salt becomes microscopic in one place; while phosphorus at least three times shows its affinity for o by taking up this letter into its last syllable; but all of these are changes which occur frequently in the composing room, and are of minor importance. The reviewer would prefer the Latin to the hybrid spelling of sulfur, the name columbium to niobium throughout, and diatomaceous to infusorial earth (since there are no infusoria in it). He also does not believe that classification of minerals by their metals is less scientific than by their non-metals; but that every one does not agree on such matters is an advantage to science, and not a detriment to this book.

To sum up: Because of the excellent illustrations, the up-to-dateness, and the practical nature of the information furnished, there would seem to be room for this "Mineralogy" even in a somewhat crowded field.

Edgar T. Wherry
U. S. Department of Agriculture

SPECIAL ARTICLES

ACID PRODUCTION BY A NEW SULFUR-OXIDIZING BACTERIUM

In a series of investigations on the oxidation of sulfur, which resulted in the isolation of a very strong sulfur-oxidizing bacterium, a striking fact has presented itself, namely, an intense oxidation of sulfur to sulfuric acid and a large accumulation of acids, even in the absence of neutralizing substances.

The organism is autotrophic, *i.e.,* is able to derive its energy not from the decomposition of organic substances, but from the oxidation of sulfur, although the presence of organic substances is not detrimental to its activities. The carbon, necessary for the building up of its body substances, is derived from carbon dioxide of the air. In a medium entirely free from any traces of organic materials and carbonates and containing ammonium salts as sources of nitrogen and some inorganic minerals, the organism rapidly oxidizes sulfur into sulfuric acid; the latter acts upon neutralizing substances present in the medium (tricalcium-phosphate has been used chiefly) transforming them into salts and acid salts; when all the neutralizing substances present have been used up, free acids begin to accumulate.

Free acidity was measured both by titration, using phenolphthalein as an indicator, and by the determination of the concentration of hydrogen ions, using the phonolsulfonephthalein series of indicators added to buffer solutions. For the determination of the highly acid solutions, tropaeolin 00, methyl-violet and mauvein were used and the results checked up by the electrometric method.

The following table is typical of the acid accumulation by the organism:

TABLE I

Age of Culture	P_H	Titration. C.c. of N/10 Alkali Required to Neutralize 1 C.c. of Culture
At start	5.6	0.16
33 days	2.2	1.25
61 days	1.8	2.25
85 days	0.58	4.00

The titration does not give a true indication of the true acidity of the medium, and, although the culture, when 83 days old, was equivalent to 0.4 N acid by titration, the presence of large amounts of soluble phosphates in the medium would tend to diminish the actual free acids in the medium. But the P_H value gives a true indication of the acid concentration of the medium. The highest concentration of acid ever reported for a living phenomenon was the production of citric acid by *Aspergillus niger,* which reaches a P_H equivalent to 2.0–1.8 (Clark and Lubs[1]). The acidity produced by this sulfur-oxidizing organism, as expressed in terms of P_H—0.58—is greater than that of any acidity ever reported for biologic phenomena.

A detailed study on the sulfur oxidation by this organism will soon be published in *Soil Science.*

Selman A. Waksman,
Jacob S. Joffe
N. J. Agricultural Experiment Station

[1] W. M. Clark and H. A. Lubs, *J. Bact.,* 2, 1917, 1–34, 109–136, 191–236.