a rotating sector. The record then consists of strong dots which, for normal recording, form a continuous line, for a strong earthquake a discontinuous but well-defined curve. This arrangement has served the present purpose satisfactorily, but a simpler device may be found to accomplish the same purpose. I hope those of you who are interested will take the trouble to examine this instrument. It is proposed to equip a number of stations with them during the present year.

This plan of primary triangulation, then, has given us a control upon surface displacements which I think has never been surpassed before in any region of equal extent. The geological study of the region and the submarine soundings have given us much information regarding its structural weaknesses (faults). Now by the use of this instrument we cherish the possibility of establishing the sources of tremors and the direction of their path along and across the zones of weakness. Already some opportunity has been found to test this mode of analysis. There have been two heavy discharges of explosive in California, one of 182 tons of dynamite, within about forty miles of Pasadena, and in both cases a very precise record was obtained. Nothing was known in advance about the first case, but in the second it was possible to obtain very accurate timing and an excellent measurement of the rate of transmission of the wave between the site of the blast and the recording instrument. It is therefore believed to be quite possible, by the use of these instruments, properly distributed, to locate the probable sources of most of the tremors in California, whether they originate near the surface, or, as we suspect in the case of the 1906 earthquake, the displacement had its origin at considerable depth.

It is in our minds also to determine tilt. Those of you who have followed the work of Professor Jaggar know that for a number of years he has been making careful observations of tilt on the flanks of the great volcano Mauna Loa and on the crater-rim of Kilauea, on the island of Hawaii, to see whether, from the variation in tilt, he can predict volcanic outbreaks. So far I think he has not altogether succeeded in that; or at least he has made use of other evidence in addition to tilt in the predictions he has made hitherto. Be that as it may, he has shown that tilt is definitely measurable. Now if the bulging of the mountain can be measured then obviously certain other kinds of "creep" can be measured, and it is definitely a part of our purpose to develop apparatus in California through which these slow, cumulative displacements may be determined both in direction and in magnitude in the same fashion as it has been possible to obtain a measure of the bulging of Mauna Loa in Hawaii. If we succeed in attaining that and have at our disposal competent laboratory determinations of the elastic limitations of the participating rock types, we shall presently be in a position to establish the degree of probability of release of such cumulative stresses by earthquake. I am speaking now of prediction in place rather than of prediction in time. It is not unlikely that prediction of the probable place of release of such strain can be undertaken with reasonable certainty in future. Prediction of the probable time of rupture involves factors which are not yet within our reach.

It is also a part of our purpose to measure internal pressures. It is not difficult to arrange an apparatus which will give a continuous record of deep-seated pressures which will also be of value in the elucidation of these structural relations.

If I have been successful at all I have outlined to you what is probably the most comprehensive plan that has yet been developed in the study of earth movements. It is characterized, more than anything else, by the effective cooperation between research organizations with widely different points of view. I have named the agencies, all well known to you, which are participating with us in this particular enterprise. The Coast Survey and the Hydrographic Office, approaching the problem from their respective viewpoints, have given us a trustworthy system of coordinates upon which displacements are to be plotted and relations shown; the Geological Survey and the universities of California have added the geology and subsurface relations; and finally the California Institute of Technology and two departments of the Carnegie Institution of Washington, Mt. Wilson Laboratory and the Geophysical Laboratory have aided in the development of appropriate apparatus, the establishment of stations, etc., in preparation for the systematic study of tremors. The trustees of the Carnegie Institution of Washington have set aside certain funds for the project, and the advisory committee in seismology has undertaken the administrative responsibility. Such a number of vigorous agencies, thus brought together, can not fail to accomplish a great deal more than any one could do alone; such a representative group of agencies, I believe, can not fail of success.

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THE SECOND GENERAL ASSEMBLY OF THE INTERNATIONAL GEOPHYSICAL UNION

THE second general assembly of the Union took place in Madrid, beginning October 1, in the build-

ing of the National Parliament. The king of Spain presided at the first meeting and the proceedings consisted of addresses of welcome. Then for a week the several sections met in different rooms and discussed matters of special interest to themselves. There are now thirty nations adhering to the Union, and nearly all were represented by delegates or by proxy. The United States had but four delegates, which made it impossible to keep in close touch with the discussions of the seven sections. At the final meeting on October 8th the several sections reported the results of their conferences to the general assembly.

