

When the disk revolves, however rapidly, in the beam of sunlight parallel to its surface as stated, the eye regarding the *inner* surfaces of the rods a, b, c, d, e , sees the usual sheen of light intersected with intensely black shadow bands due to f, g, h, i, j , projected in the positions a, b, c, d, e . The experiment is specially striking in a dark room. This phenomenon is easily explained, for the points a, b, c —are nodal points, as it were, or loci of perpetual eclipse.

The second phenomenon is even more striking: if the light after passing the revolving disk parallel to its face (which therefore is seen as a mere line) is caught on a screen, either close at hand without a lens, or at long range by lens projection, the loci $\alpha, \beta, \gamma, \delta, \epsilon$, are again stationary, appearing however *bright* on a dark ground. Judged merely by the eye, the effect is just

volving rods. Hence more light must get through along the lines fe, gd, hc , than in the same direction between these lines.

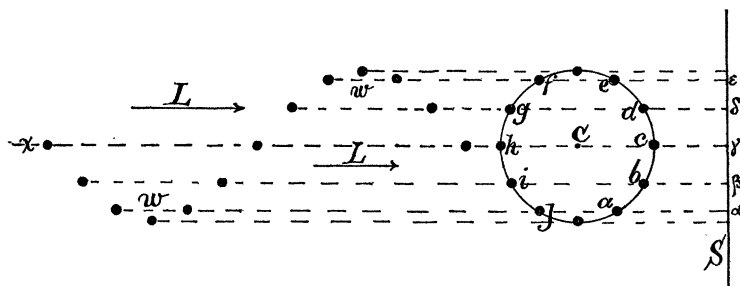
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THE INTERNATIONAL GEODETIC ASSOCIATION.

THE sessions of the Thirteenth General Conference of the International Geodetic Association were held at Paris, France, between the 25th of September and the 6th of October, 1900.

The following countries were represented at the Conference: Germany (8), Austria (2), Denmark (1), Spain (1), United States (1), Great Britain (1), Hungary (1), Italy (3), Japan (1), Mexico (2), Norway (1), Holland (3), Roumania (2), Russia (1), Sweden (1), Switzerland (1), France (8),



as if the rods where they cross in double thickness were perfectly transparent. It would take considerable acumen to predict this kinematic result.

Without entering into details, I may point out in explanation that every part of the area of projection, S , is swept by the shadow of each rod twice per rotation. The result must be perceptible and at first, sight uniform darkening of the field. But whereas throughout the whole semicircle, f, g, h ,—and also *between* the points a, b, c ,—light has been removed backwards (*i. e.*, from the screen) by reflection, none has been removed at the points a, b, c ; for these appear as black lines in the sheen of re-

the number following the name of each country indicating the number of delegates sent from the country. Belgium, Greece and Portugal were not represented.

At the opening session of the Conference the French Minister of Public Instruction presided, and welcomed the delegates in the name of the French Government. The sessions were held in the new Sorbonne, and a great many interesting reports were read. From these reports the following details have been extracted:

M. Schumann has undertaken a new computation of all the great arcs already measured, in order to deduce the elements of the terrestrial ellipsoid.

By relative gravity measures, M. Schumann has connected Königsberg, Guldenstein, Copenhagen and Christiania with Potsdam.

M. Borrass has connected Bucharest with Potsdam; M. Nagaoka will soon connect Tokio with Potsdam; and M. Putnam has recently connected Washington with London, Greenwich, Kew, Potsdam and Paris.

The funds of the association will be used to effect other connections of the principal gravity stations of Europe.

M. Helmert continues to keep up complete statistics of relative gravity stations. The actual number of these stations is now 1,450, of which 83 are connection stations. The results are very numerous, and the exact connection of the principal stations is an accomplished fact. M. Helmert hopes to be able, in 1901, to give a comprehensive discussion of all the results so far obtained.

A report was made upon the observations already made at international latitude stations, and the provisional calculations of the observations so far made have given satisfactory results.

General Bassot suggested the desirability of making similar observations on a parallel in the Southern Hemisphere.

The labors of Albrecht and Chandler have made great progress in developing the theoretical question of the variation of latitude. The first, from observations at 13 stations in Europe and America, from 1890 to 1897, has shown that the pole of rotation of the earth has described in that space of time an irregular spiral about a mean position, with a maximum elongation of $0''.30$. The second, after a profound discussion of observations made between 1825 and 1893, represents this displacement by an expression of two terms, periodic functions of time. The period of the first oscillation covers 429 mean days, that of the second 365. These terms vary,

respectively, from $0''.085$ to $0''.185$ and from $0''.115$ to $0''.135$. The mechanical causes of the displacement of the terrestrial axis of rotation are still far from being known.

A resolution was passed requesting Professor Gore to prepare a new edition of his *Bibliography of Geodesy*, issued by the Coast and Geodetic Survey in 1889.

A special report on triangulation was made by General Ferrero, and on base lines by General Bassot.

