1401

Bulletin No. 5

INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION
(UNION GÉODÉSIQUE ET GÉOPHYSIQUE INTERNATIONALE)

SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

TRANSACTIONS OF MADRID MEETING, OCTOBER 1924

Edited by
LOUIS A. BAUER,
Secretary, and Director of Central Bureau

NOVEMBER 1925

Price, Three Dollars and Fifty Cents

THE JOHNS HOPKINS PRESS
BALTIMORE, MARYLAND

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PREFACE

The present *Bulletin No. 5* is the fifth of a series of publications by the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union.

Bulletin No. 1, of 8 pages, was issued in 1919, and was devoted to the "Organization, Minutes, and Proceedings" of the Brussels Meeting, held July 18-28, 1919; its price is 25 cents.

Bulletin No. 2, of 12 pages, was issued in 1922, and was devoted to a "General Report" of the Rome Meeting, May 1922. It is in a measure superseded by pages 173-181 of Bulletin No. 3; its price is 25 cents.

Bulletin No. 3 comprises 182+viii pages, and contains the "Transactions" in full, of the Rome Meeting. For convenience of reference there was added Part I, containing the statutes and organization of the International Research Council and of the International Geodetic and Geophysical Union, list of officers, adhering countries, national committees, addresses of members, and other matters likely to be of interest. The price of this bulletin is $3.50.

Bulletin No. 4, of 10 pages, was issued in December 1924, and was devoted to a "General Report" of the Madrid Meeting held October 1924. It is largely superseded by the fuller information given in Bulletin No. 5; its price is 25 cents.

One copy of each of the above bulletins, if not already supplied, will be sent gratis to members of the national committees, investigators, and institutions of countries adhering to the International Geodetic and Geophysical Union; requests for such copies should be addressed to the undersigned. Orders may be sent to the Johns Hopkins Press, Baltimore, Maryland.

LOUIS A. BAUER,
Secretary, and Director of Central Bureau.

36th Street and Broad Branch Road,
Washington, D. C., U. S. A., November 14, 1925.

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MADRID MEETING

PROCEEDINGS AND MINUTES, MADRID MEETING

ADDRESS OF PRESIDENT OF THE SECTION[1]

Gentlemen:

The exhaustive discussion of all the questions proposed for consideration by the Section and its Committees would occupy many days. The questions are, however, of varying degrees of ripeness. In some cases there may be already a consensus of opinion, not merely that a decision is desirable, but also as to what that decision should be. In either case the subject may be of general interest, and though no immediate decision may be called for, or may be possible, a fairly full discussion may be desirable. Discussion may be useful even in cases where the subject is one that would naturally be referred to a committee of specialists, because it may elucidate where opinions differ, and indicate lines on which agreement is most likely to be reached. Some of the questions may be matters for the future rather than the present, but even so, their inclusion on the list may serve a useful purpose by showing what ideas are fermenting.

The geophysical subjects entrusted to our Section are, it should be remembered, in different stages of development. The instruments and methods of observation employed in terrestrial magnetism have been the subject of long study, and there can be no doubt that the results obtained in different countries are at least approximately concordant. Magnetometers may not give identical values of H, but the differences are of the order of 1/10 per cent, not 10 per cent. They may not give identical values of the declination, but the differences are of the order of 1′, not 1°. Even so, the intercomparison of the standard instruments in different countries has long been a recognized desideratum. In the case of Atmospheric Electricity, on the other hand, no one, I think, really knows how nearly comparable are the results obtained at different stations in the same country, and there seems as yet comparatively little curiosity on the subject. Unless there is serious local disturbance, we know that magnetographs at the Earth's surface, 20 or 30 km. apart, will show practically identical changes in the magnetic elements, even on disturbed days. In the case of Atmospheric

[1]Presented at the first meeting of the Section, October 2, 1924.

Electricity this is not the case. I had occasion recently to compare curves of potential gradient from Greenwich and Kew, places only some 20 km. apart in the same river basin. Bold changes there were in plenty, sometimes even there was a similar sequence of such changes at the two stations. But the changes that most closely resembled one another were not simultaneous. This is moreover only natural, because these changes represent meteorological happenings such as showers, which take a considerable time to travel 20 km. In one respect, perhaps, all the geophysical subjects in our Section have a common burden. It has long been recognized that large centres of population, furnished with the numerous modern applications of electricity, are unhealthy places for magnetographs. For the same reason they are unsuitable for earth-current measurements, while their illumination interferes with auroral observations. But the atmospheric pollution found in and around most towns may be an even greater obstacle to the acquisition of atmcspheric-electricty data fairly representative of the country to which they belong. It is obviously desirable that data should be obtained from country as well as from urban or sub-urban districts. This is a direction in which voluntary observers of a superior class, willing to submit to some supervision, might do valuable work.

The present method of characterization of days—though it seems to me to discriminate not unsatisfactorily between the days of the same month—is probably not the best conceivable. But in view of the diversity of opinion which prevails as to what is an ideal measure of disturbance, I do not think we shall lose anything by the continuation unchanged for a year or two of the methods now followed at De Bilt. Meantime I hope the subject will be further explored. I believe that Prof. van Everdingen would be only too pleased that the theoretical and practical aspects of the case should be investigated by our Section.

Before I conclude, I should like to testify how much the Section has owed to Dr. Bauer as Secretary, and Director of the Bureau. The correspondence, the finance, and the preparation of the Bulletins must have made a very serious inroad on his time. A man who is profoundly interested in a scientific subject naturally wishes to devote to research such spare time as his ordinary daily duties leave at his disposal. To devote a considerable fraction of that time, as Dr. Bauer must have done, to further the objects of a society, calls for a sacrifice which most of us, I suspect, would be unwilling to make. C. CHREE.

REPORT OF SECRETARY, AND DIRECTOR OF CENTRAL BUREAU, 1922–1924[1].

Gentlemen:

Though the time elapsed since the Rome meeting—but two years—is too short, in general, for putting into effect resolutions and matters pertaining to international procedure and cooperation, it is gratifying to be able to report that some progress, nevertheless, has been achieved, as recorded briefly in the following paragraphs.

Publications.—A general report of the Rome meeting, 1922, consisting of 12 octavo pages and containing the general proceedings, list of officers, membership of committees, and resolutions was published in the September, 1922, number of the Journal of "Terrestrial Magnetism and Atmospheric Electricity," and then issued separately as "Bulletin No. 2" of the Section. Owing to some outstanding matters, it was not feasible to proceed with the publication of the complete "Transactions of the Rome Meeting, May, 1922," until the summer of 1923. This complete publication containing 182 + viii octavo pages, 3 plates, and a text figure, was issued at the end of 1923, as "Bulletin No. 3." This last Bulletin comprises briefly Part I (Statutes of the International Research Council and of the International Geodetic and Geophysical Union, Organization and Officers of the latter Union and its several Sections, List of Adhering Countries, Composition and Addresses of Members of National Sections for Terrestrial Magnetism and Electricity, and General Information pertaining to other Unions of interest to our Section); Part II (Reports and Communications received for the Rome Meeting, relating to Status of Magnetic Surveys in 1922, Status of Observatory Work in 1922, Magnetic Instruments and Methods, Magnetic Curves and Characterization, Comments on the Agenda, and Communications of Terrestrial Electricity); and finally Part III (Proceedings and Minutes of the Rome Meeting).

The edition of Bulletin No. 3 was 400 cloth-bound copies and 108 paper-bound copies, and at present there are about 200 copies on hand for future distribution and sale. A copy of the Bulletin was mailed to each member of the National Committees interested in terrestrial magnetism or electricity, to the officers of the International Research Council and of certain Unions, and to a carefully selected list of investigators and officials, who in one way or another, might be helpful in advancing the objects of our Section.

[1]Presented at first meeting of the Section, October 2, 1924.

Favorable comments on this publication have been received from various sources, indicating that the chief desires of the Section were measurably achieved, namely, the promulgation of the latest information and suggestions in the form of resolutions respecting observations and investigations concerning terrestrial magnetism, atmospheric electricity, earth currents, and polar lights.

It was hoped that it might be possible to issue another publication, "Bulletin No. 4," containing the reports and communications for the Madrid Meeting, but this did not prove practicable of accomplishment in advance of the present meeting.

Adhering Countries.—The following Table (No. 1) shows the countries adhering to the International Geodetic and Geophysical Union, as based upon the latest information supplied by the General Secretary, Col. Lyons. Besides the countries listed, preliminary information has been received that Peru and Egypt will also join the Union. [For later Table, See p. 35.]

TABLE 1.—*Countries Adhering to the International Geodetic and Geophysical Union*, 1924.

Country	No. of Units of Contribution	No. of Votes	Country	No. of Units of Contribution	No. of Votes	Country	No. of Units of Contribution	No. of Votes
Australia...	2	2	Greece.....	1	1	Siam......	2	2
Belgium....	2	2	Holland[1]....	1	1	South Africa....	1	1
Brazil......	8	5	Italy.......	8	5	Spain......	8	5
Canada....	2	2	Japan......	8	5	Sweden....	2	2
Chile......	1	1	Mexico.....	3	3	Switzerland.....	1	1
Czecho-Slovakia..	3	3	Norway[1]....	1	1	United Kingdom.	8	5
Denmark...	1	1	Poland.....	8	5	United States....	8	5
France.....	8	5	Portugal....	2	2			
						Totals....	89	65

The Secretary has received recent information from some geophysists in Norway indicating that Norway will before long join the entire Union, instead of, as at present, adhering merely to the Section of Geodesy.[2] Most likely by the time of the next meeting, three years hence, all of the chief countries interested in

[1]These countries have at present joined only the Section of Geodesy.

[2]Norway joined the entire Union in 1925.

geophysical work will have become members of the Union and of our Section. Already about 85 per cent of the magnetic observatories, which at present regularly send the so-called "magnetic character" numbers to the Commission for Terrestrial Magnetism and Atmospheric Electricity of the International Meteorological Committee, for publication by the De Bilt Observatory, are situated in countries adhering to or affiliated with the Union.

Reports of National Committees.—Some delays have been experienced by the Secretary in receiving promptly the reports from the various National Committees in response to a circular request sent out by him last December. These delays are probably to be ascribed chiefly to the fact of the differing dates at which National Committees of the various adhering countries have stated meetings. Direct correspondence with the chairmen of the national sections, or sub-committees, concerned with the subjects of terrestrial magnetism and electricity would prove more effective were it not for the fact of changes in organization of the national committees from time to time. However, in spite of the difficulties mentioned, reports from the chief adhering countries have already been received or, doubtless will be received, at Madrid.

It would seem justifiable to conclude from the reports and communications on hand that interest in terrestrial magnetism and electricity has, indeed, been stimulated by the establishment of our Section. Magnetic surveys, or resurveys, are being prosecuted energetically wherever the financial means and conditions permit. Three *magnetic observatories*, Lerwick (Shetland Islands), Teoloyucan (Mexico), and La Quiaca (Argentina), may be added to the list published on pages 72-74 of Bulletin No. 3. Furthermore, plans are in progress for the establishment of continuously-operating magnetic observatories in Norway and Sweden, and information is being received from time to time, especially from Russian countries, of the resumption of work at magnetic observatories, which during the late war were obliged either to curtail or even to suspend their operations. The New Zealand Government, in accord with our Resolution No. 7, passed at the Rome Meeting, has taken the necessary steps to provide for the continued full activities of the Apia Observatory, Western Samoa, with the cooperation of the British Admiralty and the Carnegie Institution of Washington.

Interest in observational and investigational work in *atmospheric electricity* has notably increased in recent years.

Whereas at Rome we had the results of *earth-current observations* at but one station (Observatorio del Ebro, Tortosa, Spain), there are now three stations at which earth-current potential-gradients are being measured, namely: Observatorio del Ebro, Spain; Älvasjö, Sweden; and Watheroo, Western Australia.

The recent investigations of Professors Stoermer and Vegard of Norway, Professors McLennan and Shrum of Canada, Lord Rayleigh of England, and Dr. Babcock of the Mt. Wilson Observatory, have served to stimulate further investigational work with regard to *polar-light phenomena*.

Committee Reports.—The chairmen of the Committees established at the Rome Meeting have encountered somewhat the same difficulties in obtaining prompt replies from members of their respective committees as those the Secretary has just mentioned with respect to reports from National Committees. In consequence it was not feasible to have the reports in printed form for the Madrid Meeting. However, the manuscript reports are on hand for discussion and consideration by the Section.

