

interest, but they at any rate show the capability of this method for the examination of subjects which would in the ordinary way be considered beyond the reach of experiment. It is hardly necessary to say that the examples given by no means reach the limit of what may be done, I have examined the explosions produced by fifteen-grain fulminate of mercury detonators and of heaps of iodide of nitrogen, a material which is rather unmanageable, as if a fly even walks over it it violently explodes. In these cases the explosive flash was used to make the B gap of Fig. 4 conducting, for which it answered perfectly. One might in the same way examine the form of the outrush of powder gases past the bullet, and so find at once their velocity with respect to the velocity of the bullet, and I see no great difficulty in tracing, if this should be desired, the whole course of a single bullet for perhaps as much as 100 yards by means of photographs taken every few inches on its way. Though it may not be evident that these or similar experiments are of any practical importance, there can be no doubt that information may be readily obtained by the aid of the spark photograph, as in fact has been shown by Prof. Mach, Lord Rayleigh, Mr. F. J. Smith, and others, which without its aid can only be surmised, and that if, as in other subjects, the first wish of the experimentalist is to see what he is doing, then in these cases surely, where in general people would not think of attempting to look with their natural eyes, it may be worth while to take advantage of this electro-photographic eye.

I wish in conclusion to express my obligation to the gentlemen to whom I have already referred, to Messrs. Chapman and Colebrook for their assistance, and to Messrs. Moore and Grey for having supplied me with weapons and ammunition.

MICRO-ORGANISMS AND THEIR INVESTIGATION.¹

AS the field of bacteriological investigation becomes extended, we have of necessity constant additions to the various methods rendering possible the pursuit of researches in these novel directions. We have only to look at the first edition of Hueppe's "Methoden der Bakterien-Forschung," published in 1885, consisting of 174 pages, and compare it with the bulky volume of 488 pages which forms the fifth edition, to see at a glance the advance which has been made in the matter of methods alone. In Flüggé's "Die Mikro-organismen" we have another type of book, dealing exclusively with micro-organisms themselves, and the information which has been gathered together concerning them, whilst all details of bacteriological practice are purposely omitted. Dr. Günther has attempted a welding together of these two types of book, special attention being given to microscopical technique with which his name is indeed more particularly associated.

The first part is devoted to a survey of our knowledge concerning bacteria in general, commencing with the earliest observations of Leeuwenhoek in 1683. In this review we find an account of their morphology, the principles upon which their classification is attempted, &c., together with a detailed account of the most recent methods for their cultivation and subsequent study, including careful directions for the use of the microscope, and a most elaborate description of the available means for staining bacteria.

The second part is confined to a consideration of the best-known pathogenic and non-pathogenic micro-organisms.

There could not be a more admirable account of the

¹ "Einführung in das Studium der Bakteriologie." By Dr. Carl Günther. Second Edition. (Leipzig: Georg Thieme.)

"Technique Bactériologique." By Dr. R. Wurtz. Encyclopédie Scientifique des Aide-Mémoire. (Paris: Gauthier-Villars et fils, 1892.)

numerous manipulations involved in bacteriological investigations; all the minutiae are described with the utmost care, and what is usually left for the student to learn in "profiting by his experience" is here carefully anticipated, and if he tumbles into any pitfalls, it is not because he has been without warning.

With such a big task as Dr. Günther has set himself it is not surprising to find some parts less amply dealt with than they would seem to deserve. Thus we find but a very meagre supply of culture media given, there is no mention of the preparation of milk, or of the special solutions employed by Pasteur, Naegeli, and others, neither is there any account of Kühne's silica jelly, which since our knowledge of the fact that certain organisms will only flourish in media devoid of all organic matter, ought surely to have been included.

On the other hand a minute description is given of gelatine-plate, dish and tube cultures, as well as of the most modern methods for the anaërobic cultivation of bacteria, &c. In connection with the abstraction of certain colonies from gelatine-plates, mention may be made of a piece of apparatus (the description of which was only published after Dr. Günther's book appeared) originally devised by Fodor, and called "Bakterien-Fischer," which has been, under the name of "Bakterienharpune," more recently modified and considerably cheapened by Unna. Every one has experienced the difficulty of fishing out a particular colony in a crowded plate, how it is almost impossible to look through the microscope and fix upon the centre to be abstracted, and at the same time keep the needle steady and ensure touching only the one colony which is required. By using the above contrivance, which can be attached to the microscope, the fishing out of such centres is greatly facilitated.

