

association." This conference had been preceded by the international meeting in Brussels of representatives of the scientific academies of the Allies, at which meteorology was amongst the subjects considered. A Geodetic and Geophysical Union was set up, one of its branches being meteorology with Sir Napier Shaw as chairman and Dr. Marvin (of the U.S. Weather Bureau) as secretary. A meeting in Paris followed, summoned by the French Government, at which a new international meteorological committee was appointed, with Sir Napier Shaw as president, in continuation of the old committee. A further

complication arises out of the convention relating to aerial navigation, which formed part of the work of the Peace Conference, and by Annexe G regulates "the collection and dissemination of statistical, current, and special meteorological information."

What shape international co-operation may ultimately take is sufficiently obscure, but it is satisfactory to know that Sir Napier Shaw, who has been responsible for so great a development in the past, is to continue to act as president of the new International Committee.

E. M. W.

## Proposed British Institute for Geodetic Training and Research.<sup>1</sup>

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GOOD maps are necessary for the development of a country, for such purposes as defining property boundaries, limits of mining and other concessions, and so on, as well as for such engineering purposes as railway, road, and canal schemes, hydro-electric schemes, water-supply, irrigation, etc. The importance of good charts, as well as of trustworthy information as to tides and currents, scarcely needs emphasising. An incorrect or out-of-date chart will cause losses due to delays to shipping, even if it does not lead to more direct loss. Anything that will assist in the production of up-to-date and accurate charts is of great and direct benefit to the shipping industry, and through it to the nation. Even when such work has once been completed there is no finality, as both maps and charts require periodical revision at more or less frequent intervals, according to circumstances.

The economical and speedy production of such maps and charts necessitates a thorough knowledge of the principles on which all survey work is based and of the best means of applying such principles under varying conditions. Apart from revision work, there is still a great deal of survey work waiting to be carried out, enormous areas still exist in the Empire which are surveyed very inadequately or not at all.

Very large sums have been misapplied in the past owing to a lack of appreciation of the principles which should underlie all survey work. The Egyptian Survey of 1878-88 cost some 360,000*l.*, and produced incomplete maps of some 2000 square miles. Almost the whole of the work had to be repeated in 1892-1907, when, owing to the adoption of proper methods, and in spite of many difficulties, some 13,000 square miles were satisfactorily mapped at a cost of less than 450,000*l.*

The methods to be adopted depend upon circumstances, the nature of the country, and the objects of the survey. The difficulties to be overcome vary in different parts of the world. The experiences of the various surveyors have been published in their records and reports, but these are not in an easily accessible form, nor is there any general index or summary to be found. The originals are circulated to a limited number of persons and institutions, and buried in libraries, even if their existence is not forgotten. When a new difficulty arises in any survey it has to be tackled *de novo*, though it is quite likely that similar circumstances have arisen before. In such a case it is probable that the surveyor in question does not know of it; and, even if the reports are accessible to him (which they frequently are not), the

actual information he wants is most effectually buried. This leads to much waste of effort, as there is no central body to which he can refer.

As regards existing departments and institutions, the Dominion, Indian, and Colonial Surveys are all independent, and, broadly speaking, train their own staff. There are, however, good survey schools in some of the Dominions. The Ordnance Survey produces its well-known maps, which are revised periodically, and they are so complete that no extensive survey work is required by outsiders in this country. This accounts for the lack of attention paid to the subject outside Government Departments, but the result has been that the development of the science of surveying has largely stagnated in this country, the centre of the Empire.

There is, therefore, a distinct need for a school and institution in which students can be trained in the principles of survey work, and where the subject is studied as a whole. This school would also serve as a central information bureau, enabling the scattered surveyors of the Empire to keep in touch with developments, and to which they could apply for information and assistance.

It might seem at first sight that this could and should be undertaken by a Government Department, but this is scarcely possible for various reasons. There is no central authority which deals with the Government Surveys of the Empire, though a link is kept between the Colonial (as distinct from the Dominion) Surveys by the Colonial Survey Committee. The various Surveys and Departments naturally have to consider their own immediate needs first; they are usually short of funds, and consequently not in a position to carry out the work now being discussed. Even if a central authority were formed for this purpose, it could deal only with Government Surveys, and could not train surveyors and engineers for private work.

There seems little doubt that most of the Government Surveys would welcome a school from which they could recruit their staff and an institution to which they could apply for information, and which could keep them in touch with the activities and progress in other parts of the world.

The existence of such an establishment would also encourage the production of improved designs of instruments and the production of new time-saving devices; there have been many such improvements of late years, but mostly from abroad, *e.g.* invar tapes and wires for base measurement (France) and an improved levelling instrument (Germany). There are also many developments in view which require working out, *e.g.* the use of wireless time-signals for the determination of longitude in the field, survey from aircraft, etc. At present makers have little

<sup>1</sup> From an address on "The Urgent Need for the Creation within the Empire of a Central Institution for Training and Research in the Sciences of Surveying, Hydrography, and Geodesy," delivered to a joint meeting of Sections A and E at the Cardiff meeting of the British Association on August 27.

inducement to bring out new and improved patterns of instruments; their largest customers are engineers, who, as a rule, have had a very elementary training as surveyors, and are shy of adopting any new instrument or method.