As no chairman had been appointed at Rome for Committee No. 3 (On Measures of Magnetic Characterization of Days), Dr. A. Crichton Mitchell, a member of the Committee, was requested by the Administrative Bureau to act as Chairman. In the case of Committee No. 4 (Committee on Best Methods, Instruments and Compilations for Polar-Light Observations) no chairman having been appointed, the Secretary solicited the views of the individual members.

In view of the initiative taken by the Section at the Brussels Meeting, 1919, namely, "welcoming cooperation with the International Astronomical Union in investigating the relationships between solar and terrestrial magnetic and electric phenomena," the Section will, no doubt, be interested to know that the Secretary has continued to serve as a member of the Solar Commission of the International Astronomical Union, and has presented a report to the present chairman of that Commission, namely, Dr. St. John of the Mt. Wilson Observatory.

The Section will also be interested to learn that the International Research Council has recently appointed a committee for the investigation of relationships between solar and geophysical phenomena, in general. Dr. Sydney Chapman of England is the Chairman of this special committee, and, in accordance with information received from the General Secretary of the International Research Council it is entirely appropriate for our Section to recommend some one as its representative on this committee.

Agenda.—According to the Statutes of the International Geodetic and Geophysical Union, Article 13, the agenda of business to be transacted at a meeting are to be communicated to the countries adhering to the Union at least four months before the day of the meeting, hence, in the case of the Madrid Meeting it was to be not later than June 1, 1924. The prime purpose of this statute is doubtless to have the final Agenda reach the National Committees in time for discussion and preparation of appropriate instructions to their respective delegates. As the meeting place will most likely be generally in some European country, and in view of the time required for interchange of correspondence of the adhering countries, the statutory limit (four months) for the promulgation of the Agenda is none too long. As soon as definite word was received from the President and from the General Secretary of the Union as to arrangements for the Madrid Meeting, your Secretary mailed a circular letter, dated December 24, 1923, to the presidents of National Committees calling attention to the statutory requirements with regard to Agenda, and expressing the hope that all questions for the Agenda be received preferably not later than March 1, 1924. In the same letter requests were made for reports on work in terrestrial magnetism and electricity during 1922 and 1923, to reach the Secretary not later than April 1, 1924. Only to a very limited extent were questions for the Agenda and reports on work accomplished received in time to enable the Secretary to comply with the statutory requirement. It would seem necessary that arrangements for meetings be completed, if possible, at least a year in advance of the date set, in order that National Committees may have ample time to submit questions for the Agenda of the Union, as a whole, and for the several sections, and to transmit the desired reports.

The printed Agenda, as mailed to National Committees the end of May, include certain questions left over from the Rome Meeting, regarding which the Secretary was requested to obtain further information from observatories and organizations engaged in work pertaining to terrestrial magnetism and electricity. A questionnaire was prepared and submitted to the President of the Section, however, on further consideration it seemed, in view of the conditions existing in various countries, that the time was not yet ripe to elicit by a questionnaire the requisite information to enable the Executive Committee, in accordance with Resolution No. 20, passed at the Rome Meeting, to formulate definite recommendations for submission to the Section. Instead, it appeared that the present objects would be best accomplished by obtaining desired information either from publications received or by direct correspondence with directors, and deferring the formulation of specific recommendations until post-war conditions had improved sufficiently to permit institutions to resume their pre-war activities. The information obtained in this manner by your Secretary will be submitted when the appropriate items of the Agenda are before the Section for discussion. It should be mentioned, however, that *as regards the time to be used in curve measurements of magnetograms (Item IB1a of Agenda), the Section at the Rome Meeting, after careful consideration of the opinions expressed*[1] *and received "finally agreed on the recommendation of using in general, Greenwich Mean Time or Zonal Time (Time differing from Greenwich by an integral number of hours).*" Because of an oversight, this recommendation was not included in the "Resolutions" of the Rome Meeting.

Personalia.—We regret to be obliged to record the deaths since the Rome Meeting of 13 of our colleagues (see Appendix B), notably, Prof. C. A. Angot, Dr. E. G. Deville, and Dr. Otto Klotz, who were present at previous meetings of the Section. Changes of observatory personnel, etc., will be found mentioned in the reports of National Committees.

Finances.—During the term of office of the present Secretary and Director of the Central Bureau, beginning with the Brussels Meeting of 1919 and closing with the present meeting at Madrid, the total funds advanced by the General Secretary of the Union amounted to 36,650 francs, which, according to the prevailing exchange rates when the various drafts in French francs were received, aggregated $2,198.55. The total disbursements for publications, international comparisons of instruments, grants, and miscellaneous expenses by the Secretary's office through August 31, 1924, amounted to $2,096.31,[2] leaving on that date a balance on hand at the National Metropolitan Bank of Washington of $102.24, or 1,955.81 French francs. Some disbursements made, in behalf of the Section since August 31, 1924, and expenses to be incurred in connection with the Madrid Meeting, especially by the employment of the Secretary's assistant, Mr. H. D. Harradon, as translator and stenographer, as authorized by the Administrative Bureau, will exhaust the balance on hand and entail some slight additional expenditures.

The General Secretary of the Union reported on September

[1]See "Transactions of Rome Meeting," Bulletin No. 3, p. 165, item A5a.
[2]$2,113.81 less $17.50 for sale of five copies of Bulletin No. 3.

18, 1924, that the balance of funds still remaining on March 31, 1924, to the credit of the Section of Terrestrial Magnetism and Electricity, after deduction of the total advance of 36,650 francs above mentioned, was 35,003 francs, which amount will still be available to the Section, at the close of the present meeting.

The Secretary has brought with him a complete financial statement, accompanied by receipts, covering all disbursements made by him through August 31, 1924, for any examination and auditing which the Section may decide upon. There is annexed also to this report a statement (see Appendix A) by Mr. McClain B. Smith, Chief Clerk and Cashier of the Department of Terrestrial Magnetism, certifying that he has examined the financial statement and found it correct, and that he has verified the bank balance of $102.24 on hand August 31, as reported above. The General Secretary of the Union has been supplied with receipts for all funds advanced, and in his letter of January 15, 1923, in answer to your Secretary's enquiry has expressed the opinion that his office did not desire to have a detailed account of disbursements by the several Sections and that the rendering of detailed accounts was the concern of the individual Section. The Secretary, therefore, submits to the Section his complete accounts for such action and disposal as it may see fit.

One matter concerning financial matters should also be submitted to the Section for its consideration, namely, the loss of available funds owing to greatly fluctuating values of the French franc during the past years. The average loss in available funds resulting from this source has been about 50 to 70 per cent. At the recent meeting of the International Union of Pure and Applied Chemistry held at Copenhagen, the following action was taken concerning this question: "The Council voted that the funds of the Union are to be kept on a gold basis in a bank accepting such deposits, in order to avoid embarrassment to the Union resulting from fluctuation of exchange rates. It voted also that, beginning with 1925, the quotas of the various member-countries shall be paid on a gold franc basis."

The representative of the Section on the Finance Committee of the Union may be requested to express an opinion as to the funds to be allocated to the Section after the present meeting. At Brussels, in 1919, the annual contribution to the Section was fixed at the rate 400 francs per contributing unit, but at Rome in 1922, because of the addition of another section (Volcanology) to the

Union, the rate was reduced to 320 francs per contributing unit. The total number of contributing units, as shown in Table 1, is at present about 89; hence, if the rate fixed at Rome be continued, the annual contribution of funds to the Section would be about 25,920 francs, with prospect of further funds as additional countries join the Union. On the other hand, one of the questions which will come up for discussion before the Committee on Finance is whether the adhering countries may be expected to contribute funds to all sections of the Union, or only to the section they join.

Admission of Additional Countries.—It may be recalled that the Section in its Rome Resolution No. 1, expressed the hope "that a day will come when the collaboration of all countries in the labors of the Section will become possible." Since then various Unions have passed resolutions recommending to the International Research Council that at the appropriate time such amendments be made in its statutes as to make possible the joining of the Council and of its Unions by other countries than those which may conform to the requirements of the present statutes. This matter is brought to the attention of the Section for its information so that it may be prepared to express its opinion on any action referred to it.

Concluding Remarks.—In conclusion the Secretary, at the termination of his term of office, desires to express his very sincere appreciation and his deep obligation to all members of the Section, particularly to the Presidents of the Section, Prof. A. Tanakadate, 1919-1922, and Dr. Chree, since 1922, and to his colleagues of the Executive Committee, for the very substantial assistance received and for the good-will and extreme patience ever shown him in the performance of his various duties during the past five years.

Louis A. Bauer.

Appendix A.

REPORTS OF AUDITORS.

To Whom It May Concern:

This will certify that I have audited the accounts of Dr. Louis A. Bauer, Secretary of the International Section of Terrestrial Magnetism and Electricity and Director of its Central Bureau, and have found the receipts to agree with the entries as made on the accounts and with the checks as drawn. I have verified the advances received by Dr. Bauer, totaling $2,198.55 and the disbursements totaling $2,096.31 and have verified the bank balance of $102.24 (August 31, 1924), which is equivalent to 1,955.81 francs at the rate $0.052275 per franc used for the conversion of the last advance (December 1923), received by Dr. Bauer from Col. H. G. Lyons, General Secretary of the International Geodetic and Geophysical Union.

Washington, D. C., August 31, 1924. McClain B. Smith,
Chief Clerk and Cashier, Department of Terrestrial Magnetism.

The accounts of the Central Bureau of the Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics presented by the Director were examined, and every item was found to be correct and in order.

Madrid, September 30th, 1924. A. TANAKADATE, *Auditor.*[1]

Appendix B.

LIST OF DECEASED INVESTIGATORS IN TERRESTRIAL MAGNETISM AND ELECTRICITY SINCE ROME MEETING, 1922.

C. A. Angot, distinguished meteorologist and magnetician of France, who was for many years director of the Bureau Central Météorologique, died on March 16, 1924, at the age of 75;

James B. Baylor, connected for many years with the United States Coast and Geodetic Survey during which he made extensive magnetic observations in all parts of the United States, died on May 23, 1924, at the age of 75;

Darius W. Berky, leader of notable magnetic exploratory expeditions in Africa and South America while on the staff of the Department of Terrestrial Magnetism, 1912-1915, and later professor of physics in the University of the South at Sewanee, Tennessee, died on September 24, 1924, at the age of 41 years;

Frank Hagar Bigelow, an active contributor for many years to terrestrial and cosmical physics chiefly while connected with the United States Weather Bureau and later with the Argentine Meteorological Office, died in Vienna, Austria, on March 2, 1924;

W. W. Bryant, since 1904 in charge of the Meteorological and Magnetic Department of the Royal Observatory, Greenwich, died on January 31, 1923, after a brief illness;

E. Colin, S. J., a zealous missionary, founder and director of the Observatory of Tananarive, Madagascar, and who made various magnetic observations in Madagascar, died in 1923 at the age of 71;

Marc Dechevrens, S. J., director of the Zi-ka-wei Observatory in China, 1875 to 1887, and director of the Observatory St. Louis, Jersey, since 1894, died on December 6, 1923, at the age of 79 years;

Edouard G. Deville, director-general of surveys in the Canadian Department of the Interior, and Chairman of the National Committee of Canada for geodesy and geophysics, died on September 21, 1924, at the age of 75 years;

M. Ch. Dufour, formerly director of the Parc Saint-Maur Observatory.

Otto Klotz, who distinguished himself in various branches of geophysics and was director of the Dominion Observatory at Ottawa, Canada for many years, died on December 28, 1923, at the age of 71 years (Dr. Klotz participated in the proceedings of the Rome Meeting and soon after his return to Canada was stricken with an illness from which he never recovered);

Thomas Corwin Mendenhall, superintendent of the United States Coast and Geodetic Survey, 1889 to 1894, and one of the pioneers in atmospheric-electric observations in the United States, died on March 23, 1924, at the age of 82;

Carl Hartwig Ryder, distinguished director of the Danish Meteorological Institute, died on May 3, 1923;

Robert Simpson Woodward, author of many notable investigations in various branches of geophysics and President of the Carnegie Institution of Washington, 1904 to 1921, died on June 29, 1924, at the age of 75 years.

[1]Appointed by the Executive Committee, September 30, 1924.

INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION.

SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY.

Agenda for Madrid Meeting, October 1-10, 1924.

1.—Opening of Meeting.
2.—Report of Secretary and Director of Central Bureau.
3.—Miscellaneous Reports (National and other Committees, Special Investigations, etc.).
4.—Subjects for Discussion and for Consideration by Committees.
5.—Election of Secretary and Director of Central Bureau.
6.—Appointment of Committees.
7.—Resolutions.

