which might influence certain geophysical investigations, and the fact that alluvium might mask small tremors, are conditions that cannot be avoided.

In the *Beiträge zur Geophysik* (vi. Band, 3 Heft) issued "Zur Begrüssung der II. Internationalen Seismologischen Konferenz," Prof. Dr. Bruno Weigand gives an account of the instruments now in use at Strassburg Observatory, and an explanation of the monthly reports issued from the same.

The instruments longest in use are two Rebeur-Ehlert horizontal pendulums. In each instrument there are three pendulums arranged at angles of 120° with each other, the idea being that the three records would enable an observer to determine the direction in which an earthquake motion was propagated. Inasmuch as it has been well known for many years past that the movement of the ground as recorded at a given station may be in any azimuth, we are not surprised when Dr. Weigand tells us that no satisfactory result has been obtained.

The records are photographic, the source of light and the record receiving surface being at a distance of 5 metres from mirrors on the pendulums. This necessitates the use of powerful electric lamps. This condition, the high sensibility due to high multiplication of the instrument, which on certain foundations leads to wandering of the light spot, and the cost of photographic paper, which is run at the rate of 36cm. per hour, preclude the use of this instrument excepting at a few selected stations. Other instruments are Wiechert's astatic pendulum, Vicentini's microseismograph, and Ômori's conical pendulum, all of which write on smoked paper, Milne's photographic horizontal pendulum, which is a type adopted by the British Association, and Schmidt's trifilar gravimeter.

Brief references to the records of these instruments are published in a *Monatsberichte*. All that this gives about the Strassburg records of an earthquake is a time for its commencement and its duration as recorded by a Von Rebeur pendulum. The times of maximum or other phases of motion, amplitudes, periods, and other information required by seismologists is omitted. A plus or minus sign indicates whether other instruments did or did not respond to the movement, and the latter signs predominate.

With the object of showing the superiority of the Strassburg type of instrument, particularly as compared with the type adopted by the British Association, which latter, according to his opinion, should cease to exist, Dr. Weigand emphasises the discrepancies between his various registers. As illustrative of the supposed want of sensibility in the British Association type, he points out that the Strassburg *Circular* for August, 1901, shows that the Rebeur pendulum recorded twenty-four earthquakes, whilst a British Association type, in the same building, only recorded seven. This latter number he now raises to ten. As a matter of fact, seventeen of the Strassburg records correspond with seventeen records obtained in Britain, whilst five entries in the Strassburg list refer to very small disturbances peculiar to that place, which therefore may well be regarded as being of doubtful origin. The earthquakes recorded in a given period by the Rebeur and British Association pendulums were therefore nineteen and seventeen. Dr. Weigand published these numbers as twenty-four and seven, and similar discrepancies between the records of the Rebeur pendulum and the records of all other instruments in use at Strassburg appear in each of the Strassburg registers.

That the Rebeur pendulums as installed at Strassburg have a higher sensibility than other seismographs is well known, but it must not be overlooked that this high sensibility is one factor which prevents their general adoption. That the British Association type of instrument is sufficient for the purposes for which it was intended is amply shown in the reports issued by the Association. Experiments are now in progress to increase the speed of the record receiving surface connected with this apparatus about four times, and to reduce the cost of photographic material to about 3*l*. per annum. It now costs 6*l*. 10*s*. per annum, whilst paper for the Rebeur apparatus costs 15*l*.

When Dr. Weigand complains of the want of sharpness in the trace yielded by the British Association instrument, he should evidently look to its adjustments, for it is its pronounced sharpness that compensates for its want of multiplication. In this respect the records it yields are far superior to those obtained from any other form of photographically recording seismograph.

That it should be affected like other instruments with so-called "Mikroseismische Unruhe" is what might be expected if located in a cellar.

Altogether, the institute at Strassburg as "der Kais. Hauptstation" might easily be improved, whilst if its publications took the form of the excellent registers issued in the *Bollettino della Societa Sismologica Italiana*, they would be of greater value to working seismologists.