The French Geographic Service has undertaken a revision of all the French triangulation, with the aid of the instruments and methods of high precision used in the New Meridian of France; and work is actually in progress on the parallel of Paris.

In Italy the geodetic junction of Malta and Sicily has been made.

Roumania submitted her first report of geodetic work. The arc of the parallel already measured between the Atlantic Ocean and the Danube has been extended across Roumania to the Black Sea, and the meridional arc measure by Struve between the Arctic Ocean and the Danube has been extended entirely across the country.

In Russia the recomputation of all trigonometric points upon the same spheroid has been undertaken. A determination of the terrestrial elements from Russian arcs alone shows that the elements of Bessel conform more nearly to the curvature within the boundaries of Russia than those of Clarke.

Two proposed operations were submitted to the Conference:

The Observatory at Nice will undertake experiments to determine the velocity of sound and light, using the distance between Mt. Mounier, near Nice, and Mt. Rotondo, in Corsica. This distance will be redetermined with modern precision by the French and Italian geodesists.

The difference of longitude, Paris-Greenwich, will again be determined according

to an elaborate program. One determination will be made in October, 1901, and another in March, 1902, so that the first results can be discussed before undertaking the second set of observations. Two pairs of observers, using four instruments, as nearly similar as possible, will be employed. At each station the French and English observers will frequently exchange their instruments. The pairs of instruments and observers will be exchanged twice during each determination. The method employed will be submitted to the examination and approval of the Central Bureau of the Association.

In this connection M. Albrecht called attention to the advantage of using the registering micrometer of the Repsold system, which eliminates the personal equation of observers.

Mr. Foerster spoke of errors resulting from the instability of the optical axes of instruments, caused by the movement of the objectives in their mounting.

General Bassot emphasized the necessity of watching attentively the nature and constancy of the electric communication, whose variability may explain the marked differences.

M. Cornu exhibited and explained an apparatus to determine the zenith distance of a star culminating near the zenith. On motion of M. Hirsch the Association resolved that a similar apparatus should be constructed and studied in one of the great observatories, and that M. Cornu, continuing his useful studies, should realize a portable zenitho-nadiral apparatus for use in temporary observatories, permitting numerous and easy determinations of latitude at all the points of a geodetic net.

Upon the invitation of the Association, M. Guillaume, of the International Bureau of Weights and Measures, presented a very interesting communication concerning nickel-steel. He remarked in 1896 that nickel-steel,

with 30 per cent. nickel, had an expansion sensibly less than platinum, and since then has conducted most interesting studies concerning these alloys. He dwelt upon their singular magnetic, thermometric and mechanical properties, and stated that a certain alloy with 35 per cent. to 36 per cent. nickel possesses an expansion ten times less than that of platinum and twenty times less than that of brass. He then passed to the uses of the alloy for geodetic purposes. He considers it impracticable to use the alloy in the construction of standards of the first order, where perfect stability and invariable dimensions within the limits of precision measures are demanded for long periods of time, on account of certain changes which have been observed as a function of time. In geodesy the question presents a different aspect, and it suffices in practise that the length varies very little, say a millionth part in a year, and that the change should be very regular. The small coefficient of expansion, the malleability, the feeble oxidation, and the homogeneous character of these alloys all increase their usefulness in the construction or use of geodetic instruments.

The applications of nickel-steel have passed the experimental stage and entered the practical field in the two methods of measuring bases actually in use, viz., those of rigid bars and wires.

The problem of constructing a base bar has been solved in a very satisfactory manner in the one actually being constructed for the Geographic Service of the French Army, from the plans of MM. Benoit and Guillaume. The bar, which is four meters long, has a section in the form of an H inscribed in a square of 40 millimeters. It is enclosed in a case, made of an alloy of aluminum, with openings for necessary observations. It rests in its case on two normal points of minimum flexure. It weighs 50 kilos, case included.

Nickel-steel wires have been made and furnished to the Geographic Service of the French army, to the Swedish-Russian Expedition to Spitzbergen and to the Geodetic Service of Cape Colony, for experimental use.

Work in Spitzbergen is in progress under the extremely difficult climatic conditions usually found in this region. The missions sent out by the two Governments were engaged in field work from the last of June to the beginning of September. They are now in winter quarters, isolated from the rest of the world during nine months, engaged in making astronomical and meteorological observations and in studying gravity, refraction, etc.

Sir David Gill addressed the Association on the motion of Professor Darwin, the delegate from Great Britain. He announced that since the publication of the first volume of the Geodetic Survey of South Africa, two extensions of the Geodetic Survey have been undertaken there. The first was required for the purpose of delimiting the boundary of British Bechuanaland and German Southwest Africa; with the cordial cooperation of both governments concerned, it was arranged to carry out this work as far as latitude 22° S. with the accuracy of a geodetic operation.

Connection was made with previous work, and the combination of these observations secures the measurement of a latitude arc along the 20th meridian from Cape Agulhas, (the southernmost point of Africa), to latitude 22° S.—an arc of nearly 13° .

