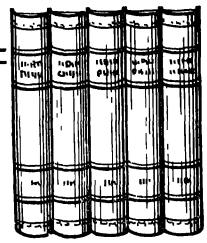

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