tained both in Dr. Forbes's paper and in the resolution; and, as it is a question of deciding on a system of units to be used in measuring the nutritive energy of farm feeds and of obtaining cooperation and support for a certain program of work for the Pennsylvania Institute of Animal Nutrition, he feels that some further discussion is justified.

The following statements seem to the writer particularly questionable:

(*From Dr. Forbes's article*)

The net-energy conception of Armsby is the simplest and most inclusive of all general measures of nutritive value. . . .

But net energy is the best possible standard for the expression of the most extensive nutritive requirement, and is, in this sense, the best possible single measure of food value generally.

(*From the resolution*)

These investigations (of Dr. Armsby) . . . have furnished the most accurate quantitative measure of the productive value of different feeding stuffs. . . .

The society endorses the Armsby conception of net-energy values derived from his researches with the respiration calorimeter.

The subject of the energy values of foods is a complicated one. Further articles on it from this laboratory have already been prepared for publication, and further experimental work has already been started. But certain important aspects of the situation may be briefly outlined here.

In Armsby's calorimetric experiments the quantities of heat given out by an animal are compared in two different periods, in which it receives different amounts of a given food. The extra heat given out in the period in which the larger amount of food is consumed is taken as the energy expended in the consumption of the extra food given in that period, and the net energy of the food in question is found by subtracting the energy expended in its consumption as above determined from its total metabolizable energy.

A study of Armsby's work makes it quite clear that a considerable part of the "energy expended in food consumption" in his experiments is expended through increased muscular activity of the animals during the periods in which they receive the larger amounts of food. All energy lost through muscular activity, therefore, is counted as waste in Armsby's system; and it is clear that the net-energy values are not a general measure of the nutritive energy of foods, but at best a measure of the nutritive energy for the special purposes of maintenance and fattening. Other physiological considerations make it questionable whether the net-energy values can be accepted as a measure of the relative values of different foods under practical conditions even for the purposes of maintenance and fattening.

The muscular activity of animals is under the control of the central nervous system, and it is doubtful, therefore, whether its extent under different conditions will be subject to any simple mathematical law. In Armsby's experiments muscular activity is a considerable factor in the energy expended in the consumption of the feeds used by him. If his figures for net energy are to hold good under practical conditions, therefore, it must be assumed not only that the muscular activity stimulated by a given food will be proportional to the quantity of food given, but also that the relative amounts of muscular activity stimulated by different foods under practical conditions will be the same as under the very unusual conditions which obtain in the calorimetric experiments. To the writer both of these assumptions seem highly improbable; and he feels that for this and other reasons it is still far from settled whether figures obtained in such calorimetric experiments as those of Armsby will be of value in comparing different foods for practical use. These experiments have been carried on for about twenty years now, and an extensive table of net-energy values has been published. It is desirable that at this point in the progress of the science of nutrition the net-energy values already in existence should be thoroughly tested out in long-continued practical experiments to determine whether they are a better index of the values of foods for the maintenance and fattening of cattle than are the total digestible nutrients which have been used in the past.

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SCIENTIFIC BOOKS

The Cactaceae, Descriptions and Illustrations of Plants of the Cactus Family. By N. L. BRITTON and J. N. ROSE. The Carnegie Institution of Washington. Vol. I, 1919; Vol. II, 1920; Vol. III, 1922; Vol. IV, 1924.

THE Cactaceae, an exclusively American family of plants of wide geographical range and of varied economic importance, has long needed a thorough revision. Several attempts had been made before, chiefly in Europe, where these plants always were favorites and where quite a special literature treats of their cultivation.

We are therefore much indebted to the Carnegie Institution of Washington for having taken up this matter, at the recommendation of Dr. D. T. MacDougal, in 1912, and to the authors, Drs. Britton and Rose, for their comprehensive monograph.

