course, at low magnifications, leave little to be desired in regard to sharpness and beauty. A collection of Sorby's original polished and etched sections of metals is carefully preserved by the University of Sheffield, and was lent on the occasion of the symposium.

Sorby's discovery aroused little interest, and when, in 1877, Prof. Martens, of Berlin, soon followed by Osmond and by Le Chatelier in Paris, began the study of metals with the aid of the microscope, the work of their predecessor had been forgotten. By this time, however, a general interest in the subject had been awakened, and Sorby's important papers in the Journal of the Iron and Steel Institute in 1886 and 1887 met with a more appreciative audience. By employing higher magnifications, Sorby was able to show that the "pearly constituent" of steel, as he had called one of its principal constituents, owing to the mother-of-pearl lustre often exhibited by it, was in reality an aggregate of parallel plates of a soft and a hard material. This discovery placed the metallography of steel on a firm basis, and prepared the way for the complete explanation of its structure when thermal methods were added to those of the microscope. Great as were the services of other investigators, it is to Sorby that we owe, without question, our modern metallographic methods.

Sorby laid great stress on the extension of our knowledge by the use of higher magnifying powers, so well illustrated by his own discovery of the true nature of pearlite. Most metallographic work is done at magnifications not exceeding 500 diameters, but excellent results have been obtained by some workers with magnifications of 1000 and even of 1500 diameters. The minuteness of many metallic structures, especially those of hardened and tempered steels, has made many metallographers wish for a means of applying much higher magnifications. Since the discovery of new detail depends, not on the magnifying power, but on the resolving power of the microscope, it is necessary to increase the latter. This may be effected either by increasing the numerical aperture of the objective, or by shortening the wave-length of the light used for illumination. The numerical aperture can be increased beyond its present maximum only by the use of other materials than glass, a plan which is likely to be adopted at some future time, whilst the use of ultra-violet light, the magnificent results of which in bacteriology were shown at the meeting by Mr. J. E. Barnard, has so far given disappointing results with metals.

A valuable contribution to the study of highly magnified metal sections was made by the third paper under notice, that by Sir Robert Hadfield and Mr. T. G. Elliot. The numerous and very beautiful plates illustrate both the advantages of high magnifications and the pitfalls which have to be avoided if success is to be obtained. For example, a field containing ferrite and pearlite is shown in three photographs, all taken at a magnification of 600 diameters, but with objectives of different resolving power. With a 12-mm. objective, the pearlite is structureless (Fig. 1), and only when a 2-mm. apochromat is used is its minute lamination fully revealed (Fig. 2). Another pearlite has its structure revealed at 1500 diam. (Fig. 4), but becomes much clearer at 5000 (Fig. 5), using the same objective. No further advantage is shown at 8000 diam. The effect of narrowing the aperture too much is shown by the apparent broadening of the cementite lamellæ in the pearlite, the true breadth being seen very clearly when the iris diaphragm is opened sufficiently. The photographs, all of which are remarkably good, may be said to be most successful in the case of pearlitic structures. The structure of martensite at 5000 diam. is not so clearly seen as at a much lower magnification, whilst the minutely granular structures of troostite and sorbite evidently call for a higher resolving power rather than for mere enlargement to indicate their true nature. The paper will serve a most useful purpose in directing attention to the nature of the problem, and perhaps attracting skilled optical workers and physicists to its solution.

C. H. D.

REPORT OF THE CALCUTTA UNIVERSITY COMMISSION.[1]

AT first sight a report in five volumes, each of upwards of four hundred pages, on the Calcutta University Commission would appear somewhat portentous; but anyone alive to the importance of university education in India who makes a study of these volumes will be quickly reconciled to their length and number. For it may be fairly claimed that they contain scarcely a sentence which one would desire to see omitted. The whole report of the Commission, including evidence and appendices, comprises no fewer than thirteen volumes, but we are here concerned only with the first five. Vols. i., ii., and iii. contain a very masterly analysis of the present conditions of education obtaining in Bengal, and vols. iv. and v. the actual recommendations of the Commission.

Although this report ostensibly deals only with education in Bengal, the greater part of it naturally has bearing on our educational systems throughout India. The whole report is a model of style, and bears testimony to the infinite pains and care taken by its editors. The names of the members of the Commission were a sufficient guarantee of its thoroughness and accuracy. The review of the present conditions of education in Bengal constitutes in itself one of the most valuable documents for the student of British rule in India. Reports, annual and quinquennial, have been issued in quantity from the various secretariats in India, but we know of nothing to compare for thoroughness and instructiveness with the chapters under review.

