In recognition of the fact that the progress of astronomy in America has made magnificent contributions to that science, it is befitting that we should find in the oldest school for astronomical graduate work a course pertaining to the history of astronomy in America. The Detroit Observatory of the University of Michigan has in itself a wonderful history, in respect to training astronomers who have all been leaders in astronomical research. Dr. W. Carl Rufus's work in the history of astronomy consists of two courses—the first being the general history of astronomy and the second following with the history of astronomy in America. The second course is of particular interest to us now, since it is building the framework upon which the history of science in America must rest.

A cooperative course in the history of science is now being offered for the first time at the Northwestern University. It is given in two divisions, namely: the history of the physical sciences, given by Dr. Henry Crew, and the history of the biological sciences, by Dr. William A. Locy.

We may venture here to state that this form or division of the history of science teaching is probably the most satisfactory form in which to conduct the whole subject, since it is becoming more apparent that no single individual will be able to teach the subject as a whole.

At the University of Chicago we find a rather unique institution in the form of two historical courses being offered in the correspondence-study department by Dr. G. W. Myers. The history of mathematics and the history of astronomy are given primarily with emphasis placed upon the cultural value. Aside from the regular established course in the history of mathematics and biology, and a new course being offered in the history of astronomy, Yale University has announced a series of public lectures in the history of science.[6] These lectures clearly emphasize this growing movement for a more sympathetic understanding of the past, a regard for the past human relationship of those whose labors have prepared the way.

And, finally, it is to be accepted as a recognition of the worth and importance of the history of science when we read of the successful conference the American Historical Association carried on in December, 1919.[7] The interest the historian of the social and political sciences has in the history of science, is decidedly different from the historian of the sciences themselves. One may be termed the cultural interest, whereas the other is the technical interest. That is, the former is interested in the history of science from the point of view of methodology and the influence science has had on civilization—the latter is mainly concerned in the development of the concepts in science, and the growth of the subject matter and its influence upon related problems. It is evident that the interest can be, with profit, fostered by two widely different organizations, which never meet in common.

Such has been the progress of the movement to cultivate the history of science in the United States within the last few years. The remarks concerning these various steps of the progress are necessarily brief, but sufficient has been quoted to indicate that a new cultural epoch in the intellectual history of America is dawning. This cultural epoch must, from the very fact of its influence and interpretation, come to be known as the "new Humanism."

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SPECIAL ARTICLES

OPTIMUM NUTRIENT SOLUTIONS FOR PLANTS

During recent years numerous investigators have devoted considerable time and resources to the study of the salt requirements of various plants. Plans have been proposed for the extension of this work, with the hope that certain fundamental data may be obtained which shall indicate the composition and concentra-

6 Science, N. S., Vol. LII., No. 1347, p. 383–384, October 22, 1920.

7 Science, N. S., Vol. LI., No. 1312, pages 193–194, February 20, 1920.

tion of the solution or solutions best suited to the growth of the plant. It now seems to be an opportune time to raise the following questions: first, is it probable that the plant has any definite response within broad limits, to a particular ratio of salts or ions contained in the complete nutrient solution; and second, assuming the existence of such optimum solutions, are the methods generally employed adequate to determine their composition?

With regard to the second point, in a previous communication the writer[1] has attempted to show that in many experiments the total supply of nutrients may have limited the yield of crop, rather than the salt proportion. In another article[2] it is shown that insufficient attention has been given to the possible limitation on growth with certain solutions, due to the insolubility of iron, when this element is added in the form of the phosphate. Recent work by Waynick[3] and Davis[4] has emphasized the necessity for interpreting the data obtained in plant culture experiments with due consideration given to the variability of plants. In the majority of previous experiments this question has been almost completely overlooked.

During the course of an investigation on certain phases of plant nutrition, an incidental experiment has been carried out which may be suggestive in connection with the first point mentioned in this note. Three series of nutrient solutions were prepared:[5]

(*a*) Solution used by the author.
(*b*) Shive's best solution, R_5C_2.
(*c*) Shive's solution diluted to 1/3 of its concentration in *b*.

In each case 15 barley plants were grown for six weeks under favorable and uniform conditions of sunlight. The containers were of one liter capacity and only one plant was grown in each bottle. The solutions were changed weekly. Thus the total volume of solution provided for each plant was considerably larger than that used in most experiments of this type. Iron tartrate was added twice each week to all cultures. All the plants grew at a uniform rate and there was no apparent difference between the three sets at any time. The initial composition of the three solutions and the weights of the plants air dried were as follows:

