TEACHING OF MATHEMATICS IN GERMANY.[1]

IN previous issues we have referred to papers on English education in mathematics which were laid before the 1912 International Conference on Mathematical Teaching. We have now before us, in five volumes, the German contribution to that conference. They give an account of mathematics at the primary and secondary schools, at the universities, in technical education, and in training colleges for teachers. They deal mainly with Prussia, but include also the non-Prussian parts of the German Empire, with an occasional reference to Austria.

Germany also has its reform movement in mathematics, and most of the changes that have been made lie to the credit of a body which bears the euphonious name of "der Damnu," into which its full title "Deutscher Ausschuss für den Mathematischen und Naturwissenschaftlichen Unterricht" has for the sake of brevity been telescoped. This body was formed in 1907, by the united action of a number of voluntary scientific associations, and is playing much the same part that the British Association committee has played in this country.

The aims and the present position of the movement are well illustrated by a scheme of teaching proposed by Dr. Schimmack for the Oberrealschule. The scheme covers the nine school years between the ages of nine and eighteen.

In geometry the scheme begins in the manner to which we are now accustomed in England, with measuring, drawing, practice with instruments, and work which familiarises geometrical concepts.

It is noticeable that there is two years' work in geometry before algebra is begun. This procedure, so excellent because of the more abstract and difficult nature of algebra, is not the result of the reform movement, but has long been the practice in Germany. It is a promising sign that the report of the curriculum committee of the Headmasters' Conference advocates this procedure, and gives us leave to hope that in this matter England will follow Germany's lead.

Algebra, then, is begun in the fourth school year, geometry having been begun in the second. It leads off well, with signless quantities, and it is rather a pity that the subject is not carried on for a year or so with such quantities before the distinction between positive and negative quantities is introduced.

The trigonometry of right-angled triangles is to be introduced in the sixth year, as is also "projective geometry" (or cross-ratio geometry). The former proposal would find much support in this country; the value of the second item is not so clear.

In the seventh year the calculus is begun, differential and integral at the same time, a proposal which many in England will approve. Not so many will, however, approve of Dr. Schimmack's relegation of arithmetical and geometrical series to their proper place beside the calculus.

The scheme closes with "discussion of the foundations of geometry," too metaphysical perhaps for most boys; but we must remember that the scheme is intended for the Oberrealschule, and that less ambitious schemes would be appropriate to the Gymnasium and Realgymnasium.

An important note is appended to the scheme to say that throughout the course geometrical figures are to be thought of as variable and not rigid, and that attention is to be directed to the interdependence of the parts as the form of the figure changes.

The consideration of this scheme goes to justify our English reformers in their view that they are not sacrificing thoroughness to the desire to cover ground. It is much that the Germans, with their love of beginning from the very foundations, should declare for "functional thinking" from the start, for the introduction of trigonometry at fourteen or fifteen, and of the calculus at fifteen or sixteen, and should feel it possible to prune the course sufficiently to allow that.

The language of these volumes is at times curiously heavy. One happens on long, long sentences the meaning of which cannot be extracted by ordinary reading; they have to be logically dissected. And such sentences are frequent. Is the accusation true that command of language is spoilt by a mathematical training? Or have the Germans spoilt their language by the replacement of foreign words by sesquipedalian words of home manufacture? Whatever the cause, these volumes contain also the germs of better things. "Der Damnu" has been referred to. "Die IMUK" is a portmanteau word for die Internationale Mathematische UnterrichtsKommission, and "Der DATSCH" for der Deutsche Ausschuss für Technische SCHulen. Some extension of this idea will quickly reduce the most unwieldy sentence to manageable size.

[1] "Abhandlungen über den mathematischen Unterricht in Deutschland-veranlasst durch die Internationale Mathematische Unterrichtstkommission." In twenty-five parts. Herausgegeben von F. Klein. (Leipzig and Berlin: B. G. Teubner, 1909–12.)

"Berichte und Mitteilungen veranlasst durch die Internationale Mathematische Unterrichtskommission." In four parts. (Leipzig and Berlin: B. G. Teubner, 1910–12.)

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE annual conference of the above association was held at Bradford during Whitsuntide. The address of the president of the association (Mr. P. Coleman, Northern Polytechnic, London) dealt mainly with the organisation of technical education, the value of "internal" examinations for technical students as compared with "external" examinations, and the London University Commission report in its bearing upon polytechnic work. He remarked in reference to this:—

"The report and the recommendations based thereon unfortunately show a bias that can only be due to a complete misconception of the work and standing of the London polytechnics. . . . The reasons given in the report appear to be based on insufficient evidence, and at variance with the facts as known to those who have a close acquaintance with the polytechnics."

Mr. Coleman urged the development of "non-vocational courses in the technical schools, partly because in many towns these schools are the only suitable institutions in which to hold such courses for adult students (whether technical students or not), and also in order to bring home to students whose main interest is necessarily the study of science or technology that "the work associated with their future occupation should not lead them to forget every other means of culture." As a practical measure in this direction, he suggested that the technical institutions "should definitely associate with themselves the University Extension Lectures of the locality, or such work as that of the Workers' Educational Association."

Papers were read to the conference upon vocational education, by Mr. Arthur C. Coffin, director of education, Bradford; co-ordination within a county area, by Mr. F. W. Cook, chief officer for technical education for the West Riding of Yorkshire; and the corporate life of technical institutions, by Mr. W. Hibbert, Regent Street Polytechnic, London. A number of sectional meetings were held, attended by teachers of special subjects, at which questions such as the qualifications for the registration of teachers, the syllabuses

and courses of work put forward by various examining authorities, and methods of teaching were discussed.