It is, of course, impossible for us in this place to do more than refer briefly to one or two of

[1] Reports of the Calcutta University Commission, 1917-19. (Calcutta Superintendent Government Printing, India, 1919.) Prices: Vol. i., Part i. 3*s.*; Vol. ii., Part i., 3*s.* 6*d.*; Vol. iii., Part i., 1*s.* 6*d.*; Vol. iv., Part ii., 2*s* 6*d.*; Vol. v., Part ii., 2*s.*

the many important topics dealt with, but before discussing any of these we may mention that the key to the reforms recommended by the Commissioners is the establishment of a Board of Secondary and Intermediate Education. The object they have in view is to secure the admission of students to the university who are duly prepared for higher studies, and the exclusion of those who are not. Under existing conditions an enormous number of candidates are sent up for the matriculation examination who are totally unfit to enter on university studies.

There are, of course, a number of excellent high schools in Bengal, and especially in Calcutta, but there are a far greater number of inferior schools. Their inferiority is due in a great measure to the low standard of the teaching staff. English, for example, is often taught by an Indian on a poor salary, who is not really qualified to teach it. As the time approaches for the matriculation examination, a test examination is held in each school, and on the result of that test candidates are allowed to go in for the university examination. A percentage of marks is demanded of students who are allowed to proceed, but the test varies very much from school to school, and owing to the solicitations of parents and other causes there is a tendency to show great leniency, for so important is the prestige attaching to higher English education that to have failed in the matriculation is already regarded as an achievement. All Anglo-Indians are familiar with the claims that are supposed to attach to a man who has failed in the B.A., his value in the marriage-market being far greater than that of a man who has not sat for the B.A. at all.

The main problems, therefore, which the Commission set itself to solve were: (1) how to improve the higher classes of the secondary schools, and (2) how to secure the admission only of qualified students to university courses. Having convinced themselves of the impossibility of exercising full control of all the secondary schools in the province, which would involve an extensive inspectorate and interference with many private enterprises, the Commissioners came to the conclusion that control could be exercised at the stage now represented by the intermediate stage at universities, and they therefore suggest the establishment of intermediate colleges, which should be either attached to selected high schools or organised as distinct institutions. These colleges should be under the immediate control of the Board of Secondary and Intermediate Education, the constitution of which is representative of all classes. The intermediate colleges should afford instruction not only for the ordinary degree courses of the university in arts and science, but also for the medical, engineering, and teaching professions, and for careers in agriculture, commerce, and industry. There should be two secondary-school examinations: the first, approximately corresponding to the present matriculation, to be taken at the end of the high-school stage, at the normal age of sixteen, or, in special cases, at the age of fifteen, and to be known as the high-school examination; the second, approximately corresponding to the present intermediate, but much more varied in its range, to be taken at the end of the intermediate college course, at the normal age of eighteen, and to be known as the intermediate college examination. Success in this examination should constitute the normal test of admission to university courses.

The constitution of the board is, of course, a very important matter. It is to consist of from fifteen to eighteen members, with power to appoint outside members to sub-committees. The president of the board should be a salaried official appointed by Government, of high status. This board will naturally take a good deal of responsibility out of the hands of the universities, which will, however, be represented on it by seven members, for they will define the curricula, not only of the intermediate colleges, but, as naturally follows, also of the high schools; and they will further conduct the two secondary-school examinations which we have mentioned above. This board will also, of course, relieve the Director of Public Instruction of much detail work, without, however, reducing in any way the importance of his department.

Such is the Commission's proposal for improving the system. The Commissioners have also gone very thoroughly into the all-important question of improving the teaching staffs, which is chiefly a matter of finance. In this connection they have made several important proposals, of which the three following are the most important: (1) That facilities should be given for the interchange of teachers between privately managed schools and Government schools: (2) that teachers in Government schools and colleges should be placed upon a professional rather than a service basis; (3) that a superannuation fund should be instituted to replace the existing pension system for future recruits to the profession. This last suggestion, which is based upon the federated superannuation scheme which has been adopted in the home universities, should do much to encourage recruiting for the Bengal educational service.

One of the most difficult subjects with which the Commission has had to deal was the question of the medium of instruction to be used in secondary schools. Although, as is natural, there is a general desire among Indians that their children should be educated on a bilingual basis, there is an overwhelming mass of opinion in favour of English as the chief medium from the intermediate stage upwards. The difficulty is to decide at what stage to begin to use English as a medium, and for what subjects. The Commission is of opinion that the vernacular should be used for instruction throughout secondary schools for all subjects other than English and mathematics. It was convinced that the use of English in secondary schools as a medium is excessive. The Commissioners are, however, "emphatically of opinion that there is something unsound in a system of education which leaves a young man, at the conclusion of his course, unable to speak or write his own mother tongue fluently and correctly."