THE INTERNATIONAL STUDY OF THE SEA.[1]

THE publications mentioned below are the first reports of the International Council for the Study of the Sea which was constituted by the meeting of representatives of the maritime Powers of northern Europe at Christiania in 1901, and now has its seat at Copenhagen. The bulletins deal with what has come to be known as hydrographic work carried out on the quarterly cruises, in which special ships of each of the participating States take part. The word hydrography is not, however, used in the sense made familiar by the hydrographic offices of the various Admiralties; it means, if we may borrow for a moment the terminology of chemistry, scarcely more than inorganic oceanography. We say scarcely more, for in these bulletins it does include the study of the distribution of plankton, but for this purpose plankton are treated rather as current-floats than as organisms.

It will be remembered that the International Council was formally constituted at a conference held at Copenhagen in July, 1902, and that no time was lost in getting to work is plain from the fact that the first number of the Bulletin deals with a series of cruises in August, 1902, the second with a similar series in November or December, 1902, and the third with February, 1903. These cruises have since been continued quarterly, and we understand that they are now more complete, and the results obtained more readily comparable than was possible when the collaboration was only beginning. Viewed from the standpoint of scientific efficiency, the work of the Council is hampered by the very short term for which the various Governments have granted the necessary funds and the stringent conditions as to endeavouring to obtain practical results directly beneficial to fisheries which have been insisted on in some cases. But there is reason to hope that these very difficulties will act as a spur.

The bulletins are mere records of observations, they contain a minimum of explanatory letterpress, and no discussion at all. It might be found desirable to print

[1] Conseil permanent international pour l'Exploration de la Mer. Bulletin des Résultats acquis pendant les courses périodiques. Publié par le Bureau du Conseil avec l'assistance de M. Knudsen, Chargé du Service Hydrographique. Année 1902-1903. Nos. 1, 2 et 3. (Copenhague: A. F. Höst et Fils, 1903.)

a little more information, for instance, as to the constitution of the International Council and its administrative bureau, the address of the office and a brief statement of the objects for which the organisation has been brought into existence. The salient features of the maps of the physical conditions of the surface water might also be expressed in words, and the stations at which observations were made ought to be indicated on the map of each cruise by dots. We are inclined to lay stress on this point, as without some indication of the kind the maps are difficult to interpret, and the scale is not large enough to permit the figures of each observation to appear.

The August and November cruises were carried out in the Baltic by Finland, Sweden, Denmark, and Germany, in the North Sea by Germany and Scotland, and in the North Atlantic and Arctic Sea by Norway and Russia. To these there were added in February observations in the North Sea by Holland, and in the English Channel by England, England and Scotland being separately represented, mainly on account of the different nature of the fishery problems in their respective areas. It may be noted that these bulletins do not touch on the fishery observations, nor on the biological work (the determination of plankton excepted), which occupy the whole time of the various national staffs between the quarterly cruises. They do not refer either to the work of the Central Laboratory at Christiania.

The importance of the bulletin lies in the fact that it gives particulars of the temperature and salinity at a great number of points from latitude 45° to 75° N., observed nearly simultaneously and with comparable instruments of the highest precision, the temperature being determined by means of the Pettersson-Nansen insulating water-bottle and thermometers graduated to the fifth or even the tenth of a degree centigrade, the salinity by estimation of chlorine.

Both for August and November the central part of the North Sea appears to have been left without observations, but this gap was partly filled up in February when the system of quarterly cruises was more complete, and a number of supplementary observations by trading steamers had been added. The indications in the published maps are of a slight freshening along the British coast, a belt of maximum salinity running parallel to the coast towards the middle of the North Sea, increasing in salinity rapidly to the north-west between Scotland and Faeroe, and to the south-west towards the English Channel. The whole of the eastern half of the North Sea shows a rapid freshening towards a stream issuing from the Baltic close along the west coast of Jutland.