The authors began their work about 20 years ago. They carefully examined the previous literature, went to Europe to look up the types preserved in the great herbaria or still in cultivation in the collections of public and private botanic gardens, and besides visited and collected cacti in almost every country in the Americas. Thus the authors brought together a most complete collection of herbarium specimens, photographs and drawings as a basis for their work. These large and unique collections are preserved at the Smithsonian Institution in Washington and at the New York Botanical Garden, to which institutions every future student will have to turn. The amount of work involved in this study can hardly be overestimated, but to every student of this family the difficulties which were to be overcome are at least partly known.

The whole monograph consists of four large quarto volumes, beautifully printed and freely illustrated with drawings and photographs in the text and with excellent plates, most of them from colored drawings of Miss Mary E. Eaton, the able artist of the New York Botanical Garden. These plates, besides being most useful to the student, add a great deal of charm to the books and give to the uninitiated at a glance an idea of the wealth of forms and colors of the cactus family.

The whole work describes 1,235 species under 124 genera. Most of these genera have been revived or are newly proposed by the authors. I see in these many newly created genera, the greatest progress made in our knowledge of these plants. They all form well circumscribed and natural groups and convey to us a precise picture of the development or the evolution of these strange plants, which was completely obscured under the old 20 to 24 collective and arbitrary genera of the older monographs.

In looking through these four volumes we are gratified to see the painstaking care of the authors to do justice to their fellow-workers and the enormous amount of new facts and data, which will make this the standard reference work for generations to come. A complete index of the four volumes, carefully compiled by Miss Rebecca Rose, adds to the value of the work for its ready use.

It is to be hoped that the efforts of both the Carnegie Institution and the authors will find ample reward in the increased interest of botanists as well as of the general public in this marvellous entirely American family of plants. The work is purely systematic, but it suggests on every page any number of biological problems which are still to be solved and which will prove the cacti to be one of the most promising fields for investigation.

It is impossible here to enter into detail, tempting as it may be. We must leave that to the reader himself. The authors deserve great credit for their work and the Carnegie Institution is to be congratulated on having presented such an elegant series of volumes to the students and lovers of plants.

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LABORATORY APPARATUS AND METHODS

A SHORTER CELLOIDIN METHOD

THE celloidin method of embedding has never enjoyed the popularity of the paraffin method among botanists, and some laboratories have now abandoned it or employ it only when the desired results can not be obtained by other means. This antagonistic attitude has undoubtedly arisen because of the length of the process, the need of a long series of celloidin solutions, and the application of heat, which is detrimental to delicate tissues, for long periods of time. These objections have been surmounted in a shortened process now employed in this laboratory wherein air pressure is used and only two celloidin solutions are needed.

The pressure tank, which can be manufactured by a millwright for a nominal sum, is made from a piece of iron pipe six inches in diameter and one foot in length with the lower end closed by a cap and the upper bearing a flange two inches wide and about one inch in thickness. A cast iron cover, the diameter of which equals that of the flange, is fitted with an automobile tire valve to permit the introduction and release of air. This cover is ground smooth on the lower surface and by means of eight bolts can be drawn tightly down on to a rubber gasket laid over the flange. Approximately 30 two-ounce bottles can be placed in a tank of this size, providing pieces of wire gauze are inserted between the layers.

The material to be embedded is covered with two per cent. celloidin in uncorked bottles, placed in the tank, and subjected to an air pressure of approximately 100 pounds per square inch for 30 minutes. Slightly lower pressures have been used with good results, but it has been impossible to obtain much higher pressures with a hand-operated tire pump. After the half-hour interval the pressure is slowly released through the valve, the material transferred to 16 per cent. celloidin and the process repeated. A few shreds of celloidin will then serve to thicken the matrix at room temperature, and hardening in chloroform may take place the following day.

To date this method has been used on only two types of material. Dormant buds of trees and woody plants showed an imperfect penetration, nevertheless the infiltration was much better than that obtained by the older method. Cambial material of woody plants, together with the adjacent phloem and xylem, showed excellent penetration with no distortion of the delicate tissues, and cuttings taken in both the resting