The subjects proposed (No. 4) include the following:

I.—TERRESTRIAL MAGNETISM.

A.—Instruments and Constants.

1. Program for national and international comparisons of magnetic standards.
2. Expediency of designing and constructing an instrument to measure the vertical intensity directly in absolute measure.
3. Best way of calculating and using the "distribution constants" of magnetometer magnets, employed for the determination of the horizontal intensity.

B.—Observatory Work.

1. Curve measurements. (*a.* Time local, G. M. T., or zonal? *b.* Instantaneous or mean values? *c.* If mean values, 60 minutes to center at hour or at half hour?)
2. Diurnal inequalities. (*a.* From all or selected days, and if selected days, type or types? *b.* Application of non-cyclic corrections. *c.* Fourier coefficients.)
3. Publications. (*a.* What should be published? *b.* Form. *c.* Terminology.)
4. Should monthly and annual means be derived from all days or selected quiet days?
5. Characterization of days and magnetic activity.
6. Terminology for magnetic elements and variations. (*Cf.* IB3c.)
7. Minimum distribution of observatories and urgency of early establishment of at least one and preferably two observatories suitably located where auroral displays are frequent. (*Cf.* II C2.)
8. Desirability of obtaining magnetic data from high magnetic latitudes in years near sunspot maximum, for comparison with the results obtained in the Antarctic, near sunspot minimum (in 1902, 1903, 1911, 1912, 1913).
9. Adoption of a scheme for observing at selected magnetic observatories the times of occurrence of "sudden commencements of magnetic storms" with special instruments admitting of very high precision in the determination of time.

C.—Magnetic Surveys.

1. Urgent need of additional observations and secular-variation data in regions north of 60°N and south of 50°S.
2. Need of further ocean work. (*a.* Secular variation. *b.* Magnetic anomalies. *c.* Distribution of magnetic observations. *d.* Atmospheric-electric observations. *e.* Earth-current observations.)
3. Best methods of correcting field results on account of diurnal variation and secular variation.
4. Adoption of stated epochs to which all field data by various organizations should be reduced.
5. Accuracy with which it is worth while to express terrestrial magnetic data.
6. Upper-air observations of magnetic elements and their variations.

II.—Terrestrial Electricity.

A.—Atmospheric Electricity.

1. Terminology for atmospheric-electric elements and variations.
2. Methods as to curve measurements, electric characterization of days, and determination of diurnal and annual variations to be given same consideration as for terrestrial magnetism. (*Cf.* IB1-5.)
3. Atmospheric-electric survey and iso-electric charts, including work at sea and determinations of diurnal variations of the potential gradient simultaneously at as many different latitudes and longitudes as possible.
4. Minimum requirements for control observations at observatories.
5. Upper-air observations of electric elements and their variations.
6. Desirability of calculating the mean value of the potential gradient of atmospheric electricity and its diurnal variation from two groups of days. (*a.* From the international magnetic quiet days. *b.* From the international magnetic disturbed days.)

B.—Earth Currents.

1. Terminology for elements and variations.
2. Methods as to curve measurements, characterization of days, and determination of diurnal and annual variations to be given same consideration as for terrestrial magnetism. (*Cf.* IB1-5.)
3. General consideration of existing methods and desirability of new and independent methods, including investigation of earth currents at sea.
4. Arrangements for utilization of earth-current disturbances recorded by telephone and telegraph companies throughout the world, and improvement of such records.

C.—Aurora Polaris.

1. Minimum standard requirements for recording auroral displays. (*a.* Photographically. *b.* Visually.)
2. Urgent need for one or two suitably located observatories where auroral displays are frequent, and minimum requirements for observations at such observatories. (*Cf.* IB7.)

Union Géodésique et Géophysique Internationale.

SECTION DE MAGNÉTISME ET D'ÉLECTRICITÉ TERRESTRES.

Ordre du Jour, Conférence de Madrid, 1-10 Octobre, 1924.

1.—Ouverture de la Séance.

2.—Rapport du Secrétaire, Directeur du Bureau Central.

3.—Rapports variés (des Comités nationaux et autres, sur les investigations spéciales, etc.).

4.—Questions diverses soumises à l'étude et à la considération des Comités.

5.—Élection du Secrétaire, Directeur du Bureau Central.

6.—Nomination des Comités.

7.—Voeux.

Les questions soumises (No. 4) sont les suivantes:

I.—Magnétisme Terrestre.

A.—Instruments et Constantes.

1. Programme pour la comparaison nationale et internationale des étalons magnétiques.
2. Opportunité de projeter et de construire un instrument pour évaluer directement la composante verticale en mesure absolue.
3. La meilleure manière de calculer et d'employer les "constantes de distributions" des aimants employés dans les magnétomètres pour la détermination de la composante horizontale.

B.—Travaux des Observatoires.

1. Relevé des courbes. (*a.* L'heure locale, l'heure de Greenwich, ou l'heure zonale? *b.* Les valeurs instantanées ou horaires moyennes? *c.* Si horaires moyennes, les 60 minutes sont-elles centrées à l'heure ou à la demi-heure?)
2. Inégalités diurnes. (*a.* Doivent-elles être déduites de tous les jours, ou de certains jours choisis, et comment? *b.* Corrections non périodiques. *c.* Coefficients de Fourier.)
3. Publications. (*a.* Ce qu'on doit publier? *b.* La forme. *c.* La terminologie.)
4. Doit-on calculer les moyennes mensuelles et annuelles de tous les jours ou de jours calmes choisis?
5. Caractérisation des jours et l'activité magnétique.
6. Terminologie pour les éléments et variations magnétiques. (*Cf.* IB3c.)
7. La distribution minimum des observatoires et la nécessité de fonder bientôt un, ou de préférence deux observatoires convenablement placés en des lieux où les aurores polaires se manifestent fréquemment. (*Cf.* IIC2.)
8. Serait-il convenable d'obtenir des données magnétiques pour les hautes latitudes pendant les années voisines du maximum des taches solaires afin de les comparer avec les résultats obtenus dans les régions antarctiques aux époques du minimum des taches solaires (1902, 1903, 1911, 1912, 1913)?
9. Adoption d'une manière d'observer les instants des "commencements brusques des orages magnétiques" dans les observatoires choisis et munis d'instruments spéciaux de haute précision pour la détermination du temps.

C.—Réseaux magnétiques.

1. Nécessité pressante d'avancer les observations et les déterminations de la variation séculaire pour les régions au nord de 60° N et au sud de 60° S.
2. Nécessité d'avancer les observations en mer. (*a.* Variation séculaire; *b.* Anomalies magnétiques; *c.* Répartition des observations magnétiques; *d.* Observations d'électricité atmosphérique; *e.* Observations des courants telluriques.)
3. Les meilleures manières d'effectuer les corrections des mesures en campagne pour la variation diurne et la variation séculaire.
4. Adoption d'époques choisies auxquelles les résultats des mesures en campagne peuvent être ramenés par les établissements divers.
5. L'exactitude avec laquelle il vaut la peine d'exprimer les données magnétiques du globe.
6. Observations des éléments magnétiques et étude de leurs variations dans les couches supérieures de l'atmosphère.

II.—Électricité Terrestre.

A.—Électricité atmosphérique.

1. Terminologie pour les éléments et variations de l'électricité atmosphérique.
2. Les méthodes pour le relevé des courbes, la caractérisation électrique des jours, et la détermination de la marche diurne et annuelle doivent être l'objet de la même délibération que pour le magnétisme terrestre. (*Cf.* IB1-5.)
3. Réseaux de l'électricité atmosphérique; cartes des courbes isoélectriques; observations en pleine mer; déterminations simultanées des variations diurnes de la chute de potentiel aux latitudes et longitudes aussi diverses que possible.
4. Le minimum nécessaire des observations de contrôle dans les observatoires.
5. Observations des éléments électriques et étude de leurs variations dans les couches supérieures de l'atmosphère.
6. Intérêt qu'il y aurait à déduire la valeur moyenne de la chute de potentiel atmosphérique et la marche diurne de deux groupes de jours. (*a.* Les jours internationaux magnétiquement calmes. *b.* Les jours internationaux magnétiquement troublés.)

B.—Courants telluriques.

1. Terminologie pour les éléments et variations.
2. Les méthodes pour le relevé des courbes, la caractérisation des jours, et la détermination de la marche diurne et annuelle, doivent être l'objet de la même délibération que pour le magnétisme terrestre.
3. Examen général des méthodes employées et des méthodes nouvelles et indépendantes, y compris l'étude des courants telluriques en mer.
4. Mesures à prendre pour utiliser les troubles enregistrés par les lignes télégraphiques et téléphoniques autour du monde, et pour perfectionner leur enregistrement.

C.—Aurores polaires.

1. Le minimum nécessaire pour enregistrer les aurores. (*a.* Au moyen de la photographie; *b.* A la vue.)
2. Nécessité pressante de fonder un ou deux observatoires convenablement placés en des lieux où les aurores polaires se manifestent fréquemment, et le minimum nécessaire pour les observations aux dits observatoires. (*Cf.* IB7.)

MINUTES OF THE EXECUTIVE COMMITTEE.

SESSION OF SEPTEMBER 30, 1924.

The session was opened by the president, Dr. Chree, at 6 P. M. Other members present were: Prof. Palazzo, vice-president; Dr. Bauer, secretary; Prof. Maurain, and Prof. Tanakadate.

Prof. Tanakadate was appointed Auditor of the Secretary's accounts and was requested to make, if possible, a report at the first session of the Section.

The Committee then prepared the time-table for all the sessions of the Section to be held October 2-7, 1924, and authorized the President and the Secretary to conclude arrangements for one joint session of the Sections of Meteorology and Terrestrial Magnetism and Electricity for the discussion of topics of common interest.

The session adjourned at 7 P. M.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

SESSIONS OF OCTOBER 4, 1924.

During the morning session from 9^h to 10^h A. M., the Executive Committee formulated the objects for which funds were to be solicited from the Finance Committee, for submission to the Section (see Minutes, Article 1, of Session of Section, October 4, 1924).

The Section having approved the proposals of the Executive Committee, the Committee at its session from $7^h\,15^m$ to $8^h\,10^m$ P. M., formulated the following tentative budget for expenditures of the Section during the next three years, to be submitted to the Finance Committee by Prof. Tanakadate, namely:

		Francs
I.	Publication and Miscellaneous Expenses of Central Bureau	60,000
II.	International Comparisons of Instruments	20,000
III.	Magnetic and Electric Characterization of Days	10,000
IV.	Construction of Instruments for Special Investigations	15,000
V.	Grants to Committees for Special Investigations	15,000
	Total	120,000

It was estimated that the total balance of funds (35,003 francs) still remaining to the credit of the Section would barely suffice for the publication of the Madrid Transactions and lists of observatories engaged in magnetic and electric work and the requisite information regarding instruments and methods in use at these observatories.

At both sessions, the president, Dr. Chree, presided, and besides himself there were present: Bauer, Maurain, Palazzo and Tanakadate.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

SESSION OF OCTOBER 7, 1924.

During the session from $5^h\ 40^m$ to $7^h\ 30^m$ P. M., the Executive Committee prepared the draft of the various resolutions as authorized by the Section, both those pertaining to the scientific work of the Section and those expressing thanks and appreciation of courtesies extended and entertainment provided by the governmental authorities of Spain, by the Spanish Local Committee, by the mayor and municipality of Tortosa and by the Director of the Ebro Observatory.

All members of the Committee were present the major part of the time, except M. Jaumotte.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

SESSION OF OCTOBER 8, 1924.

The Committee met from $4^h\ 10^m$ to $6^h\ 30^m$ P. M., all members being present most of the time, excepting M. Jaumotte.

The final draft of the resolutions authorized by the Section was prepared and approved.

Prof. Maurain was appointed chairman of the Committee on Terminology and Prof. Tanakadate was appointed reporter of the Committee on the Investigation of Sudden Commencements of Magnetic Disturbances. Pending the receipt of further information, the appointment of chairmen, or reporters, for other committees had to be deferred, as also the complete composition of the various committees. [See page 36.]

The President was nominated the representative of the Section on the Committee of the International Research Council dealing with Solar and Terrestrial Relationships.[1]

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

[1]The other members of the Committee are: C. G. Abbot, S. Chapman (chairman), H. Deslandres, G. Ferrié, G. C. Simpson, C. E. St. John, and C. Störmer.

MINUTES OF MADRID MEETING, OCTOBER 2-7, 1924.

SESSION OF OCTOBER 2, 1924.