The examination of air for micro-organisms is only very slightly touched upon, as is also the bacteriological investigation of water. It is a little rash to assert that "pathogenic micro-organisms can live for a long time in sterilised water," considering that it has been shown in some cases that their *immersion* only is sufficient to destroy them. Again, no mention is made of Hansen's special methods for the examination of particular waters; although they are opposed to the Koch school, this ought not to preclude a reference to what has been proved by a large number of investigations to be, in some cases, of great practical utility.

The second part opens with a short introduction, in which the nature of pathogenic organisms in general is described, and an account given of the rigid proof which is required before a particular organism may be said to be the cause of a particular disease. Protective inoculation and immunity are briefly referred to, and Metschnikoff's brilliant theories of phagocytosis summarily dismissed, and declared incapable of standing the test of the "careful experimental criticism to which they have been submitted by Flüggé, Baumgarten, and the author's own pupils."

As many as twenty-seven different varieties of micro-organisms are described in the section on the most important pathogenic bacteria. Amongst these we find the micro-organisms associated with anthrax, tuberculosis, diphtheria, cholera, pneumonia, tetanus, typhoid fever, and chicken-cholera, more especially dealt with, an exceedingly useful and comprehensive summary being given in each case of what is known concerning them, together with numerous references to original papers published on the subject. That Dr. Günther is an ardent disciple of Koch's will at once be admitted, when we read the terms in which he speaks of the *Tuberculinum Kochii*: "Eine neue Aera begann nicht allein für die Tuberculoselehre, sondern für die gesammte Medicin, mit der grossen Entdeckung Koch's der Heilung der Tuberculose."

Amongst the non-pathogenic forms we find an account of the *Micrococcus agilis*, which was found by Ali-Cohen in drinking water. This was not the first motile coccus found, as is stated by Günther, for previous to this, Mendoza isolated and described a motile form which he called *Micrococcus tetragenus mobilis ventriculi*. The *Micrococcus agilis* was the second variety found; whilst later, in 1890, Loeffler also discovered and described a motile coccus. It is surprising, therefore, to read that Ali-Cohen's variety is the only motile micrococcus known. The list has further been quite recently (1892) enriched by the discovery by Maurea of a motile sarcina, which he has designated *Sarcina mobilis*.

A fine set of seventy-six photographs, mostly taken from original preparations, together with a very exhaustive index, completes the volume. Amongst the photographic figures the series of twelve representing anthrax in every stage of development from the individual bacteria to their appearance as colonies on gelatine-plates, and growing in test-tube cultivations, are particularly beautiful; the surface colonies photographed after forty-eight hours' growth are especially characteristic and successful.

In the handy little volume "Technique Bactériologique," of Dr. Wurtz, chief of the laboratory for experimental pathology in the Faculty of Medicine in Paris, we have an entirely different stamp of book. We read in his preface: "On ne trouvera, dans ce précis de Technique bactériologique, ni l'histoire, ni l'exposé détaillé des nombreuses méthodes techniques qui ont été préconisées jusqu'à ce jour en microbiologie. Conformément au programme tracé par la Direction de l'Encyclopédie Scientifique des Aide-Mémoire, nous nous sommes efforcés d'exposer, aussi clairement que possible, les notions qu'un débutant doit posséder à fond avant d'aborder l'étude proprement dite des microbes."

Proceeding on these lines Dr. Wurtz gives us a very clear and precise account of all the various important stages passed through in bacteriological manipulations, commencing with a chapter on the principles of sterilisation.

But a novel feature in this volume is the description of the various methods of conducting experiments on animals for bacteriological purposes. This is carefully recorded and supplemented by woodcuts, and would appear to be a most useful addition, for although the possibilities of carrying out such experiments in this country are very limited, yet in those cases where they are permitted such an accurate description of the methods to be adopted should prove very helpful, more especially as in very few of the German and English bacteriological text-books is any account to be found for the information of those desiring to undertake such investigations. A chapter is also devoted to the enumeration of the substances, in as far as they have been investigated, which are elaborated by micro-organisms and a description of the most convenient methods for their successful extraction.