The principal resolutions passed by the conference dealt with the educational proposals of the Government, and the London University Commission Report. The conference urged the "necessity for improved provision for technical education and the organisation of technical education on a national basis." In addition, attention was directed "to the urgent necessity for increased grants from the State in aid of technical education," higher salaries for teachers to be a first charge upon these increased grants. With regard to the London University Commission report, a resolution was passed unanimously opposing any limitation of the existing facilities for obtaining external degrees, and the proposed exclusion of external students from the examinations in the faculty of technology, including engineering. This resolution also stated that many of the criticisms made in the report concerning London polytechnics and technical institutions are obviously founded on an incomplete knowledge of the work done in these institutions. The association strongly deprecated any weakening of the connection between these institutions and the University in view of the excellent results which have followed in the past as a result of the present relationships between the polytechnics and the University. The higher work in these institutions, whether day or evening, should form an integral part of the organisation of the faculties of science and technology.

A public meeting was held in connection with the conference in the large hall of the Bradford Technical College, the principal speaker being the Right Hon. J. A. Pease, M.P., the President of the Board of Education. During the course of his speech, Mr. Pease emphasised the importance of technical education, especially in the day-time if possible, and the necessity of "gradually bringing into the educational net nearly the whole of the population which left school between the ages of twelve and fourteen." New regulations would shortly be issued which, by means of larger grants and more elastic conditions, would favour the development of junior technical schools, "which would be linked up with the colleges and classes of a superior character." Mr. Pease criticised external examinations "as a waste of money and effort, and resulting in very little good." In concluding, he suggested that the key of the educational situation is to give more power, coupled with greater financial aid from the State, to the local authorities. J. WILSON.

THE NATIONAL PHYSICAL LABORATORY.

THE annual meeting of the general board of the National Physical Laboratory was held recently at the rooms of the Royal Society, when the report and accounts for the year 1912 and the statement of work for 1913 were presented and approved for transmission to the president and council of the Royal Society.

In former years this meeting has usually been held at Teddington during the month of March, and has been combined with an inspection of the laboratory by the members of the board. In consequence of a change in the financial year, the annual inspection will in future be held at a later date. This year it is to take place on Thursday, June 26, when the Right Hon. A. J. Balfour will open the new buildings recently erected.

These buildings complete a scheme initiated in 1909 to provide laboratories for metallurgy and optics, with administrative offices, at an estimated cost of 30,000*l*., exclusive of equipment; of this sum the Treasury undertook to provide 15,000*l*., provided the remainder were forthcoming from other sources.

In 1910 the late Sir Julius Wernher generously provided 10,000*l*. for the erection of the metallurgy laboratory, and on learning lately that the actual cost had exceeded the sum available by 936*l*., Lady Wernher most kindly defrayed the deficit.

To secure the further sum necessary for the completion of the scheme, and to obtain funds for the equipment of the buildings, an "Additional Funds Committee," of which the late Sir William White was chairman, was appointed during 1912. In its report this committee states that the Royal Commissioners for the Exhibition of 1851 had generously given a donation of 5000*l*. to the building fund, thus completing, with the gift from Sir Julius Wernher, the 15,000*l*. required to meet the Treasury grant.

Generous help towards the equipment has been received from many sources, including a number of the City companies. The committee, however, points out that considerable sums are still necessary to provide adequately the equipment which is essential for the proper development of the work.

The block of buildings for optics and administration is now nearly complete, and it is to open these that Mr. Balfour has promised to be present on June 26.

ATMOSPHERIC REFRACTION IRREGULARITIES.

THE anomalies of atmospheric refraction are numerous, and at various times irregularities extending over periods of one minute, one day, and one year have been discussed, that of the order of one second being generally known and causing "unsteady seeing." The variation of the order of one minute was discovered by Nusl and Fric experimentally in 1908, and they concluded that this irregularity had an amplitude of nearly a second of arc. The existence of such a large amplitude and its importance in meridional work suggested to Prof. Frank Schlesinger a redetermination by a perfectly independent method, and this he has done and described in a recent number of the Publications of the Allegheny Observatory (vol. iii., No. 1). He has based his measures on photographs of ordinary star trails made with the help of stationary long-focus instruments, and these he has had secured for him, according to a programme, by Prof. Slocum with the 40-in. Yerkes refractor, and Prof. Seares with the Mount Wilson 60-in. reflector, the star trails being those of the Pleiades group. The result deduced from the Yerkes plates, as is illustrated by curves in the publication, is to show the presence of this slow fluctuation, every one of the seven trails remaining at times above or below its mean position for a considerable fraction of a minute.

The same series of photographs was used to determine whether neighbouring stars showed the same fluctuations and whether the minor fluctuations were real. The curves plotted from these photographs thoroughly endorsed both these views, one figure showing the fluctuations of Merope and Alcyone as absolutely identical. To decide whether such one-minute fluctuations were common to mountain sites as well as low-lying situations, the Mount Wilson photographic trails were employed, and handled in the same way. The conclusion drawn was that the irregularities were of the same character, the amplitude being of the same order and the extreme range about one second of arc. Prof. Schlesinger thus directs attention to the fact that these results set a limit of accuracy to meridian work and show that photographic determinations of the distance between