There is, we are aware, an ever-increasing desire on the part of Indians to see the vernaculars encouraged and developed; for a long time Englishmen also have aimed at fostering the development of vernacular literatures, and post-graduate research in the vernaculars is already a recognised branch of study. But it is, we feel, important to keep distinct the two objects in view, namely, (1) to provide the best education for schoolboys, and (2) to cultivate the vernacular languages.

Space will not permit us to discuss at any length the cognate subject of the teaching of English, but it may fairly be claimed that hitherto university instruction in English has been conducted on unpractical lines. Textual analysis of seventeenth-century literature on the part of students who have not mastered the modern idiom tends to unintelligent cram. What is wanted is the more rapid perusal of standard modern works. Nothing can be more pitiable than to see a class of Indian students taking down verbatim notes (always in English) from a lecturer on such a book as "Samson Agonistes." This is not the way to learn English for practical purposes, which is the main object of all except those who take English as a subject for their degree. It is satisfactory to note that the Sanskrit College and the Madrasahs have received ample treatment by the Commission, and are to be placed on a better footing.

We have not space to deal now with the important proposals of the Commission in regard to the organisation of the University of Dacca, the reorganisation of the University of Calcutta, and their many recommendations in regard to examinations, women's education, medical education, agricultural education, engineering and technological education, and Oriental studies. We can only congratulate the Commissioners on the admirable report they have produced, and express a hope that their main proposal, the Board of Secondary and Intermediate Education, may become before long a practical reality.

E. DENISON ROSS.

NOTES.

ONE of the most useful functions that can be performed in these days of minute specialisation of scientific research is the promotion of meetings at which workers in various fields can discuss subjects of common interest. Since Sir Robert Hadfield became president of the Faraday Society in 1914, fifteen such discussions have been held, the last, of which an account is given elsewhere in this issue, being in the meeting-room of the Royal Society on January 14, in association with the Royal Microscopical Society, the Optical Society, and the Photomicrographic Society. Sir Robert Hadfield and the secretary of the Faraday Society, Mr. F. S. Spiers, are to be heartily congratulated upon the great interest taken in this discussion, the subject of which was "The Microscope: Its Design, Construction, and Applications," and the exhibition of instruments connected with it. There were meetings in the afternoon and evening, and on both occasions it is scarcely too much to say that as many people were unable to find places in the meeting room as those who filled it to the doors. With characteristic generosity Sir Robert Hadfield entertained a large company to dinner at the Ritz Hotel between the two meetings. The whole session was most successful and encouraging to all who are interested in the advance of British optical science, both theoretical and applied. By organising such joint meetings the Faraday Society is indeed promoting the best interests of both science and industry, and doing what might be undertaken even more appropriately by the Royal Society itself.

AN interesting pamphlet on the work of Faraday and the Faraday Society was prepared by Sir Robert Hadfield in connection with the joint discussion on the microscope held on Wednesday, January 14. It appears that the Faraday Society was chiefly responsible for the appointment of a special Nitrogen Products Committee by the Munitions Inventions Department, and this Committee was, in turn, instrumental in establishing a research department, which provided much valuable information for the practical consideration of sources of nitrogen supply when the submarine campaign made the subject a matter of national concern. One of the members of the council of the society, Dr. J. A. Harker, was entrusted with the direction of this work, and the final report of the Nitrogen Products Committee, which has just been published (Cmd. 482, 4*s.* net), is a most substantial survey of the position of supplies of nitrogen compounds and the practical problems involved in the establishment of processes for nitrogen fixation in this country. Referring in the pamphlet to his own particular lines of work, Sir Robert Hadfield mentions that Faraday, in his experiments on alloys of iron with other elements carried out in 1821 and 1822, was the pioneer of the great technical advances which have been made in alloy steels during the past thirty years. It was Sir Robert's own discovery and invention of manganese steel in 1882 which led others to explore the rich field first entered by Faraday, and has resulted in the production of chromium steel, silicon steel, nickel steel, tungsten steel, and many other types.

THE recent death of Dr. John Wilson, lecturer in agriculture and rural economy in the University of St. Andrews, robs the University and science of a keen and brilliant agricultural biologist. Dr. Wilson was one of the few who regarded agriculture as a sister science of biology rather than as a branch of chemistry, and his work on the improvement of farm crops has borne excellent fruit. Whilst demonstrator in zoology he devoted considerable attention to the development of the common mussel, and published an elaborately illustrated memoir on the subject, but his name will be more permanently associated with his successful investigations on the improvement of such plants as the potato turnip, and oat. He raised an enormous number of new varieties. Amongst those