Where the temperature observations were sufficiently close and regular to permit of isotherms being drawn, they present a remarkable relation to the isohalines. In August the one isotherm shown is that of 12° C., which runs from Aberdeen to Lindesnaes, cutting the isohalines at right angles. In the November map, however, the isohalines and isotherms exhibit a most striking parallelism, so that the circulation of the water in that month could be studied with equal facility by considering either the temperature or the salinity. Thus at the southern end of the North Sea the isotherm of 13°·5 C. coincides with the isohaline of 35·25 per mille, and the isotherm of 13° C. with the isohaline of 35·00 per mille. At the mouth of the Baltic the two sets of lines though parallel, do not correspond symmetrically, while on the north-west side of the Baltic stream 10° lies close to 34‰, on the east side it lies close to 32‰. Still the axis of the Baltic stream is the same whether it is drawn from the one set of lines or the other.

The February map shows the isotherms parallel with the isohalines in the south and east of the North Sea, but cutting them nearly at right angles in the more open waters of the north and west. The difference in the broad action of the Atlantic in the wide part of the sea and the river-like action of the Channel in the southern part is brought out in a most interesting manner.

It is very important to secure a great extension of surface observations, and this, we believe, is now being done by many shipmasters who make regular observations on the various trade routes across the North Sea. Even if these fall short of the high accuracy attained by the special scientific vessels, they will prove invaluable in fixing the general run of the isotherms during the quarterly cruises, and of following the changes which take place between them.

We consider that these bulletins are satisfactory and full of the promise of large results. The too scanty letterpress is printed in parallel columns in German and English; the title only is in French.

ARCTIC GEOLOGY.

DR. P. SCHEI'S preliminary sketch of the geological work accomplished during Captain Sverdrup's four years' exploration of the region west of Smith Sound, an account of which is given in the *Geographical Journal* for July, makes important additions to our knowledge of Arctic geology.

About a quarter of a century ago Sir G. Nares's expedition examined the northern and eastern coasts of Grinnell Land down to the north-east corner of Ellesmere Island. The collections brought back by the *Fram* continue the geological information from this district round the southern part of that land mass, now named King Oscar Land, and all up its western shore to the north of Greely Fjord, including also the eastern coast of a newly-discovered island called Heiberg Land, and the coast of North Devon, south of Jones Sound, thus filling in the angle between Smith Sound and the group of the Parry Islands. Possibly they complete our general knowledge of this region, for Captain Sverdrup is disposed to think no more land exists to the north and north-west of Heiberg Land.

Previous explorations, summarised by Messrs. Feilden, De Rance and Etheridge in the *Quarterly Journal* of the Geological Society for 1878, proved the existence of crystalline Archæan rocks in the north-east of Ellesmere Island, of ancient sedimentaries, possibly Huronian, along the western coast of Kennedy Channel as far as the north-east angle of Grinnell Land, where they were succeeded by Carboniferous strata (with a little Devonian). West of these were Archæan schists, and those in the south were parted from the Huronians by a tract of Upper and Lower Silurian. Tertiary deposits, presumably of Miocene age, were discovered at more than one spot on both sides of Smith Sound and the channel north of it, and ample proofs obtained of a comparatively recent general elevation of the land, in some cases amounting to a thousand feet. Dr. Schei confirms the existence of the older Palæozoics near the middle of Ellesmere Island. Archæans follow them to the south, and continue along the coasts of Smith and Jones Sounds, appearing also on that of North Devon. On both sides they are succeeded by Cambro-Silurian deposits, and these, just at the western end of Jones Sound, by Devonian, which occur on both sides of the strait and extend some distance up the west coast of King Oscar Land. That formation had been already identified in the Parry Islands, and is now proved to extend over a considerable area. The strait parting Ellesmere Land from Heiberg Land is bordered by Mesozoic strata, which had already been detected in the Parry Islands, and these in the most northern part of