The second operation is the more important of the two, and provides for the extension of an arc along the 30th meridian of E. longitude, from the southern border of Rhodesia (22° S.), to the southern end of Lake Tanganyika. The work owes its inception to the enlightened policy of the Chartered Company, which has accepted the results of all experience and has determined to

base its surveys of the country on a framework of the most accurate possible triangulation. The work has been in progress for some years and a chain of triangulation has been carried along the 30th meridian from Gwelo (lat. $19\frac{1}{2}^{\circ}$ S.) to the Zambesi.

Sir David Gill plans an extension of this work to Alexandria, Egypt, with the cooperation of Germany and Belgium through their African possessions, and of the Egyptian Government, and sees no special difficulties in the way of accomplishing the measurement of this great meridional arc, covering 66° of latitude.

Splendid as is the scientific prospect which the realization of these projects would present, its importance is further enhanced by the consideration that by the execution of a triangulation around the Levant to join Struve's great arc of the meridian (which extends from the North Cape, in Norway, along the 30th meridian to the southern limit of Russian territory), an arc having an amplitude of 104° would be completed.

A resolution was adopted expressing appreciation and approval of the project proposed by Sir David Gill.

The new measure of the Equatorial Arc of the meridian, known as the Peruvian Arc, undertaken by the Geographic Service of the French Army, was discussed by the Association with great interest. Captains Maurain and Lacombe, of this service, spent five months in South America during 1899, and finished the reconnoissance, during this time, of an arc of 6° , extending the old arc 1° on the north and 2° on the south. The scheme includes base lines, azimuth stations, astronomical observations, leveling, gravity and magnetic observations, topographical work and geological investigations.

The French Minister of Public Instruction referred the report of MM. Maurain and Lacombe to the French Academy of Sciences

for a statement whether the interests of science required this long extension of the arc, and the Academy has replied, through M. Poincaré, that the arc should be extended to 6° , and that the Academy should exercise a scientific control of the work through a permanent commission, but that the actual work on the ground should be confided to the Geographic Service of the French Army.

The sentiment of the Association was in favor of the prompt execution of this work. It was stated that two officers would shortly leave for South America to finish all preliminary preparations, and that three other officers and their staff would probably start about the last of April, 1901, to take up the field work. A French astronomer is already in charge of the observatory at Quito, under appointment from the Government of Ecuador.

During the discussion of the project for a great meridional arc in Africa, proposed by Sir David Gill, the Astronomer Royal at the Cape of Good Hope, I had occasion to make the following remarks, in response to the request of Professor Darwin for some statement from the delegate of the United States in reference to the suggestion offered by General Bassot, one of the French delegates, that in America there was an opportunity of measuring an arc of the meridian from Cape Horn on the south to the Arctic Ocean on the north :

"In response to the request of M. Darwin, I have the honor of expressing my appreciation and admiration of the grand scheme of triangulation proposed by Professor Gill, Director of the Observatory of the Cape, and take pleasure in stating that the motion for its endorsement by the International Geodetic Association will receive my earnest support. I will present the plan to my government and feel confident that it will receive all possible support from the geodesists of my country.

"In reference to the suggestion of General Bassot that a great meridional arc might be measured in America, I have to state that the United States is now engaged in measuring an arc along the 98th meridian west of

Greenwich, which will extend entirely across the country and cover 23° of latitude.

"The details of the condition of this work at this time will be found in my report to the Association.

"This arc can be extended south 9° of latitude by Mexico, and north by Canada to the limit of ice and snow in the Arctic regions, an unknown distance. I do not think that my Government is prepared to undertake any extension of the above scheme at present."

After discussing Sir David Gill's scheme, the Association indicated its approval by a unanimous vote.

When the report on the new measurement of the Equatorial Arc (known as the Arc of Peru), was before the Association, I took occasion to make the following statement :

"The delegate on the part of the United States desires to express, in the most positive manner, admiration and appreciation of the work already accomplished by the French geodesists, as shown in their report on the reconnaissance of the Arc of the Meridian of Quito, and to extend to them the most cordial congratulations.

"Feeling the deepest interest in the prosecution of the work and in its successful completion, he trusts that no serious obstacle will cause delay.

"Its ultimate completion is assured, now that it has been undertaken by those who will make any necessary sacrifice to add this additional glory to the illustrious position already attained by French geodesists.

"If assistance of any kind is needed to complete the work, he hopes that his country will be given preference in doing all in its power to supply whatever is demanded by the exigencies of the case."

ISAAC WINSTON.

U. S. COAST AND GEODETIC SURVEY.

THE ALBANY MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

II.

Stereographic Projection in Map-Construction :

SAMUEL L. PENFIELD, New Haven, Conn.

By means of lantern slides and diagrams, Professor Penfield illustrated the methods of projecting maps of the various parts or countries of the globe upon the plane of its equator or of any other great circle. The methods are those employed by crystallographers for the projection of the polar points