81; and this company, to which the United pipe-lines have also been transferred, is said to have $15,000,000 invested in plant for the transport of oil to tide water. They operate a total of 880 miles of main pipe-line alone, ranging from 4 inches to 6 inches in diameter; or, adding the duplicate pipes on the Olean New-York line, we have a round total of 1,330 miles, not including loops and shorter branches, and the immense network of the pipes in the oil regions proper.

A general description of the longest line will practically suffice for all, as they differ only in diameter of pipe used, and power of the pumping-plant. As shown on the map, this long line starts at Olean, near the southern boundary of New-York state, and proceeds by the route indicated to tide water at Bayonne, N.J., and by a branch under the North and East River, and across the upper end of New-York City to the Long-Island refineries. This last-named pipe is of unusual strength, and passes through Central Park. The following table gives the various pumping-stations on this Olean New-York line, and some data relating to distances between stations and elevations overcome: —

Pumping-stations.	Miles between stations.	Elevation above tide.	Greatest summit between stations.
		Feet.	Feet.
Olean	–	1,490	–
Wellsville	28.20	1,510	2,490
Cameron	27.91	1,042	2,530
West Junction	29.70	911	1,917
Catatonk	27.37	869	1,768
Osborne	27.99	1,092	1,539
Hancock	29.86	922	1,873
Cohecton	26.22	748	1,854
Swartwout	28.94	475	1,478
Newfoundland	29.00	768	1,405
Saddle River	28.77	35	398

On this line two 6-inch pipes are laid the entire length, and a third 6-inch pipe runs between Wellsville and Cameron, and about halfway between each of the other stations, 'looped' around them. The pipe used for the transportation of oil is especially manufactured of wrought-iron to withstand the great strain to which it will be subjected. The pipe is made in lengths of 18 feet, and these pieces are connected by threaded ends and strong sleeves. The pipe-thread and sleeves used on the ordinary steam and water pipe are not strong enough for the duty demanded of the oil-pipe. Up to 1877, the largest pipe used on the oil-lines was 4-inch, with the usual steam thread; but the joints leaked under the pressure, 1,200 pounds to the square inch being the maximum the pipe would stand. This trouble has been remedied by the pipe of the present day, which is tested at the mill to 1,500 pounds' pressure, while the average duty required is 1,200 pounds. As the iron used in the manufacture of this line-pipe will average a tensile test strain of 55,000 pounds per square inch, the safety factor is about one-sixth.

The line-pipe is laid between the stations in the ordinary manner, excepting that great care is exercised in perfecting the joints. No expansion joints or other special appliances of like nature are used on the line, so far as we can learn; the variations in temperature being compensated for, in exposed locations, by laying the pipe in long horizontal curves. The usual depth below the surface is about 3 feet, though in some portions of the route the pipe lies for miles exposed directly upon the surface. As the oil pumped is crude oil, and this, as it comes from the wells, carries with it a considerable proportion of brine, freezing in the pipes is not to be apprehended. The oil, however, does thicken in very cold weather, and the temperature has a considerable influence on the delivery.

A very ingenious patented device is used for cleaning out the pipes, and by it the delivery is said to have been increased in certain localities fifty per cent. This is a stem about 2½ feet long, having at its front end a diaphragm made of wings which can fold on each other, and thus enable it to pass an obstruction it cannot remove. This machine carries a set of steel scrapers somewhat like those used in cleaning boilers. The device is put into the pipe, and propelled by the pressure transmitted from the pumps from one station to another. Relays of men follow the scraper by the noise it makes as it goes through the pipe, one party taking up the pursuit as the other is exhausted. They must never let it get out of their hearing, for, if it stops unnoticed, its location can only again be established by cutting the pipe.

At each station are two iron tanks 90 feet in diameter and 30 feet high. Into these tanks the oil is delivered from the preceding station, and from them the oil is pumped into the tanks at the next station beyond. The pipe system at each station is simple, and by means of the 'loop-lines' before mentioned, the oil can be pumped directly around any station if occasion should require it.

The engines vary in power from 200 to 800 horse-power, according to duty required. They are in continuous use, day and night, and are required to deliver about 15,000 barrels of crude oil per 24 hours, under a pressure equivalent to an elevation of 3,500 feet.

The enterprise has been so far a great engineering success, and the oil delivery is stated on good authority to be within two per cent of the theoretical capacity of the pipes. From a commercial stand-point, the ultimate future of the undertaking will be determined by the lasting qualities of wrought-iron pipe buried in the ground, and subjected to enormous strain. Time alone can answer this question.