The third general meeting of the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union was opened at 3:40 P. M. by the President of the Section, Dr. C. Chree, who made some introductory remarks relating mainly to the matters coming before the Section for consideration (see pp. 3 and 4). He announced the appointment by the Administrative Bureau of Mr. H. D. Harradon, librarian of the Department of Terrestrial Magnetism to act as the Secretary's assistant at Madrid, in the capacity of translator and stenographer.

The Secretary next presented his report, giving a summary of the work done by the Section since the Rome Meeting (see pp. 5-13). His report as Secretary, and Director of the Central Bureau, contained a list of the countries adhering at present to the Union, and was accompanied by a financial statement covering the expenses incurred during his term of office, beginning with the Brussels Meeting, 1919, and continuing to August 31, 1924. This report was accepted and filed together with the report of the auditing committee consisting of Prof. A. Tanakadate, appointed by the Executive Committee and of Mr. M. B. Smith, cashier and bookkeeper of the Department of Terrestrial Magnetism, who represented the Secretary.

Prof. Tanakadate as a member of the Section of Terrestrial Magnetism and Electricity on the Finance Committee of the Union was asked to request that the balance of the funds still remaining to the credit of the Section, viz., 35,003 francs, be made available to the Section and also that the funds to be allotted to the Section in the future be not less than the rate fixed at Rome, viz., 320 francs per contributing unit.

The Secretary called attention to the fact that in accordance with information received from the General Secretary of the International Research Council it was quite in order for the Section to recommend one or more representatives on the Committee recently appointed by the International Research Council for the investigation of the relationships between solar and geophysical phenomena in general, Dr. Sydney Chapman of England being chairman of this special committee. [See bottom of page 19.]

Abstracts of reports were next read by the respective representatives of the National Committees of the following countries: Australia, Brazil, Canada, Czecho-Slovakia, Denmark, France, Greece, Italy, Japan, Mexico, Poland, Portugal, Siam, Sweden, Switzerland, United Kingdom, and the United States of North America. Also, Prof. G. Melander, of Finland, and Prof. Sem Saeland, of Norway, were invited to report on work in terrestrial magnetism and electricity in their respective countries.

A brief statement was also made by the Secretary with regard to reports received from countries not adhering to the Unión.

A preliminary reading of the reports made by the chairmen of the special committees appointed at Rome, next followed, the discussion of the respective reports being reserved for later sessions when the various items of the Agenda would be discussed.

Prof. Tanakadate who attended the first meeting of the Finance Committee of the Union at 5:30 P. M. made a preliminary report to the effect that the balance of funds still remaining to the credit of the Section would be made available, and that the minimum allotment of funds for the Section of Terrestrial Magnetism and Electricity in future would not be less than the amount, 20,480 francs, set aside in 1923. He further stated that the Section could make suggestions to the Finance Committee, to be received not later than Monday, October 6, for definite projects requiring additional funds during the next three years.

There were 20 persons present, 13 of whom were delegates and 7 specially invited guests, 11 countries being represented. The first session was adjourned at 8 P. M. until 10 A. M., October 4.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

SESSION OF OCTOBER 4, 1924.

The session was opened at $10^h 15^m$ A. M., by the President, Dr. Chree, who presided until $11^h 30^m$ A. M., when he was obliged to attend to other duties; the Vice-president, Prof. Palazzo, then presided from $11^h 30^m$ A. M. to $12^h 15^m$ P. M. After an intermission of about 30 minutes, the President re-opened the session, which continued until $2^h 10^m$ P. M., and then was adjourned to permit the members to participate in the festivities arranged by the Spanish Local Committee.

The following matters after discussion by various members were transacted:

1. The Executive Committee was authorized to transmit a request to the Finance Committee of the Union, through the representative of the Section, Prof. Tanakadate, for an allocation of funds to the Section amounting, if possible, to 40,000 francs per annum, for the following objects: *a.* Publications and miscellaneous expenses of the Central Bureau; *b.* International comparisons of instruments; *c.* Magnetic and electric characterization of days; *d.* Construction of instruments for special purposes; and *e.* Grants to committees for special investigations.

2. After reading of the several recommendations contained in the report of the Chairman of the Committee on Magnetic Surveys and International Comparisons of Instruments, it was decided to refer to the Executive Committee of the Section the definite formulation of a program for national and international comparisons of magnetic standards and the consideration of the best way of calculating and using the "distribution constants" of magnetometer magnets, the Executive Committee to appoint such committees, "or reporters," as may be found necessary, for

the accomplishment of these purposes (Items IA1 and IA3 of the Agenda).

3. That the Section is in accord with "the expediency of designing and constructing an instrument to measure the vertical intensity directly in absolute measure," and leaving to countries interested the actual construction of such an instrument (Item IA2 of the Agenda).

4. That the Section empowers the Executive Committee to appoint any necessary committee for the magnetic and electric characterization of days, which committee is to select different methods of estimating activity and characterization of days in the various branches of terrestrial magnetism and electricity, to correspond with observatories engaged in these branches of work for obtaining the requisite data to investigate the applicability of the different methods, the results of such investigations to be circulated among members and others interested, the Committtee furthermore to make a report to the Section at the next General Assembly (Items IB5, and respective items IIA2 and IIB2).

5. Señor de Azpiazu and Father Rodés gave brief accounts of the work in terrestrial magnetism and electricity in Spain, which they were unable to present at the session on October 2.

There were present during the session 13 delegates and 6 specially invited guests, making a total of 19 persons, representing 12 different countries.

(Signed) Charles Chree, *President;*
Louis A. Bauer, *Secretary.*

MORNING SESSION OF OCTOBER 6, 1924.

The morning session was opened at 10^{h} 15^{m} by the President, Dr. Chree, who presided until its close at 12^{h} 10^{m} P. M. The following matters, after consideration and discussion by the various members present were transacted:

1. The action taken at the Rome meeting with regard to magnetograph measurements, viz., according to Greenwich mean time or zonal time, rather than according to local time was confirmed (Item IB1a of the Agenda).[1]

2. The Secretary reported that following the request made at the Rome Meeting, information was compiled from existing publications and from letters received from directors of observatories, indicating that about one half of the magnetic observatories actively engaged at present in magnetic work, were obtaining mean values from their magnetograms for an interval of 60 minutes, and about one half were still measuring instantaneous values at the full hours. At about three fourths of the observatories scaling mean values, the mean centers at the half hour, and at the remaining fourth at the full hour.

In view of the fact that complete information was not obtainable from certain observatories owing to their curtailed or suspended

[1]See "Transactions of Rome Meeting," Bull. No. 3, p. 165, item A5a.

operation, and as similar questions to those under discussion in terrestrial magnetism also apply to methods of curve measurements in atmospheric electricity and earth currents, it was finally resolved to empower the Executive Committee to take such action, or appoint any necessary committee for full report at the meeting of the next General Assembly (Items IB1b and c; IIA2; IIB2, of the Agenda).

3. That the Executive Committee appoint a committee for the consideration of terminology in terrestrial magnetism, atmospheric electricity and earth currents, for report at the next meeting of the General Assembly (Items IB6; IIA1; IIB1, of the Agenda).

4. The Section recommended the desirability of obtaining magnetic data from high latitudes in years near sun-spot maximum to supplement the results near sun-spot minimum already obtained to some extent by certain Antarctic expeditions and that this matter be brought to the attention of future expeditions (Item IB8 of the Agenda).

5. It was recommended that the Executive Committee formulate a scheme for obtaining at selected observatories the times of occurrence of sudden commencements by methods and appliances adequate for the purpose (IB9, of the Agenda).

There were 16 persons present, of which 9 were delegates and 7 were invited guests, 11 countries being represented.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

JOINT SESSION OF OCTOBER 6, 1924.

The joint session of the Sections of Meteorology and Terrestrial Magnetism and Electricty was opened at 12^{h} 30^{m} P. M. by the President of the Section of Meterology, Sir Napier Shaw, who, after a brief introductory statement with regard to questions set for discussion, called upon Dr. Kimball of the United States Weather Bureau to give the reasons for the proposals made by the American Geophysical Union pertaining to fundamental world-wide meterological questions.

He next called upon Dr. Chree and Dr. Bauer for discussion of the questions proposed by the British National Committee relating to possible correlations between meteorological phenomena and activity in the Earth's magnetism (Article 13, Agenda, Section of Meteorology), and as to the correlation between atmospheric electric phenomena and terrestrial magnetic activity (Item IIA6, Agenda, Section of Terrestrial Magnetism and Electricity). Father Rodés and Prof. Tanakadate also contributed to the discussion of these questions.

It was finally decided by the Section of Meteorology to make a request to the Finance Committee of the Union for 500 pounds to cover expenditures incurred by any possible international meteorological bureau or committee which would investigate the meteorological questions proposed by the American Geophysical

Union and the question of the British National Committee relating to the correlation between meteorological phenomena and terrestrial magnetic activity.

Furthermore, it appeared desirable to those present that the investigation suggested in Item IIA6, of the Agenda of the Section of Terrestrial Magnetism and Electricty, be carried out. It was also recommended by Dr. Bauer that the question of any relationship between solar activity and atmospheric electricity be investigated directly for complete sun-spot cycles.

There were about 26 persons present at the joint meeting.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

MORNING SESSION OF OCTOBER 7, 1924.

The session was opened at $10^h\ 05^m$ A. M., by the President, Dr. Chree.

The minutes of the morning session of October 6 and of the afternoon joint session with the Section of Meteorology were read and approved.

Items IB2, 3, 4 and 7, and IIC2 were next briefly considered, and the comments received concerning these items were read. Remarks concerning the application of non-cyclic corrections were made by Drs. Chree and Bauer and by Father Rodés. Owing to the state of affairs still prevailing in many countries with regard to the full operation of observatories, it was considered best not to formulate at present definite recommendations on these items, other than to indicate where it would be desirable to establish additional completely equipped observatories when conditions permitted (See Resolutions Nos. 8, 9, 10, 11, and 13).

The Section next took up the election of Secretary and Director of the Central Bureau. Prof. Palazzo moved that Dr. Bauer be requested to continue to perform the duties of this office, which motion was seconded by Prof. Tanakadate. As it was the unanimous desire of the delegates present that Dr. Bauer consent to re-election, he stated that though he had hoped to be allowed to retire at the expiration of his term which began at the Brussels meeting of 1919, and though he was in principle opposed to successive continuation of office, he felt that it was his duty, under the present circumstances, to abide by the wishes of those present.

Items IC 1, and 2 were next discussed by Dr. Carlheim-Gyllensköld, Prof Tanakadate, Mr. Greaves and Dr. Bauer. On motion of Mr. Greaves, who described the aid received in the preparation of the magnetic charts of the British Admiralty from the magnetic data obtained by the Carnegie Institution of Washington on land and sea, Resolution No. 14 was passed. Concerning action taken regarding Item IC 1, see Resolution No. 15.

Prof. Mathias gave an account of recent work in atmospheric electricity in France (See report, pp. 73-76).

Items IC 3 and 4 were briefly commented upon by Dr. Chree, Prof. Mathias, Prof. Tanakadate and Dr. Bauer, and comments received from the United States Coast and Geodetic Survey and from the Department of Terrestrial Magnetism were read.

Prof. Tanakadate expressed his preference for reduction to January 1 (0^h) rather than to middle of year. It seemed inexpedient, in view of the varying objects of the organizations engaged in the preparation of magnetic charts, to recommend stated epochs for these charts.

Regarding Item IC 5, it was the general opinion of those (Dr. Chree, Prof. Tanakadate, Prof. Palazzo, Prof. Mathias and Dr. Bauer) who participated in the discussion of this item that the question of accuracy desirable in magnetic observations depended upon the particular purpose in view, e. g., intercomparisons of instruments, establishment of stations for obtaining secular-variation data, determination of magnetic variations, or study of magnetic anomalies. In the latter case only approximate values of the magnetic elements are required so that multiplicity of stations, rather than high precision of the magnetic elements should be the aim. It was the general opinion that after the application of all necessary corrections, field values of the horizontal intensity need not be given beyond the fourth decimal C. G. S. (See further comments on Agenda, pp. 158 and 165).

After an intermission from 12:10 to 12:30 P. M., the Section resumed its work.

Dr. Stenquist gave an abstract of the investigational work respecting earth-currents in Sweden (see report, pp. 153–155), and the comments received concerning items II B 3 and 4 were read. (See pp. 155–156, and 168–169).

