twenty years of study. It is a fine example of coöperative work in discovering the relationships of an unusually difficult group. Not only was field material studied, but the plants were cultivated in greenhouses. The work also involved visits to Europe to examine type material, and also extensive field trips into the various cactus regions. The work was financed not only by the Carnegie Institution, but was aided also by the New York Botanical Club, the U. S. National Museum and the U. S. Department of Agriculture. As a result, 1,255 species are presented, under 124 genera.

There is also an increasing number of publications dealing with special subjects, especially cytology. Attention may be called to the work of Stomps[9] on heredity and cytology, which summarizes the most important recent results. It presents the subject under three general divisions, namely, the cell, with its ordinary division and reduction division; heredity, calling attention to the functions of the nucleus; and the relation of chromosomes to heredity. In connection with this last topic an account is given of the important researches, and the opinion is given that Morgan's work with Drosophila will hold.

Another cytological work by Schürhoff[10] is a monograph on plastids, dealing with the details of their morphology, cytology, composition, physiology and pathology. It is a general summary of our knowledge of plastid organization and behavior and brings together a mass of scattered information.

In this connection, attention should be called to the fourth edition of Chamberlain's[11] "Methods in Plant Histology." This edition is an excellent illustration of the rapid advances in cytological technique. The first edition was published in 1901, the second in 1905, the third in 1915, and now it was found necessary to almost completely rewrite the fourth edition. Since this book is a standard in its field, this edition will serve the purpose of bringing much technique up to date.

An interesting and unique book, which occupies a field of its own, is by Trelease.[12] It is a companion to his "Plant Materials of Decorative Gardening," published in 1917. It is a pocket manual for field use, and presents keys for the recognition of woody plants in winter, when the flowers and leaves used by the ordinary manuals are lacking. It enables one to recognize a plant from its winter twigs, using such characters as leaf scars and bud and pith characters. Since the characters used are "small differences in small parts," a pocket lens is necessary, supplemented by text illustrations. The Conifers are excluded, because they are evergreens, retaining the characters used in classification. The amount of work involved in this assembling of a new group of characters may be inferred from the fact that 328 genera are described in 94 families. There was no attempt to differentiate all the species and varieties, but this little book will certainly make an excellent companion in winter botanizing.

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9 Stomps, Theo J., "Erblichkeit und Chromosomen," Jena. 1923.

10 Schürhoff, Paul N., "Die Plastiden," Berlin. 1924.

11 Chamberlain, C. J., "Methods in Plant Histology," University of Chicago Press. 1924.

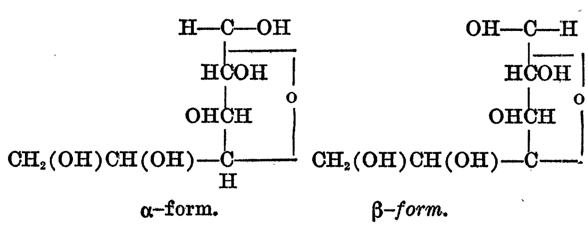
12 Trelease, Wm., "Winter Botany," Publ. by author, Urbana, Ill. 1925.

SPECIAL ARTICLES

ON THE α- AND β-FORMS OF SUGARS AND OF SUGAR DERIVATIVES

THE differentiation between the α- and β-forms of sugars is accomplished according to a rule introduced by Hudson. According to this rule, in a pair of sugars either substituted or non-substituted, the one with a higher dextrorotation (or lower levorotation) is recognized as the α-form and that with a lower dextrorotation (or higher levorotation) is regarded as the β-form. The rule of Hudson led to many important conclusions regarding the configurational relationship of carbon atom (1) of simple and complex sugars. The rule, however, was based on an entirely arbitrary principle. In the course of recent work, there arose doubts as to the applicability of Hudson's rule to every sugar derivative. This circumstance led to a new method for differentiation between the α- and β-forms which is based on a rational and not an arbitrary principle.