The above remarks apply particularly to land surveying, but are largely true also of hydrographic work. India and Canada have their own Hydrographic Services, but apart from these the Hydrographic Department of the Admiralty has to deal with all the seas and coasts of the Empire, and also with such others as are not dealt with by their own Governments. The task is great, and the resources available are all too small for the work. Even in home waters there is much to be done, if only due to the changes continually taking place in all estuaries. Apart from the shifting of sandbanks, etc., much of the earlier work is not up to the standard of modern requirements.

There is no school where hydrographic surveyors can receive instruction in the principles and theory of their work, and no staff available for studying methods and instruments and bringing them up to date. The hydrographic staff of the Admiralty is recruited from volunteers amongst the younger officers of the executive branch of the Royal Navy who have passed in navigation. They learn their surveying in the surveying ships while work is in progress, and the staff of trained surveyors is at present so limited that it can give little instruction to the beginners. Many officers after serving in a surveying ship for two or more years return to ordinary duties afloat, or specialise in other branches where their knowledge of survey work is of great benefit to them. The remainder are advanced in rank *pari passu* with the officers of H.M. Fleet. The existence of a school where the theoretical side of the question could be studied would be of great benefit to all.

The principles involved in survey are the same whether applied by land or by sea, and the instruments largely the same. One establishment could usefully study and give instruction in both sides of survey work.

Survey cannot be carried out over large tracts of country without consideration of the science generally known as geodesy, which is really only survey as applied to the earth as a whole. The problems involved in this require not only world-wide data, but also high mathematical skill. Problems interconnected with these are those concerning the tides and terrestrial magnetism, both of great importance to navigation. These, again, are connected with the study of the earth's structure in its wider sense, and so with seismology and geology. These problems may all be summed up in the word "geophysics."

While a knowledge of geophysics is not necessary for every surveyor, no survey authority can function satisfactorily without it. At the same time few such

authorities have the staff available for its proper study. A central institution which could be referred to for information would add greatly to the efficiency of the survey authorities.

The need for a British geodetic institute is admitted by all who are acquainted with the nature and importance of the pressing Imperial and scientific problems which depend on the great surveys. The study of such problems has hitherto been left, in characteristic British fashion, to the initiative of enthusiastic individuals or neglected altogether. Take, for example, the case of the tides—so vital a matter to our sailors. While the late Sir George Darwin still lived it could at least be said that one master-mind was devoted, with some approach to continuity, to the study of the great problems which must be attacked and solved if tidal prediction is to advance beyond its present elementary and scrappy state, but since his lamented death in 1912 the subject has lacked attention.

At the request of the British Association, Prof. H. Lamb recently reviewed the whole situation with regard to tides, and in a masterly report indicated the number and importance of the problems awaiting solution. Problems comparable in insistence are connected with the land surveys of our Empire, and a similar review of the general situation, also initiated by the British Association under the stimulus of war, directed attention to the pressing need for some determined effort to attack them. The report opened with this cogent sentence: "There is no institution, association, or department whose business it is to deal with the higher geodesy." Consideration of the report by a special committee, afterwards enlarged, developed in the direction of urging the establishment of a geophysical institute. The need for such an institute has been formally recognised as urgent by the Conjoint Board of Scientific Societies (formed during the war for the study of urgent questions), which appointed a small executive committee (which included the president and secretary of the Royal Society) to press for the immediate establishment of such an institute.

We think it would be difficult to find in any scientific matter greater unanimity amongst all the authorities concerned therein. We trust that sufficient evidence has been given as to both the national importance of the subject and the urgency of the need for action. We await the advent of the *vivus benefactor*, for, as already indicated, there is a consensus of opinion that such an institution should be established within a university by private benefactions, although assistance might, as a consequence, be forthcoming from national funds. The wide ramifications of survey, geodesy, and geodynamics into mathematical, physical, and engineering sciences call for their study in a university rather than in a departmental atmosphere.

### The Imperial College as a University of Science and Technology.<sup>1</sup>

THE real issue is whether a useful and worthy type of university can be erected on the comparatively narrow basis of a limited group of studies. In both primary and secondary education there has been a growing tendency to evolve several distinct types of school. Is it only university cloth that must always be cut to the same pattern? If we consider the enormous complexity of modern civilisation and

the degree and extent to which it is based upon science, we must think that, in the region of university education, the time has come for a further differentiation of functions, and that the first step in this development should be the creation of a new type of university based upon pure and applied science, not to supersede, but to supplement, the existing type. The normal type of university, embracing a great number of faculties, would still remain, and ought to be, the predominant and prevalent type.

Science, pure and applied, from its nature, is worthy to rank in educational and cultural values with other

<sup>1</sup> Synopsis of a paper on "The Proposed University of Science and Technology: Can a Useful and Worthy University be Based on Pure and Applied Science?" read before the Old Students' Association of the Royal College of Science on October 12 by J. W. Williamson.

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