The section of geodesy adopted the Hayford spheroid as the spheroid of reference for geodetic work, and it is hoped that it will be accepted by all nations. If all locations are referred to the same spheroid it will help greatly in connecting up the triangulations of the different countries. The principle of isostasy was discussed and accepted, and its application will improve the accuracy of the triangulations. The reduction of observations in accordance with this principle will probably be carried out in Washington. It was decided to make determinations of relative gravity between the base stations of the several countries so that the relative gravity at all stations may be properly compared. This is of great value for the determination of the figure of the earth and for studies of isostasy. A world net of longitudes is to be determined by radio; by carrying this net completely around the world systematic errors can be largely eliminated, and longitudes more accurately fixed. By repetition at a future date, any east-west movements of the continents can be measured. North-south movements can be determined from the observations at the latitude variation stations, three of which continued their observations throughout the war; the section of geodesy will assist, by appropriations in the reduction of these observations. Dr. F. A. V. Meinesz, of Holland, described a method of determining gravity at sea, by swinging pendulums in a submarine, sunk some thirty meters below the sea surface. The results of some observations in the Indian Ocean were very accordant and indicate a very close approach to isostatic equilibrium in that region.

In the seismological section the question of publishing annual lists of earthquakes was discussed, and it was decided, largely on account of lack of funds, not to undertake this for the present but Professor Turner will continue to issue the International Summary, which contains the records and locations of the more important shocks. It was decided that the transmission curve, which gives the time of transmission of earthquake waves from the origin to distant points, requires more study before an official curve could be adopted. Reports were made on the transmission of disturbances due to explosions, which travel more slowly than is indicated by the general transmission curve, due undoubtedly to the fact that they travel through the superficial part of the earth's crust. Reports were made on seismological work in Spain, which is being developed with much vigor; and on the work of the Carnegie Institution in California. The fault map of California and the diagrams of Anderson's new seismograph aroused much interest; also the account of De Quervain's large instrument which has been mounted at Zurich, and is giving satisfactory records of small shocks in the Alps. These instruments present a strong contrast; the former weighs a fraction of a gram, the latter twenty-one tons. The Japanese delegates gave interesting accounts of the great earthquake of 1923 before both the sections of seismology and of geodesy. The Central Bureau announced that it would begin the publications of seismological memoirs. The committee on that troublesome subject, microseisms, was continued.

The most important question discussed in the meteorological section was the project of compiling weather charts of the northern hemisphere for the third quarter of 1923. This is an important matter and could best be carried out by an international weather bureau. Some doubts were expressed as to the propriety of "placing money at the disposal of an existing state service for carrying on work of an international character in conjunction with a commission." Many other interesting questions were discussed: sampling air at great heights, measurement of relative brightness of ground and cloud, determination of the variations of the hydrogen content of the air, spectral measurements of solar radiation intensity, at Izana, Canary Isles, daily observations of temperature and pressure in the free air, observations of air-borne parasites, stations in mountainous districts and in the South Pacific, etc. The section recommended to the General Assembly the appointment of a committee to consider a simplification of the Gregorian calendar, and the recommendation was accepted.

In the section of terrestrial magnetism and atmospheric electricity reports were made of work accomplished in various countries. The section highly commended the work of the Carnegie Institution in the determination of the magnetic elements all over the world. It called attention to the importance of magnetic and electric observations in high latitudes, and recommended the west coast of Greenland, and Jan Mayen Island or Spitzbergen, as suitable locations for observations. Magnetic data from high latitudes

in years near sunspot maxima are very desirable. Observations to reduce atmospheric potential gradients to volts per meter over level ground are much needed. It is also most important to investigate the magnetic properties of rocks from all over the earth, and from different geological ages. An instrument to measure the vertical intensity of the earth's magnetic field in absolute measure is much to be desired.