THE STUDY OF BACTERIA.

This is the best summary of the methods best adapted for bacterial research that has as yet been published. It contains little that is

Die methoden der bakterien-forschung. Von Dr. Ferdinand Hueppe. Wiesbaden, *Kreidel*, 1885. 8+174 p., illustr. 8°.

not necessary; and yet, with this book in hand, the beginner may feel sure of not going astray, if he follows the directions laid down in it.

The book opens with a brief statement of the various classes of bacteria, which is followed by a consideration of the theory of spontaneous generation, and the principles upon which sterilization depends. These latter are very well and briefly stated. The various methods of sterilization are spoken of and explained, and due prominence is given to the method of 'discontinuous' or 'intermittent' sterilization so much used at present.

The second chapter is devoted to the various forms of bacteria, and to an elucidation of the microscopic technique. The method of observation of unstained and stained bacteria is fully shown, and the general principles of the aniline colors are explained. Here are brought together, in a convenient form, all the various staining-fluids of Koch, Ehrlich, etc., with their formulae. The various accessories in the way of reagents and instruments, are, of course, included.

The importance of the bacillus of tuberculosis in furnishing a conclusive method for the diagnosis of this disease leads the author to devote a number of pages to the methods of staining this organism; and all workers in this branch of investigation will be glad to find the full account of the methods of staining *spores* which is given. The method of treating sections of the tissues for purposes of showing bacteria contained in them closes this portion of the work. The various culture methods and materials are clearly given; and the formulae for the various nutritive media, are, of course, added. The advantages of the solid over the fluid cultures are so manifest as to need but a very few words; but these advantages are here so clearly set forth, that any sceptic may be convinced if he will but read the evidence.

Something is said of the saprophytic and parasitic bacteria, and a summary of the general biological problems involved is given.

The book closes with a few words on the special investigation of earth, air, and water.

All the more important implements needed are figured in very good woodcuts, and there are two lithographic plates showing various culture colonies and stained bacteria.

The work is a good one, and well done. It is especially needed at the present time of interest in all that belongs to bacteriological research, and will certainly prove useful to any one interested in the subject who is able to translate easy German.

SAPORTA'S PROBLEMATICAL ORGANISMS OF THE ANCIENT SEAS.

FOSSIL algae are proverbially difficult and unsatisfactory subjects for study. Usually of irregular and variable forms, without definite and characteristic surface-markings, and composed only of cellular tissue which has entirely disappeared, they have left shadowy outlines, or mere casts, that afford only the most general and superficial characters for comparison among themselves or with living plants: hence there must be considerable uncertainty in regard to the botanical relations of even those best preserved; while those which are more obscure are liable to be, and have been, confounded with tracings made by floating objects, the tracks or burrows of annelids, with sponges, alcyonarians, medusae, and other soft-bodied and perishable organisms. Yet the supposed remains of seaweeds are so abundant in rocks of all ages, from the Cambrian up, that they could not be ignored; and a large number of more or less distinct imprints, some of which are unmistakable algae, have been figured and described by Sternberg, Brongniart, and other writers on fossil botany who have followed them. Count Saporta is one of the latest and most learned of these writers, and one who has done much excellent work in his studies of the mesozoic and tertiary plants of France. In his valuable and voluminous contributions to the 'Palaeontologie Française,' and in his 'L'évolution du règne végétal,' he has given a large number of figures and descriptions of what he supposed to be fossil seaweeds, and has attempted a more thorough review of this department of fossil botany than any one else has ventured on. As to the character of much of his material, there can be no reasonable doubt; but some of his specimens are too obscure to warrant any very positive assertions, and in some cases his conclusions have been questioned.

A somewhat sweeping criticism of Saporta's work was recently made by Mr. A. G. Nathorst (*Bull. de la soc. géol. de France*, 3 sér. t. xi. p. 452), who considers that most of his so-called algae are simply casts of tracks or other impressions mechanically made on the sea-bottom.

The work now published is largely a defence of the views heretofore held by Saporta, and it contains figures and descriptions of a number of the casts and impressions which have been the subjects of controversy. Among other things noticed are those peculiar and enigmat-

Les organismes problématiques des anciennes mers. Par le MARQUIS DE SAPORTA. Paris, 1884. 4°.