If solid models of the α- and β-forms are constructed, it becomes evident that the mutual relationship of the free hydroxyl on carbon atom (1) and of the extra nuclear carbon atom or atoms are different for the two forms. Thus, for the common glucose, the arrangement will be the following:



α-form. β-*form.*

It is seen that in this instance the old α-form may be regarded as a trans-form with respect to the rigid ring and the old β-form as the "cis" form. In the <1, 4> oxidic galactose the α-form is the cis-form and the β- the trans-form. The arrangement will be analogous to malic (cis) and fumaric (trans) acids. In the latter group of acids the trans-forms are distinguished from the cis-forms by their melting points and other physical properties. Also in the sugar series the trans-forms should possess a higher melting point, and this property may serve for differentiation between the two forms of sugars. If it is agreed to name as α-forms all those in which for the d-series the hydroxyl of carbon atom (1) is to the right, then for the $<1, 4>$ oxidic glucose the α-form is the trans-form and for the $<1, 4>$ oxidic galactose, it is the cis-form. A survey of sugar derivatives in the light of the new principle is in progress.

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IRON BACTERIA

AT the Iron Spring near Mirror Lake in the Yosemite National Park the writer collected some ocherous scum. On microscopic examination the material was found to contain the iron bacteria: *Leptothrix ochracea* Kützing, *Spirophyllum ferrugineum* Ellis and *Gallionella ferruginea* Ehrenburg. *Crenothrix polyspora* Cohn may have been present, but its identification was not certain. The discovery is of interest because of the presence of Gallionella and because of the mode of occurrence. Gallionella is reported by Harder[1] as known to him in only three localities in the Unitde States; and has since been reported by Inman[2] as occurring in the chalybeate spring at Yellow Springs, Ohio.

The Iron Spring water in the Yosemite, which apparently filters through the granitic talus and morainal material prevalent in that part of the valley, issues as a seep through rich, black, sandy soil. The amount of iron available in the water has not been determined but is probably insignificant. A clear spring for drinking has been made by sinking a tile in the soil.

The collections of the bacteria were made from the small pools and seeps directly on the black soil where the scum was exposed to air and partially protected from sunlight by the foliage. Gallionella particularly has not been found previously in the open. Harder cites it from mine tunnels and from water supply pipes. Inman[3] reports it as occurring within the mouth of the Yellow Spring.

[1] Harder, E. C., "Iron-depositing Bacteria and their Geologic Relations," U. S. Geol. Survey Professional Paper 113, 1919.

[2] Inman, O. L., "Iron-depositing Bacteria." SCIENCE, n.s. 58, p. 13, 1923.

[3] Personal communication.

The water from the Iron Spring is encrusting pebbles and twigs, and below the spring for some distance the rust-colored coating can be noticed. The encrusting material, examined under the microscope, shows granules of the iron hydroxide, and also what appears to be the deformed tube-like Leptothrix. Nothing suggesting the other bacteria was found in the coating.

O. L. Inman reports as follows on the iron bacteria from the Yosemite:

> The collected material contains Leptothrix, Spirophyllum, and Gallionella, the first in greatest abundance. The staining of the iron bacteria has been noted as a difficult matter (c.f. Harder). As a rule they stain with great slowness, if at all. The Yosemite iron bacteria stained very rapidly both with methylene blue and carbol fuchsin. No definite reason can be assigned, though several suggestions may be made to explain the difference in staining properties. It may be due to differences in the organism, but variations in the thickness and penetrability of the sheaths must be considered. It should be remembered that it is the organism and not the sheath which absorbs the stains. Organisms having thick sheaths—possibly because there is more iron in their environment—may therefore not absorb the stains readily. In some instances it is not possible to tell whether the organisms are alive or dead; staining properties will, of course, differ. The specimens from the Yosemite absorbed the stains more rapidly than any I have seen, *i.e.*, in a few seconds.

The writer also found iron bacteria, chiefly Gallionella and Spirophyllum, in the scum on springs at and just above high tide level at the foot of the low sea-cliffs at Moss Beach, California, some twenty miles south of San Francisco along the sea coast. The springs represent the seepage from the poorly consolidated, coarse, Pleistocene sands. Unlike the Yosemite occurrence of the bacteria there is plentiful iron present, since the sand grains are coated and loosely cemented with the iron oxides.

A question which the last occurrence of the bacteria raises is in regard to the possible influence of iron bacteria in the original deposition of the iron oxide cement of the sands. Bacteria, iron bacteria among many other forms, may be important factors in the cementation of sand and gravel materials. Such would be a logical conclusion to draw from the results of recent studies in bacterial deposition: not only does the activity of the low forms of life provide material for the mass of rocks themselves, but also the material for binding clastic sediments. However, very little direct evidence is at present available regarding this sort of cementation.

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