Items IC 6 and IIA 5 were then discussed. Prof. Tanakadate was called upon by the President to give an account of the results of the reduction of magnetic observations in Japan to sea-level. Dr. Bauer recited the experiences encountered by the Department of Terrestrial Magnetism and by others in determining the magnetic elements at various altitudes on mountains, effects from local magnetic disturbances usually masking any variations with altitude. At the request of the President, Dr. Bauer also gave a brief account of the experiments being conducted under Dr. Millikan's direction with regard to the penetrating radiation and electric conductivity in upper altitudes. The sense of the Section on these items is embodied in Resolution No. 16.

In connection with Item IIC 1, Dr Carlheim-Gyllensköld recited briefly his experiences in observations of polar lights. (See also comments on this item of the Agenda, pp. 159 and 169.)

Prof. Tanakadate reported that the Finance Committee of the Union had adopted the recommendations of the Executive Committee for an annual allotment of 40,000 francs to the Section, during the next three years, for the objects stated in the minutes of October 4 (see pp. 18 and 21). A vote of thanks was tendered Prof. Tanakadate.

The session adjourned at 2^h 10^m P. M. There were 20 persons present, 14 of whom were delegates and 6 specially invited guests, 14 countries being represented.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

AFTERNOON SESSION OF OCTOBER 7, 1924.

The session was opened by the President at $3^h\ 40^m$ P. M.

Items IIA3 and 4 were taken up for consideration and remarks were made by Dr. Chree, Prof. Tanakadate, Prof. Mathias, and Father Rodés. The comments on these items from the United States Coast and Geodetic Survey and the Department of Terrestrial Magnetism were read by Dr. Bauer. Finally Resolutions Nos. 17 and 18 were passed as expressing the sense of the Section (see also Comments on the Agenda, pp. 165–168).

The Section next gave consideration to the various resolutions and authorized the Executive Committee to put them in final form. The President and the Secretary were also authorized to regard the minutes for the two sessions of October 7 as approved.

Dr. la Cour moved a vote of thanks to the officers of the Section.

The session adjourned at $5^h\ 30^m$ P. M. in order to give the Executive Committee time to draft the final resolutions.

There were 20 persons present, 14 of whom were delegates and 6 specially invited guests, 13 countries being represented.

(Signed) Charles Chree, *President;*
Louis A. Bauer, *Secretary.*

LIST OF PERSONS WHO ATTENDED THE SESSIONS.

Name	*Country*	*Delegate or Guest*
Chree, Charles	Great Britain	Delegate
Azpiazu, U. de	Spain	"
Bauer, Louis A.	United States of America	"
Benitez, W.	Spain	Guest
Bigourdan, G.	France	Delegate
Cabrera, B.	Spain	"
Carlheim Gyllensköld, V.	Sweden	"
la Cour, D.	Denmark	"
Crichton Mitchell, A	Great Britain	Guest
Greaves, W. M. H.	Great Britain	"
Hanslik, S.	Czechoslovakia	Delegate
Harradon, H. D.	United States of America	Guest
Madariaga, J. M.	Spain	"
Mathias, E.	France	Delegate
Matsuyama, M.	Japan	"
Maurain, Ch.	France	"
Melander, G.	Finland	Guest
Nidhes, Phra Salvidhan	Siam	Delegate
Ogilvie, N.	Canada	"
Palazzo, L.	Italy	"
Rodés, Luis	Spain	"
Saeland, Sem	Norway	Guest
Salamon, B.	Czechoslovakia	Delegate
Stenquist, D.	Sweden	"
Tanakadate, A.	Japan	"

SPECIAL RESOLUTIONS OF THANKS.

a. La Section émet le voeu que les remerciements les plus chaleureux soient exprimés au Comité National Espagnol pour l' admirable accueil fait aux Congressistes et pour l' organisation si parfaite des belles excursions et des fêtes charmantes qui leur ont été offertes.

b. La Section de Magnétisme et d' Electricité terrestres émet le voeu que des remerciements soient adressés par l' Union Géodésique et Géophysique à M. le maire et à la municipalité de la ville de Tortosa pour l' hospitalité bienveillante offerte aux Congressistes qui se rendront à Tortosa pour visiter l' Observatoire del Ebro et que des remerciements soient exprimés aussi à cet Observatoire pour l' invitation qu'il a bien voulu faire aux Congressistes.

EXECUTIVE COMMITTEE.

The *Executive Committee* consists of the president (Charles Chree), vice-president (Luigi Palazzo), secretary and director of the Central Bureau (Louis A. Bauer), J. Jaumotte (Belgium), Ch. Maurain (France), and A. Tanakadate (Japan).

SCIENTIFIC WORK.

The *scientific work* accomplished by the Section will be fully shown by the following resolutions:

RESOLUTIONS OF INTERNATIONAL SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY.

(*Adopted at Madrid Meeting, October 7, 1924.*)

1. Resolution No. 1 of the Rome meeting 1922 was reaffirmed, namely:

In view of the importance of securing world-wide cooperation in Terrestrial Magnetism and Electricity, and remembering the great contributions in these fields by men of science and instrument makers of countries not yet adherent to the Section, the hope is expressed that a day will come when the collaboration of all countries in the labors of the Section will become possible.

2. The Executive Committee was empowered to constitute the committees recommended by the Section and to appoint such additional committees, or reporters, as may be found necessary to give effect to the resolutions passed at the Madrid meeting. The committees recommended by the Section are as follows:

a. International Comparisons of Magnetic Instruments;
b. Magnetic and Electric Characterization of Days;
c. Terminology in Terrestrial Magnetism and Electricity;
d. Observatories, Instruments and Scheme of Operations for Observing Accurately Times of Occurrence of Sudden Commencements of Magnetic Storms.

3. The Executive Committee was empowered to add to its membership as may be found expedient.

4. The Executive Committee was authorized to incur the

expense necessary for the publication of the Madrid transactions and any additional publications desirable.

5. Resolutions Nos. 4 and 16 of the Rome meeting were reaffirmed, namely:

a. That National Committees be requested to designate, if possible, one observatory in their respective countries for international intercomparisons of magnetic instruments, and to secure intercomparisons of magnetic instruments within their own countries at least once within the course of three years.

b. That it is desirable there should be in every country at least one observatory making systematic atmospheric-electric observations (especially of potential gradient, earth-air currents, conductivity, and number of ions) which are intercomparable amongst themselves and comparable with similar observations made in other countries.[1]

6. That curve measurements pertaining to terrestrial magnetism and electricity be made according to Greenwich mean time or zonal time based thereon.[2]

7. That it is expedient to design and construct an instrument for measuring the vertical intensity of terrestrial magnetism in absolute measure.

8. In view of the geographical position of Greenland and of the importance which continuous magnetic and electric data obtained in this region would have for the general subject of the Earth's magnetism and electricity, it is considered highly desirable that a permanent observatory for such purposes be established at the most suitable site on the west coast of Greenland.

9. It is recommended that, if circumstances permit, a magnetic observatory be established at Jan Mayn, or at Spitzbergen, if found more convenient.

10. That in view of the highly favorable situation of the Meanook Magnetic Observatory, it is hoped that the Canadian Government may find it possible to fully equip this observatory for investigations in terrestrial magnetism and allied phenomena.

11. It is highly desirable that, as soon as conditions permit, an observatory be established in Northeast America for observations pertaining to terrestrial magnetism and electricity.

12. Learning that the magnetic work at the San Fernando Observatory is about to be discontinued because of disturbance from electric trams, the Section welcomes the information that Spain proposes to establish a new and fully equipped magnetic observatory near Madrid and the further information that a secondary magnetic observatory is in contemplation at Teneriffe, Canary Islands.[3]

[1]The Committee on Observational Work in Atmospheric Electricity, appointed at the Rome meeting, recommended that "in the present state of our knowledge it would appear to be best to direct international cooperation towards the investigation of the potential gradient, earth-air current, and conductivity of the atmosphere."

[2]This recommendation had already been agreed upon at the Rome Meeting (see "Transactions," Bulletin 3, p. 165, item A 5a.)

[3]Since this resolution was adopted information has been received that it also has been found possible to continue the magnetic work of the San Fernando Observatory.

13. The Section records its sense of the great importance of the Apia Observatory, Western Samoa, as a station for obtaining data in terrestrial magnetism and electricity and expresses the hope that this observatory will be maintained in full activity.

14. That the Section desires to place on record its deep appreciation of the valuable magnetic surveys carried out by the Carnegie Institution of Washington. The Section is of opinion that the present satisfactory condition of world magnetic charts is chiefly owing to the energy and enterprise of the Carnegie Institution of Washington, and hopes that in the future, the work of the Institution in terrestrial magnetism and electricity will be as full and as comprehensive as has been the case in the past.

15. That the Section deems it highly desirable to call attention to the need of additional magnetic and electric observations in high latitudes, especially north of 60° N and south of 50° S.

16. The Section records its sense of the importance of upper air observations in terrestrial magnetism and electricity.

17. The Section calls attention to the need of additional field observations and observatories pertaining to terrestrial electricity.

18. The Section calls attention to the necessity of frequent control observations to reduce measurements of the potential gradient of atmospheric electricity to volts per meter over level ground.

19. The Section recommends the desirability of obtaining magnetic data from high latitudes in years near sun-spot maximum to supplement those near sun-spot minimum already obtained to some extent by certain Antarctic expeditions and that this matter be brought to the attention of future expeditions.

20. Considering the special importance of extended and systematic researches on the magnetic properties and conditions of rocks, the Section believes that it would be opportune: (a) to increase the knowledge of these properties by determinations and experiments made in the laboratory on the greatest possible variety of samples, collected in the different regions of the Earth; and (b) to investigate as far as possible the natural magnetic condition of rocks of known geological ages taken from the entire surface of the Earth. Specialists are invited to cooperate in this comprehensive and exhaustive work.

21. That the Section considers the magnetic survey of the Baltic Sea desirable.[4]

22. The Section learning the possibility of securing observations of the potential gradient of atmospheric electricity on the Jungfraujoch in Switzerland, at an altitude of 3,400 meters, wishes to record its sense of the importance of such observations.

(Signed) CHARLES CHREE, *President;*
LOUIS A. BAUER, *Secretary.*

[4]This resolution is not intended to discourage land observations in the Baltic area, the importance of which is recognized by the Executive Committee.

VOEUX DE LA SECTION DE MAGNÉTISME ET D'ÉLECTRICITÉ TERRESTRES.

(*Adoptés à l'Assemblée de Madrid, le 7 octobre, 1924.*)

1. Le voeu No. 1, émis à l' Assemblée de Rome en 1922, est renouvelé:

Étant donnée l' importance qu'il y a à assurer une large coopération dans le monde en ce qui concerne le magnétisme et l' électricité terrestres, et en considération de la contribution considérable dans ces domaines apportée par les savants et les constructeurs de pays qui n' adhèrent pas encore à la Section, l' espoir est exprimé qu'un jour viendra où la collaboration de tous les pays aux travaux de la Section deviendra possible.

2. Que le Comité Exécutif soit autorisé à constituer les Commissions décidées par la Section et à nommer telle commission additionnelle ou rapporteur qui pourrait devenir nécessaires pour la suite à donner aux voeux adoptés à l' Assemblée de Madrid. Les Commissions décidées par la Section sont les suivantes:

a. Comparaisons internationales des instruments magnétiques;
b. Caractérisation magnétique et électrique des jours;
c. Terminologie du magnétisme et de l' électricité terrestres;
d. Observatoires, instruments et plan général pour observer avec précision les instants des commencements brusques des orages magnétiques.

3. Que le Comité Exécutif soit autorisé à s'adjoindre de nouveaux membres s'il est jugé nécessaire.

4. Que le Comité Exécutif soit autorisé à engager les dépenses nécessaires pour la publication des Comptes-Rendus de l' Assemblée de Madrid et pour toute autre publication désirable.

5. Que les voeux Nos. 4 et 16 émis à l' Assemblée de Rome soient renouvelés:

a. Que les Comités Nationaux soient priés de désigner, s'il est possible, un observatoire central pour leurs pays respectifs, chargé des comparaisons internationales des instruments magnétiques, et d' assurer dans leurs propres pays une comparaison des instruments magnétiques au moins une fois tous les trois ans.

b. Qu'il y ait dans chaque pays au moins un observatoire faisant des observations systématiques d' électricité atmosphérique, spécialement de: gradient du potentiel, courant air-terre, conductibilité électrique, et nombre d' ions, de telle façon que ces observations soient comparables entre elles et comparables aux observations semblables faites dans les autres pays.[1]

[1] Le comité nommé à l' Assemblée de Rome pour étudier le sujet des mesures de l' électricité atmosphérique a émis l' avis que: En raison de l' état actuel de nos connaissances il paraît préférable d' orienter la coopération internationale vers l' étude du gradient du potentiel, des courants air-terre, et de la conductibilité de l' atmosphère.