The American proposal to approve explorations of the oceans was adopted by the section of hydrology and by the general assembly. Biological oceanographers have been admitted to this section.

The committee on glaciers, which was appointed by the International Geological Congress, has lapsed since the beginning of the war. The section of hydrology of the Union wishes to take up the problems of the variations of glaciers, and the Union made a small appropriation to enable Professor Mercanton, of Switzerland, to consult with members of this section and devise some means of continuing the records.

None of the American delegates was able to attend the meetings of the sections of vulcanology, oceanography or hydrology. This emphasizes the importance of making provision for at least one American delegate to each section at future meetings of the Union.

The arrangements for the entertainment of the delegates and their families were most elaborate. The king and queen of Spain received them at the royal palace; and the mayor of Madrid held a reception at the mayoralty. The reception committee (Sen. D. L. Cubillo, Chairman, Sen. D. J. Galbis, Secretary) were indefatigable in their efforts. Excursions were made to the most interesting places in the neighborhood of Madrid, including the city of Toledo, all at the expense of the committee; a concert was given at the opera house, the bull ring and the museums were thrown open; and the meetings closed with a banquet at the Hotel Ritz. I do not think such lavish hospitality could have been tendered in any other city of the world. After the meetings excursions were arranged to the cities of southern Spain and to the eastern coast; everywhere the hospitality was most generous.

The next general assembly of the Union will be held at Prague in 1927.

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IN MEMORIAM: SIR THOMAS CLIFFORD ALLBUTT
(1836–1925)

SIR THOMAS CLIFFORD ALLBUTT, Regius Professor of Physic, in the University of Cambridge, died, during sleep, on the night of February 22, 1925, at the age of 88. He was born on July 20, 1836, at the vicarage of Dewsbury (Yorkshire), the last resting place of Robin Hood. His father, the Rev. Thomas Allbutt, was a clergyman of great influence in the West Riding and the author of various religious books. The son was educated at St. Peter's, York, and at Caius College, Cambridge (1855–60), where he held several scholarships and won the Natural Science Tripos, first class, in 1860. During 1859, he was the clinical clerk of the celebrated Bence Jones, of proteinuria fame, at St. George's Hospital (London), and, by his advice, followed the lectures of Trousseau at the Hôtel Dieu (1860), the clinics of Bazin at the St. Louis (dermatology) and of Duchenne in the Boulevard des capucins (neurology). In 1861 Allbutt was elected physician to the Leeds Fever Hospital, passing over to the Leeds Infirmary in 1864, and then successively to the Belgrave Hospital for Children (London), the King Edward VII Sanatorium (Midhurst) and the Addenbrookes Hospital (Cambridge). In 1892, he was appointed to the Regius professorship at Cambridge (established 1540), which post he held until his death.

The newspaper obituaries of Allbutt defined him as "an eminent British physicist," as he was the inventor of the short, self-registering, pocket clinical thermometer which came into vogue in 1868. Sir Clifford was, however, deeply read in modern physics, and this invention in particular was based upon his reading of Wunderlich's classic on temperature in disease (1868), which established clinical thermometry, and was based, in its turn, upon the thermodynamic principles which led William Thomson (Lord Kelvin) to establish an absolute scale of temperature for thermometry (1849). The earlier clinical thermometers were cumbersome contrivances, nearly a foot long, and were, in consequence, little used. Allbutt's invention made bedside thermometry a going concern. He was the first to describe the articular lesions in locomotor ataxia (1869), suppressed an epidemic of typhus fever by bold fresh air treatment, described the first case of Charcot's joint in England, as a member of the Alpine Club did much for the mountain cure of phthisis, and was instrumental, with the surgeon Wheelhouse, in introducing paracentesis of the pericardium (1866). His writings, which abound in subtle clinical minutiae, include his lectures on physical overstrain of the heart (1871), which was translated into German, on ophthalmascopy (1871), on auscultation of the esophagus (1875), the Goulstonian lectures on visceral neuroses (1884), the Lane lectures on heart disease (1896) and his two volume monograph on diseases of the arteries (1915). Following the tradition of Harvey, it was inevitable that English physicians should specialize