The crisp and concise language which characterises the book, together with the judgment displayed in its compilation, show that the author possesses, not only a full grasp of his subject, but is also highly skilled in the art of communicating it to others.

GRACE C. FRANKLAND.

THE ORDNANCE SURVEY.

A DEPARTMENTAL committee was appointed by the Board of Agriculture in April, 1892, to inquire into the condition of the Ordnance Survey. The committee consisted of Sir John E. Dorington, M.P. (chairman), Sir Archibald Geikie, F.R.S., Mr. Henry W. Primrose, Mr. William Mather, M.P., Mr. H. J. Roby, M.P., and Mr. Charles Fortescue Brickdale, with Major

Duncan A. Johnston, R.E., as secretary. The matters referred to then were:—

1. What steps should be taken to expedite the completion and publication of the new or revised one-inch map (with or without hill-shading) of the British Isles?

2. What permanent arrangements should be made for the continuous revision and speedy publication of the maps—1 in 500 (towns), 25 in., 6 in., and 1 in. scales?

3. Whether the maps as at present issued satisfy the reasonable requirements of the public in regard to the style of execution, form, information conveyed, and price, and whether any improvement can be made in the catalogue and indexes?

After the appointment of the committee Mr. T. Ellis, M.P., asked in the House of Commons a question which showed that there was dissatisfaction with regard to the inaccuracy and incompleteness of the names of places in the map of Wales; and this question was also referred to the committee.

The report of the committee has just been issued, and includes the following recommendations:—

1. That the 1 in. map be produced in the following forms:—
 - (a) An engraved outline map, with contours in black.
 - (b) A black engraved map, with hill-shading either in black or in colour.
 - (c) A coloured map on thin paper, adapted to military purposes, but also on sale to the public.
 - (d) A cheap map by transfer to zinc or stone.
2. That the character of the roads on the 1 in. map be shown in four classes with distinct characteristics.
3. That parish boundaries be omitted from the 1 in. map.
4. That the contours of the sea bottom round the coast line and the depths of inland waters be shown.
5. That experiments be made in the practical application of heliogravure, and that, if results not inferior to an Austrian specimen map which we have seen be produced, that process be substituted for the existing method of engraving hills, and for so much of the country as is then uncompleted in its hill engraving.
6. That special arrangements be made to revise the 1 in. map within the next four years independently of the maps on the larger scales, and that subsequently this map be constantly revised within periods of fifteen years.
7. That the cadastral maps be revised and brought up to date in the next ten years, and that subsequently they be kept revised within periods of fifteen years.
8. That the publication of these revised maps be carried out by contract, if necessary.
9. That detail, such as single trees, footpaths in gardens, &c., be omitted.
10. That the skeleton and coloured forms of the 25 in. and town maps be abandoned, and the uses of both be combined in one edition having the houses cross-hatched.
11. That the reference numbers to parcels of land on the 25 in. plans be abandoned on revision.
12. That to a limited extent additional contour lines be added to the 6 in. map.
13. That on the 6 in. map the contours be always in black.
14. That certain of the engraved plates of the 6 in. map which are not now filled up beyond the county boundary be as soon as possible filled up to the margin of the plate with the detail of the adjoining county.
15. That the cost of the engraved sheets of the 6 in. map and that of the quarter-sheets of the photo-zincographed 6 in. map be equalised by a change of their respective selling prices.
16. That the Welsh names be gone over and corrected before the first revision of that map.
17. That the cadastral maps on the town scales be no longer entirely made or revised at the cost of the State, but that the town authorities be required by statute to maintain these maps.
18. That around towns and in tourist districts the existing sheets of the Ordnance Survey on the 6 in. and 1 in. scales be united so as to form special maps of such districts, and that advantage be taken of these maps to introduce any novelties in cartography that may be thought desirable, as these maps are not required to be joined to the general maps of the United Kingdom.
19. That certain authorities be placed under statutable