Solution	Composition of Nutrient Solutions							Data on Plants				
	K, PPM.	Ca, PPM.	Mg, PPM.	PO_4, PPM.	NO_3, PPM.	SO_4, PPM.	Total Concentration, PPM.	Total Weight Tops, Gms.	Total Weight Roots, Gms.	Average Length Tops, Cm.	Average Length Roots, Cm.	Ratio Tops Roots
a. (Author)	190	172	52	117	700	202	1,433	48.9±7.5	8.4 ± 1.5	45 ± 3	30 ± 5	5.8
b. (Shive R_5C_2)	710	250	372	1,766	750	1,489	5,337	48.6±8.5	7.8 ± 1.5	48 ± 3	26 ± 2	6.2
c. (Shive R_5C_2) ⅓	237	83	124	588	250	496	1,779	39.0±4.5	7.4 ± 1.5	45 ± 3	25 ± 4	5.3

It is evident that solutions *a* and *b* produced equally favorable growth within the limits of error of this experiment, while the smaller yield from *c* is not necessarily significant, although in this case it is possible that the total supply of nitrate was insufficient. Thus in this experiment (a number of other experiments not now reported lead to the same conclusion) solutions of radically different concentrations and salt proportions have not affected the yield of the crop to any important extent. There is, however, no intention to give the impression that certain solutions (possibly including those containing large proportions of magnesium salts) may not inhibit plant growth because of unfavorable physiological balance. The point which

1 D. R. Hoagland, SCIENCE, N. S., Vol. XLIX., pp. 360–362 (1919).

2 D. R. Hoagland, *Jour. Agr. Res.*, Vol. XVIII., pp. 73–117 (1919).

3 D. D. Waynick, Ann. Rep. College of Agr., University of California, 1918–19, p. 67.

4 A. R. Davis, Univ. of Calif. Pub. in Agr. Sci. (in press).

5 J. W. Shive, Phys. Researches, Vol. 1, pp. 327–397 (1915).

it is desired to make is that the range of equally favorable ratios between nutrient salts is probably a very broad one, no doubt including the solutions of most soils. This is not a surprising conclusion in view of the observation that under proper climatic conditions many different types of plants can grow vigorously on any fertile soil, while a given type of plant may grow equally well on various soils, the extracts of which have entirely different proportions of nutrients. Again, plants of equal development may store nutrient elements in very different ratios, when grown in different soils or solutions.

It has sometimes been suggested that solution and sand culture experiments offer a fundamental means of determining fertilizer requirements of soils, in connection with a proper physiological balance for the plant. If one considers the dynamic nature of the soil system, with its constantly fluctuating soil solution and the reactive properties of the soil minerals, it seems scarcely within the limits of possibility to alter a soil solution to fit any particular ratio of nutrients. The addition of any one fertilizer salt may affect all the various components of the soil solution. Moreover, many elements are present in the soil solution besides those added to the artificial culture solutions and it may not be assumed that these are without effect on the physiological balance of the solution, if indeed such a balance is of importance ordinarily.

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THE AMERICAN CHEMICAL SOCIETY, CHICAGO MEETING

The 60th meeting of the American Chemical Society was held in Chicago, Ill., Monday, September 6, to Friday, September 10, 1920. The council meeting was held on the 6th and a general meeting on September 7th, in the morning at the Congress Hotel, Chicago, and in the afternoon at Northwestern University, Evanston. Divisional meetings were held all Wednesday morning and all day Thursday, and excursions Wednesday afternoon and Friday. Full details of the meeting and program will be found in the October issue of the *Journal of Industrial and Engineering Chemistry.* The registration was one thousand three hundred and eight.

The combined outdoor and indoor entertainment on the campus of Northwestern University on Tuesday afternoon was a new feature which met the hearty approval of all as it offered both a varied entertainment to the members and special opportunity for becoming acquainted.

General public addresses were given by Thomas E. Wilson, president, Wilson & Co., on "The value of technical training in the reconstruction of industries," and by Professor A. S. Loevenhart, head of the department of pharmacology of the University of Wisconsin, on "Chemistry's contribution to the life sciences." The chief public address was the president's annual address given by Dr. W. A. Noyes, in the Gold Room of the Congress Hotel, and was entitled, "Chemical publications." General addresses on Tuesday afternoon were given by H. P. Talbot on "Relation of educational institutions to the industries," and by W. A. Patrick on "Some uses of silica gels." The banquet, held on Thursday evening, September 9, filled the Gold Room of the Congress Hotel to overflowing. At the general opening session Charles L. Parsons reported on the International Conference of Pure and Applied Chemistry held in Rome, June 22 to 25, of which he was vice-president and to which he was a delegate from the American Chemical Society.

Abstracts of a larger part of this paper presented follows:

DIVISION OF BIOLOGICAL CHEMISTRY

R. A. Gortner, *chairman,*

A. W. Dox, *secretary*

Diet and sex as factors in creatinuria in man: Howard B. Lewis and Genevieve Stearns. There appears to be no direct relation between the phases of the menstrual cycle and the appearance of creatine in the urine of the normal adult female. Protein *per se* is not a causal factor in the production of creatinuria and there is no more tendency toward the production of creatinuria by high protein diets during the menstrual than in the intermenstrual periods. The retention of creatine ingested *per os* by women does not differ markedly from that by men.