6. Que le dépouillement des courbes relatives au magnétisme terrestre soit fait d' après le temps moyen de Greenwich, ou d' après le temps zonal basé sur le précédent.[2]

7. Qu'il y a intérêt à étudier et à construire un instrument destiné à la mesure en valeur absolue de la composante verticale du champ terrestre.

8. En raison de la position géographique de Groenland et de l' importance que des mesures magnétiques et électriques continues dans ces régions auraient pour l' étude générale du magnétisme et de l' électricité terrestres, il est hautement désirable qu' un observatoire permanent consacré à ces sujets soit établi dans l' endroit le plus favorable de la côte ouest du Groenland.

9. Qu'il soit établi, s' il est possible, un observatoire magnétique à Jan-Mayen ou au Spitzberg, si cela est plus favorable.

10. En raison de la situation très favorable de l' observatoire magnétique de Meanook, l' espoir est exprimé que la Gouvernement Canadien puisse faire équipé complètement cet observatoire pour les études de magnétisme terrestre et des phénomènes connexes.

11. Qu'il est hautement désirable que, dès que les circonstances le permettront, il soit établi un observatoire dans le Nord-Est de l' Amérique, en vue des observations relatives au magnétisme et à l' électricité terrestres.

12. Apprenant que les travaux magnétiques à l' observatoire de San Fernando vont être rendus impossibles par l' établissement de tramways électriques, la Section se félicite du projet de l' établissement près de Madrid d' un nouvel observatoire magnétique, et d' un observatoire secondaire à Ténériffe, Iles Canaries.[3]

13. La Section souligne l' importance des données magnétiques et électriques obtenues à l' Observatoire d' Apia (W. Samoa) et l' intérêt qu'il y a à ce que des observations complètes y soient continuées.

14. La Section apprécie hautement les précieux levés magnétiques effectués par l' Institution-Carnegie de Washington. Elle estime que l' état actuel des cartes magnétiques mondiales est dû surtout à l' énergie et à l' initiative de l' Institution Carnegie et exprime l' espoir que dans l' avenir le travail de l' Institution dans les domaines du magnétisme et de l' électricité terrestres sera aussi étendu que dans le passé.

15 La Section considère qu'il est désirable d' appeler l' attention sur la nécessité de nouvelles observations de magnétisme et électricité terrestres aux latitudes élevées, spécialement au-dessus de 60° Nord et de 50° Sud.

16. La Section souligne l' importance de mesures magnétiques et électriques dans les couches élevées de l' atmosphère.

[2]Ce voeu avait déjà été décidé à l' Assemblée de Rome. (Voir Comptes-Rendus, Bulletin 3, p. 165, Article A 5a.)

[3]Une communication, reçue après l' adoption de ce voeu, indique qu'il sera possible de continuer aussi les travaux magnétiques à l' observatoire de San Fernando.

17. La Section appelle l' attention sur la nécessité de nouvelles observations électriques en campagne, et de nouveaux observatoires.

18. La Section appelle l' attention sur la nécessité d' étalonnages fréquents permettant d' obtenir en volts par mètre en terrain plat les observations du gradient du potentiel atmosphérique.

19. La Section indique l' intérêt d' obtenir des données magnétiques dans les latitudes élevées au voisinage du maximum des taches solaires, de manière à compléter les resultats obtenus dans plusieurs expéditions antarctiques au voisinage des minimums, et attire à ce sujet l' attention des futures expéditions.

20. Considérant l' importance particulière qu' auraient des recherches étendues et systématiques sur les propriétés et l' état magnétiques des roches, la Section croit qu'il serait opportun: (a) d' avancer la connaissance de ces propriétés par des déterminations et des expériences au laboratoire, sur des échantillons les plus divers et récoltés dans les différentes régions du globe; (b) d' examiner quant à leur état magnétique naturel le plus possible d' echantillons de roches prélevées sur toute l' étendue de la surface terrestre et d' âges géologiques connus. Les spécialistes sont invités à collaborer dès aujourd 'hui à cette oeuvre d' ensemble et de longue haleine.

21. La Section considère qu'il serait intéressant de faire un levé magnétique de la mer Baltique.[4]

22. La Section, apprenant la possibilité que des mesures d' électricité atmosphérique soient effectuées sur le Jungfraujoch en Suisse à une altitude de 3400 mètres, souligne l' importance qu' auraient de telles observations.

(Signé) *Le Président*, CHARLES CHREE;
Le Secrétaire, LOUIS A. BAUER.

SECRETARY'S SUMMARY OF MADRID MEETING.[1]

The second General Assembly of the International Geodetic and Geophysical Union met at Madrid, October 1-8, 1924, twenty-five of the twenty-seven countries which already adhere to the Union being represented by delegates and guests.[2] The total number was about one hundred and fifty.

At the opening meeting on the morning of October 1, His Majesty the King of Spain presided. The address of welcome was delivered by the President of the National Committee of Spain, Señor Cubillo y Muro,[3] and the response by the President of the Union, M. Lallemand. In the afternoon of the same day the officers of the Union and of the sections met, in order to complete arrangements for the plenary meetings of the Union and for the meetings of the various sections, of which there are now seven, namely, Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography, Vulcanology, and Scientific Hydrology. All sessions of the Union and of the Sections were held in the Chamber of Deputies.

[4]L' objet de ce voeu n' est pas de décourager des observations sur la terre ferme dans le voisinage de la mer Baltique dont l' importance est reconnue par le Comité Exécutif.

On the morning of October 2, there was held the first plenary meeting of the Union, at which matters pertaining to the entire Union were briefly discussed and referred, as found necessary, to special committees for report at the closing plenary session on October 8. The table on page 2 shows the officers of the Union and of the various sections, at the close of the Madrid meeting.

The following general report pertains specifically to the meeting of the Section of Terrestrial Magnetism and Electricity. This section held six well-attended sessions, October 2-7, the different countries being represented by the following delegates and guests, viz.: *Canada* (N. Ogilvie), *Czechoslovakia* (S. Hanslik, B. Salamon), *Denmark* (D. la Cour), *Finland* (G. Melander), *France* (G. Bigourdan, E. Mathias, Ch. Maurain), *Great Britain* (C. Chree, A. Crichton Mitchell, W. M. H. Greaves), *Italy* (L. Palazzo), *Japan* (A.

[1]From Bulletin No. 4, with some slight revisions.

[2]The meeting at Brussels in 1919, when the International Geodetic and Geophysical Union was organized under the auspices of the International Research Council, is regarded as the organization meeting. The first General Assembly was held at Rome in May, 1922 (see *Terr. Mag.*, Volume 27, 1922, pp. 89-100, or Bulletin No. 2 and Bulletin No. 3, pp. 173-181).

[3]Information was received with great regret that Señor Cubillo died on July 10, 1925.

OFFICERS OF INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION, 1924—.

Officers of the Union.

President: C. Lallemand;*
Vice-Presidents: Presidents of the Sections;
Secretary-General: H. G. Lyons.**

Officers of the Sections.

Section	President	Vice-President	Secretary
Geodesy..........	W. Bowie†	R. Gautier*	G. Perrier**
Seismology.......	H. H. Turner*	E. Oddone* J. Galbis** H. F. Reid**	E. Rothé*
Meteorology......	N. Shaw**	C. F. Marvin* E. Delcambre*	F. Eredia*
Terrestrial Magnetism and Electricity......	C. Chree*	L. Palazzo*	Louis A. Bauer**
Oceanography.....	O. de Buén**	J. Parry* V. Volterra** H. Lamb** L. Joubin** G. W. Littlehales* H. G. Maurice**	G. Magrini*
Vulcanology......	A. Lacroix*	H. S. Washington* L. F. Navarro**	A. Malladra* G. Platania*
Scientific Hydrology......	E. B. H. Wade*	A. Wallén*	G. Magrini*

*Elected at Rome for the period 1922-1927.
**Elected at Madrid for the period 1924-1930.
†Elected at Madrid for the period 1924-1927.

Tanakadate, M. Matsuyama), *Norway* (Sem Saeland), *Siam* (Phra Salvidhan Nidhes), *Spain* (U. de Azpiazu, W. Benitez, B. Cabrera, J. M. Madariaga, Luis Rodés), *Sweden* (V. Carlheim Gyllensköld, D. Stenquist), and *United States* (Louis A. Bauer, H. D. Harradon). On October 6, the Sections of Meteorology, and Terrestrial Magnetism and Electricity held a joint session for the discussion of topics of mutual interest.

Owing to the limited time available it was not found possible to discuss fully all the items of the Agenda, but considerable work was accomplished, nevertheless. It is gratifying to note that, with but two exceptions, reports had been received from the various national committees giving an account of the work in terrestrial magnetism, atmospheric electricity and earth currents, which had been accomplished since 1922 in their respective countries; abstracts of these reports were presented by the delegates and guests present. The reports from the special committees appointed at Rome were read in full; these reports, as well as those from the national committees, appear on pages 39–53, and 57–156.

The president, Dr. Chree, in his opening address[1] called attention to the various degrees of ripeness of the Agenda items and pointed out the differences in observational methods and accuracy of results in terrestrial magnetism and atmospheric electricity. The secretary (Dr. Bauer) gave a resumé of the matters transacted since the Rome meeting and of the progress made by various adhering countries as regards putting into effect the resolutions passed at the Rome meeting.[2] He also called the attention of the Section to matters requiring early consideration and decision. At the unanimous request of the delegates present, Dr. Bauer consented to re-election as Secretary of the Section and Director of its Central Bureau.

The Executive Committee held four sessions for the transaction of matters referred to it by the Section.[3] The full composition of the committees, authorized by the Section, was deferred pending the receipt of further information and the early entrance into the Union of additional countries. Prof. Maurain, however, was appointed chairman of the "Committee on Terminology in Terrestrial Magnetism and Electricity," and Prof. Tanakadate was requested to serve as reporter of the "Committee on Observatories, Instruments and Scheme of Operations for Observing Accurately Times of Occurrence of Sudden Commencements of Magnetic Storms." [A questionnaire sent out by Prof. Tanakadate will be found on page 36.] For list of reporters appointed, see p. 36.

Funds.—In addition to the balance of funds (35,003 francs) still remaining to the credit of the Section at the time of the Madrid meeting, a total of 120,000 francs was allocated by the Union to the Section for the period 1924-1927, for the following purposes:

[1]See pp. 3 and 4. [2]See pp. 5-13. [3]See Minutes on pp. 18 and 19.

		Francs
I.	Publication and Miscellaneous Expenses of Central Bureau......	60,000
II.	International Comparisons of Instruments......................	20,000
III.	Magnetic and Electric Characterization of Days................	10,000
IV.	Construction of Instruments for Special Investigations..........	15,000
V.	Grants to Committees for Special Investigations................	15,000
	Total..	120,000

It was estimated that the total balance of funds (35,003 francs) would about suffice for the publication of the Madrid Transactions and List of Observatories engaged in magnetic and electric work, and of the desired information regarding instruments and methods in use at these observatories.

The *next General Assembly* will be held at Prague, Czecho-slovakia, in 1927.

The Spanish Local Committee made most generous provision for excursions and other social functions. Special thanks are due to Señor Cubillo and Señor Galbis, upon whom fell the chief burden for the success of the various arrangements. On the evening of October 4 the delegates and guests with their families were given a reception at the Royal Palace by their Majesties the King and Queen.

Resolutions.—The Section passed two special resolutions of thanks and twenty-two resolutions pertaining to its scientific work, concerning which reference may be made to pages 27-32.

COUNTRIES ADHERING TO THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION, 1925.[1]

Country	No. of Units of Contri-bution	No. of Votes	Country	No. of Units of Contri-bution	No. of Votes	Country	No. of Units of Contri-bution	No. of Votes
Australia...	2	2	Holland[2]....	1	1	Siam.......	2	2
Belgium....	2	2	Italy.......	8	5	South Africa....	1	1
Brazil......	8	5	Japan......	8	5	Spain......	8	5
Canada....	2	2	Mexico.....	3	3	Sweden....	2	2
Chile......	1	1	Morocco...	2	2	Switzer-land.....	1	1
Czecho-slovakia..	3	3	Norway....	1	1	Tunis......	1	1
Denmark...	1	1	Peru.......	1	1	United Kingdom.	8	5
France.....	8	5	Poland.....	8	5	United States....	8	5
Greece.....	1	1	Portugal....	2	2	Uruguay...	1	1
						Totals....	94	70

[1]According to information received from Col. Lyons, General Secretary, dated August 29, 1925.
[2]This country has at present joined only the Section of Geodesy.

