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.

P. A. LEVENE
H. A. SOBOTKA
THE ROCKEFELLER INSTITUTE

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.

A. C. SWINNERTON
ANTIOCH COLLEGE,
YELLOW SPRINGS, OHIO