CIRCULAR REGARDING SUDDEN COMMENCEMENTS OF MAGNETIC STORMS.

At the Madrid Meeting of the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union, it was decided that a systematic investigation of "Sudden Commencements of Magnetic Storms" be made; and the Executive Committee appointed me to act as the Reporter of different views on the subject. I have, consequently, the honor to submit for your consideration the following questionnaire, and I will ask you kindly to inform me of your views, if possible, before May 31, 1925, using the address given below.

It is understood that after the Report has been submitted to the Bureau of the Section, a decision will be made in the following September to take steps for constructing the instruments.

Questionnaire.

1. What kind of instrument would you suggest to use for the purpose of investigating sudden commencements of magnetic storms? Ordinary magnetographs, or currents induced in fixed circuits?
2. What magnetic elements should be observed? H, D, V (Z) or X, Y, Z? All of them or only some of them; in the latter case, which ones?
3. Have you any specifications to suggest for the suspended magnet system size of magnets, degree of damping, etc.?
4. What should be the sensibilities of the instruments? State in gammas per mm in case of magnetographs, or amperes per mm in case of galvanometer for induced currents.
5. What should be the time scale of the recorder? State in seconds per mm.
6. Would you prefer ordinary photograph or optically concentrated sharp lines which can be magnified later?
7. Would you deem it desirable at present to give a definition of "sudden commencement," say gamma per second, or rather leave this for later decision?
8. What is your approximate estimate of the cost of the instruments, and also of the running expense of carrying out the work per annum?
9. If you have already had experience in the use of such an instrument, kindly give information respecting it in sufficient detail, or supply reference to some publication in which it is described.

Any other particulars which are not included in the above list will be cordially welcomed.

A. TANAKADATE.

Koisikawaku, Zôsigayamati 144, Tôkyô, Japan.

REPORTERS FOR SUBJECTS OF INVESTIGATION.

By mail vote the Executive Committee decided in October, 1925, to appoint reporters for the subjects of investigation as follows: *a.* Comparisons of Magnetic Instruments (*Louis A. Bauer*); *b.* Magnetic and Electric Characterization of Days (*A. Crichton Mitchell*); *c.* Terminology (*Ch. Maurain*); *d.* Sudden Commencements of Magnetic Storms (*A. Tanakadate*); *e.* Magnetic Properties and Conditions of Rocks (*L. Palazzo*); *f.* Crucial Phenomena of Polar Lights (*Carl Stoermer*); and *g.* Phenomena of Thunderstorm Electricity (*E. Mathias*).

PART II

REPORTS OF SPECIAL COMMITTEFS

REPORTS OF SPECIAL COMMITTEES

REPORT OF COMMITTEE ON OBSERVATIONAL WORK IN ATMOSPHERIC ELECTRICITY.[1]

OBJECTS.

The whole science of atmospheric electricity is at present in a state of development and further advances must be made by individual workers taking up one or other of the problems for investigation according to personal interest and the facilities available. Useful international co-operation is only possible in those branches in which measurements of the same quantity are required from many places in order to discuss the geographical distribution or for the formulation of general theories.

In the present state of our knowledge it would appear to be best to direct international co-operation toward the investigation of

a. Potential gradient;
b. Earth-air currents;
c. Conductivity of the atmosphere.

a. *Potential gradient.*—We do not yet know whether the annual variation of the potential gradient over the southern hemisphere as a whole is a maximum in the summer or in the winter.

The recent suggestion that the daily variation of potential gradient is a function of universal and not of local time is of fundamental importance.

More measurements of potential gradient especially from the sea and the southern hemisphere are therefore urgently required.

b. *Earth-air currents.*—One of the fundamental problems of atmospheric electricity is the total loss of electricity from the earth's surface as a whole. Measurements have been made of the earth-air current in a few places and at odd times and always during fine weather. What is required, however, is a direct measurement of the electricity which passes from a portion of the earth's surface into the atmosphere during the whole year, the current due to precipitation being taken into account. From a number of stations making such measurements in different countries an estimate of the total loss could be formed.

c. *The conductivity of the air.*—We know very little about the variation of the conductivity of the air in different parts of the earth, and as this is one of the chief factors in atmospheric electricity much more knowledge is required.

Other problems of atmospheric electricty—the part played by different factors in ionising the air, the electricity of thunderstorms, the penetrating radiation, the distribution of electrical factors in the upper air, the aurora, etc.—would all be better investigated at individual stations, without any attempt towards international

[1]Appointed at Rome in May, 1922, to report on Objects, Instruments and Methods; see p. 173, Bull. No. 3.

co-operation. This was, no doubt, the feeling of the Section of Terrestrial Magnetism and Electricity at Rome in 1922 when they passed the following resolution (No. 16): "That it is desirable that there should be in every country at least one observatory making systematic atmospheric-electric observations (especially of potential gradient, earth-air current, conductivity, and number of ions) which are intercomparable amongst themselves and comparable with similar observations made in other countries."

INSTRUMENTS AND METHODS.

There is no need here to discuss the instruments and methods used in general investigations of atmospheric electricity; it will be sufficient to consider only the instruments and methods necessary to carry out the international observations of potential gradient, earth-air currents and conductivity. These three factors are not independent and at first sight it would appear unnecessary to observe all three, any two being sufficient. There are several reasons, however, which make it desirable to measure all three independently.

In the first place it is not certain that the earth-air current is completely determined when the potential gradient and conductivity of the air—as usually measured—are known. The settling and raising of dust may well add an appreciable amount to the total earth-air current, and there may be currents in the form of radiations which are independent of the potential gradient and conductivity. If however, we neglect these as being possibly small, it is still desirable to measure all three elements, for our methods are not entirely satisfactory and the mutual check of three things not independent but separately measured is extremely valuable.

It is essential that the three elements should be measured simultaneously. There are a few stations for which data regarding potential gradient, earth-air currents and conductivity, are available, but if the attempt is made to compare the values given for the three elements it is found that in consequence of the mean values not referring to simultaneous observations they are far from concordant. Special efforts should therefore be made to obtain simultaneous measurements of the three quantitites and the simultaneous values should be published.

It appears very undesirable to specify what form of instrument should be used, for at present there is no unanimity as to the outstanding merit of any particular type of instruments. Different instruments are in use in different countries for making the same measurement and it is largely a matter of opinion and local facilities which decide what instrument is best to use. Further, to specify an existing instrument as being the best would tend to stereotype that instrument and so retard further improvements.

It is therefore not proposed to recommend any particular instruments but only to enunciate a few general principles which apply equally to all forms of instruments.

Potential Gradient.—The efficacy of the collector should be such that five minutes after breaking the earth connection the trace appears to be following its normal course. The insulation should be tested daily in such a way that a permanent record of the state of the insulation is left on the trace. This can generally be done in the case of a radio-active collector by removing the radio-active substance and in the case of a water-dropper by stopping the water flow. The system should then be charged up to the potential at which it normally works and left for a few minutes. The rate of leak over all insulators is then shown on the trace.

Determination of the factor to reduce the scale values of the record to volts per metre over level ground should be made at least once a week. Care should be taken that the surroundings of the place where the absolute measurements are made do not change in the course of time. The growth of shrubs or trees should be prevented.

Earth-air currents and conductivity.—The development of instruments for giving a continuous record of these two factors has not yet emerged from the experimental stage. Endeavours should be made to develop satisfactory instruments which will give continuous records. Satisfactory eye-reading instruments have been put on the market and if these are used, measurements of earth-air currents and conductivity should be taken simultaneously. Whatever instruments are used for measuring the earth-air current and the conductivity, the constants to convert their readings into absolute units should be determined independently of one another. If this is done and the simultaneous measurements of the three elements agree with one another the value of the records will be greatly enhanced.

G. C. SIMPSON, *Chairman;*
A. GOCKEL;
D. PACINI;
W. F. G. SWANN.

REPORT OF COMMITTEE TO CONSIDER AND REPORT ON BEST METHODS AND INSTRUMENTS FOR EARTH-CURRENT OBSERVATIONS.[1]

While there is at the present time a marked and gratifying renewal of interest in the general subject of earth currents, the actual number of individuals and organizations actively engaged in this field of investigation is small indeed.

Efforts made by the Committee to secure information regarding the present activities along this line show that only three stations are equipped for the continuous recording of earth-currents, namely, one each in Australia, Spain and Sweden. These installations are similar in having relatively short lines, none exceeding

[1]Appointed at Rome Meeting, 1922; see p. 173, Bull. No. 3. The report was prepared at the request of the Chairman by the Secretary of the Committee.

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several kilometers in length, and in each case the angular separation of the two lines does not differ much from 90°. However the similarity ends here, for there is no uniformity in the metals used for electrodes, nor as to the methods of observation. At one station we find the registered quantity expressed in terms of current, and while both the other stations express the registered quantity as a potential gradient, this is recorded at one station by the deflections of a galvanometer and at the other by a recording potentiometer. While certain advantages are claimed for each of these methods there is not yet available a sufficient body of observational data to serve as a satisfactory basis of comparison. In fact it may be fortunate that standardization of method and equipment has not yet taken place since there is still room for considerable difference of opinion as to just what is recorded in each case.

Thus it appears that an actual report on the best methods and instruments for earth-current observations should be deferred until some later time when the results of comparative studies now under way will have become available. However, in view of the paucity of special earth-current stations it is very desirable that observations be initiated wherever possible by the best available method.

Although special stations and equipment are required for registering the normally feeble currents in the Earth's crust, much valuable information can be obtained from observations on telegraph lines during times of abnormally large values. While such observations are usually continued for short times only, they are especially valuable when a large network of observing stations is involved, for we have here the opportunity of obtaining a general view of the phenomenon such as can not at present be obtained in any other manner. The work now being done by the Swedish Department of Telegraphs is an example of this kind of organized activity. In America a similar network extending over more than a million square miles of territory has been organized by the American Telephone and Telegraph Co. for such observation during times when earth-currents interfere with the regular traffic.

It is believed that many other national and private telegraphic organizations would be willing to cooperate in the matter of making similar observations if their attention were directed to the worthwhile features of such work, since, in general, there is little necessary outlay for additional equipment or personnel. It is suggested that an opportunity exists here for the Union to stimulate interest in and to promote such cooperative work.

With reference to the value of results from such observations it may be said that preliminary reductions of data obtained on the lines of the American Telephone and Telegraph Company during several earth-current storms leave no doubt as to the desirability of such observations and the value of the results obtainable therefrom.

Another factor which deserves more attention than it has thus far received is the matter of securing reliable information regarding the conductivity of the soil in the region surrounding an observatory where earth-current observations are made. This is now receiving considerable detailed attention in the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, and while no report is possible at the present time we may in the near future look forward to some interesting developments.

ARTHUR SCHUSTER, *Chairman;*
S. J. MAUCHLY, *Secretary;*
CH. MAURAIN;
H. NAGAOKA;
LUIS RODÉS, S. J.

REPORT OF COMMITTEE ON POLAR LIGHTS.[1]

Any routine work on the polar aurora must of course be in the hands of those who live in countries where it can be observed. The work I have been engaged on myself, referring chiefly to the aurora line as it appears steadily in more southern latitudes, is not I think yet ripe for routine observation.

As regards the polar effects, I think that it would be useful to record the integrated auroral light by exposure of photographic plates to it, for the whole available time when the Moon is below the horizon, the plate being impressed with standard squares from an artificial standard source for comparison. If observations of this kind were made over a sunspot cycle, they would undoubtedly settle many important questions.

This would only be useful in places where the aurora is very frequent, and unfortunately few observatories are in such a situation.

RAYLEIGH.

Terling Place, Chelmsford, Essex,
January 14, 1924.

No suggestions have occurred to me regarding improvements in methods for photographic recording. As regards visual recording, such suggestions as I have are already contained in the instructions prepared by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for cooperating expeditions.

In this connection, permit me to call attention to the excellent practical suggestions offered by Mr. Franklin P. Ulrich, Observer-in-Charge of the Sitka Magnetic Observatory of the United States Coast and Geodetic Survey. For his work at Sitka, Mr. Ulrich has mounted a circular steel plate 10 inches in diameter on an observing post some 12 feet above the ground with a suitable platform for the observer about 8 feet from the ground. The plate is graduated into degrees and oriented so that azimuths of observed

[1]The "Committee on Best Methods, Instruments, and Compilations for Polar-Light Observations" was appointed at the Rome Meeting and consisted of the following members (see p. 173, Bull. No. 3): ————(chairman), H. Arctowski, Ch. Fabry, J. A. Fleming, Lord Rayleigh, and R. F. Stupart. In the absence of a chairman, the Secretary of the Section sent a circular letter, dated December 31, 1923, soliciting views and reports from members of the Committee.

aurora may be readily noted to the nearest degree. For the purpose of reading vertical angles, a small plumb-bob is suspended over the center of the plate, the vertical angles being determined to the nearest degree by means of a suitable scale and by sighting from the edge of the plate. For determining the brightness of the aurora, Mr. Ulrich has suggested a wedge of colored glass with a scale etched on the edge, the brightness being determined by the scale reading for that part of the wedge through which the aurora becomes invisible. Otherwise, rectangular pieces of colored glass could be glued together from strips about 2 inches wide and varying in length by 1 inch, the number of pieces depending upon the amount of color in the glass. (For later information concerning Mr. Ulrich's observations, see his annexed abstract of September 4, 1924, as communicated by Capt. R. L. Faris, Assistant Director, Coast and Geodetic Survey.)

It is of prime importance that additional magnetic and electric observatories be established as soon as possible in regions where auroral displays are frequent in order that comprehensive data for the investigation of correlations between magnetic, electric, and auroral phenomena may be accumulated.

Dr. G. Breit, mathematical physicist of the Department of Terrestrial Magnetism, makes the following suggestions regarding repetition of Babcock's experiments (in modified form) for polar lights (instead of non-polar aurora):

a. Exact measurement of λ for the 5577 Å lines (possibility of determining velocity by Doppler effect);

b. Systematic observations of intensity of non-polar aurora under comparable conditions;

c. Observations on intensity of sky luminescence in polar regions which will determine in how far the general luminescence is an afterglow effect; and

d. Simultaneous observation on different portions of the sky (some made by Rayleigh).

Jno. A. Fleming.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
April 19, 1924.

AURORAL MAGNETIC STORMS AND DIFFICULTIES IN RADIO AND CABLE OPERATION.

Method of Observation.—Auroral observations at Sitka, Alaska, which have been in progress for a year, include the determination of form, character, time, position (including angular elevation), brightness and color, the pulsation and spectroscopic analysis.

A quadrant, mounted on a graduated circle supported on a raised platform, gives the determination of angular elevation and direction. Brightness is determined by a number of layers of thin celluloid, required to completely obscure the aurora—28 thicknesses, which will eclipse a full Moon. A small spectroscope is used when the brightness is sufficient. Operators at various radio and cable stations throughout Alaska cooperated by reporting the observed aurora and also reception difficulties of any kind.

Scope.—Reports of the aurora and of difficulties with reception were received from seven cable and nine radio stations along the peninsula of Alaska and in the interior as far north as the Arctic Circle from the Canadian boundary to the Bering Sea.

Results.—Four auroras were observed at Sitka during the year, the small number being due in part to the minimum sun-spot year and to some extent undoubtedly to being obscured by cloudy weather. Of 21 cases of cable disturbances, 15 occurred on magnetically-disturbed days and on 2 of the remaining 6 days there were small and rapid fluctuations in the Earth's magnetic field.

Radio reception difficulties were reported on 14 days, 7 of which were magnetically disturbed, and on 6 days there were rapid fluctuations.

Aurora observations were too few to draw conclusions, but in general radio reception was interfered with during bright auroras and not affected by faint ones.

Recommendations.—It is intended to continue the work that has been described for a period of years. While it has not been possible to include some phases of the auroral investigation it is believed that an accumulation of results of this character in considerable quantity is essential to proper conclusions. It is hoped that every observatory near the maximum auroral belt will undertake similar observation.

FRANKLIN P. ULRICH.

United States Coast and Geodetic Survey,
Magnetic Observatory, Sitka, Alaska,
September, 4, 1924.

REPORT BY ACTING CHAIRMAN OF COMMITTEE ON MEASURES OF MAGNETIC CHARACTERIZATION OF DAYS.[1]

Various circumstances have combined to render it impossible to present a considered report by the Committee. What I have done, therefore, is to prepare an abstract of the memoranda submitted by individual members of the Committee. The abstract is appended to this Report.

Judging from what has already been published on the subject and from the general tenor of the memoranda referred to, it would appear that there is some probability of agreement in the following conclusions:

1. That a numerical measure of "activity" or degree of disturbance from normal conditions is very much required, particularly for the purpose of such researches as aim at correlation of solar or geophysical conditions with terrestrial magnetic phenomena;

2. That a measure of this kind should ultimately replace the present international scheme of character numbers.

[1]The Committee as appointed at the Rome Meeting consisted of (see p. 173, Bull. No. 3): ——— (Chairman), R. L. Faris, A. Crichton Mitchell, R. Dongier, and A Tanakadate. Dr. Crichton Mitchell was requested by the Administrative Bureau to act as Chairman.

It would also appear that opinion has so far crystallised that machinery for collating information from different observatories could be devised with comparatively little difficulty.

Unfortunately, there is still wide divergence of opinion on the question of the method to be adopted in measuring activity, and until this point is settled, no progress can be made.

It is suggested that at the Madrid Meeting, the Section should, if possible, reach a decision on this fundamental question, and remit the matter to the Committee with instructions to work out details and submit a complete scheme for final approval.

A. CRICHTON MITCHELL.

Meteorological Office, Edinburgh,
September 4, 1924.

MAGNETIC ACTIVITY AND CHARACTERIZATION OF DAYS.

Any measure of magnetic activity which is adopted ought to satisfy the following conditions:

1. It should be based on some perfectly definite measurement and thus be free from all bias which necessarily attaches to estimates depending on simple inspection of the magnetograms;

2. While it should include that particular form of activity which is due to the regular diurnal variation, it should be presented in a form which would allow of the diurnal variation being subtracted from it if necessary and in a comparatively easy manner;

3. In order to conclude the variations of activity in high latitudes, it should take into account the activity in all three components (X, Y, Z, or H, D, V), and not be based merely on the horizontal components;

4. Being intended to measure actual departures from normal or quiet conditions, it should not depend on smoothed or averaged hourly values;

5. If possible, it should have some simple relation to the changes in energy per unit volume of the Earth's field, and should be of the same physical dimensions as a change of energy per unit volume;

6. The success or failure of any particular method should not be judged by the high or low correlation of its results with any numbers representing variations in other phenomena, e.g. sunspot area.

In addition to the above, it would be a recommendation in favour of any particular method if it does not require excessive labour in its practical application. It must, however, be clearly pointed out that, in view of the great importance of obtaining a satisfactory measure of activity, even laborious methods may be necessary, for we simply must arrive at some solutions of the problems which await the introduction of such a measure.

As far as I am aware, there would seem to be only one quite perfect method for measuring activity in a nearly direct manner. Suppose a circular coil of wire be placed, with its axis in the direction of the Earth's total field at the place of observation. Connect the terminals of the coil to a moving-coil or string galvanometer, the deflections of which can be recorded continuously on a strip of photographic paper. The current in the galvanometer is proportional to the rate of change of intensity in the Earth's field. Hence, by a mechanical integrator, find the area of the photographic trace above and below the zero current line and this will give a measure of the activity in the Earth's field.

This method has been in operation for some years past at Eskdalemuir Observatory, not so much in order to measure activity, but in connection with a special investigation with regard to the minute and rapid changes in the vertical component. (A number of curves obtained from the Eskdalemuir coil were exhibited at the Madrid Meeting.)

It is not proposed, however, that this should be tried as a solution of our difficulties, for the initial outlay and running costs are considerable, and the arrangements are such that many observatories might find it difficult or impossible to adopt it.

Failing such direct instrumental means, I would submit the following proposal for measuring activity. Let r_x, r_y, r_z, be the ranges during a given hour of the three components, X, Y, Z, respectively. Find $r^2_x + r^2_y + r^2_z$, (or Σr^2 as it is termed) for the hour. Then the mean value for the 24 hours of Σr^2 is a measure of the activity for the day.

This method satisfies the first four criteria given above. It is of the same physical character as an energy change, although its exact numerical relation is, I admit, somewhat doubtful. It is an almost positively certain indication as to which of the days in a month are the least or most disturbed.

The method has now been in operation for several years at Eskdalemuir Observatory and has been found of great use, not merely as a guide in the characterization of days but also for special studies now in progress. I hope very soon to publish the results deduced for the 12 years 1911-1922, and applied to several questions in which a measure of activity is required.

Objection has been taken to the method on the ground that it is laborious. On this point I can speak with some confidence, having had considerable experience with it. As a matter of fact, in the hands of expert computers aided by labour-saving devices in the form of machines, the work is less formidable than would appear at first sight, and we can say that the calculation of the mean activity for each day in a month can be done in about 8 or 9 hours.

With regard to other schemes for measuring activity, I would submit the following by way of criticism:

Methods which depend on the measurement of changes in the horizontal force, or in the two horizontal components, alone can be applicable during quiet conditions and for stations near the equator. But for high latitude stations, and indeed for any station within 35° or 40° of the north pole, they are altogether insufficient.

Other methods, such as those proposed by Moos and Bartels, which depend upon the interdiurnal variability of the daily mean value of one or more elements, may be of some use in giving a very general character figure for a year, and possibly for a month, but are of no use in characterizing individual days. The second day of a large magnetic storm may give a comparatively low value of the inter-diurnal variability. Another objection is the wide range of the figures obtained by this method. For instance, applying Bartel's method to the 12 years 1911-1922 at Eskdalemuir, it is found that on a "0" day, his quantity u (N) may range from 0 to 59, while on a "1" day, it many be anything from 0 to 45.

Dr. Chree's proposal is to use ΣR^2, the sum of the squares of the absolute daily ranges of the three components. This method has also been used at Eskdalemuir for some years, and it gives results which are very similar to those of the method I have proposed above, for these results exhibit a high degree of correlation (a graphical representation of daily values of Σr^2 and ΣR^2 for 1919 at Eskdalemuir was exhibited). There is, however, as I have shown elsewhere, a seasonal change in the ratio of the two which requires further investigation. The only objections which can be fairly brought against the ΣR^2 method are that it characterizes a day from two measurements only, and that these measurements are not made for the same time in all three components.

A. CRICHTON MITCHELL.

ABSTRACT OF MEMORANDUM ON MAGNETIC ACTIVITY AND MAGNETIC CHARACTERIZATION OF DAYS.

The present international scheme has the advantage of great simplicity and roughly separates the disturbance activity from the diurnal-variation activity. It brings out very well the change in activitv of the Earth as a whole from day to day, but it does not permit of a satisfactory comparison of activity either at different places or in different years.

Of the various more refined methods suggested, those proposed by Bidlingmaier and Crichton Mitchell are the only ones which attempt to separate the disturbance activity, and they both involve too much labour to be practical. The others which are based on the daily range of the three magnetic elements have the advantage of simplicity, but do not separate the disturbance activity from the diurnal-variation activity. For some purposes, the method depending on the expression HR_H is admirable, but its application is limited, and it is subject to the same objection as those based on the daily range. Where the activity of individual days is needed, it is doubtful whether the range of a single component is a sufficient criterion.

Two methods of measuring disturbance activity are suggested, and neither involves a great amount of labour. The first is

$$(R_D - R_{oD}) + (R_H - R_{oH}) + (R_Z - R_{oZ})$$

that is, the sum of the three quantities found by subtracting for each component, the average range on selected quiet days from the absolute range for any day of the month.

The second method now proposed may be stated as follows: From the diurnal-variation table derived from selected quiet days of a month, plot a curve on transparent paper to the same scale as the original magnetograms. Place this over each magnetogram for the month and measure the departure of the maximum and minimum on the magnetogram from the plotted curve. The sum of the six quantities (for three elements) expressed in units of 1 gamma may be taken as a measure of disturbance activity.

The present international scheme should be maintained until a better method is established, and even then as a means of furnishing preliminary results promptly. Any other method should be tried out by a limited number of well equipped stations before its general adoption is recommended. The method to be tried should be designed to eliminate the normal diurnal variation. The following list of stations is proposed as being suitable for such a trial: Meanook, Sodankylä, Sitka, Cheltenham, Seddin, Pola, Porto Rico, Lukiapang, Helwan, Honolulu, Kodaikanal, Huancayo, Pilar, Apia, Buitenzorg, Mauritius, Watheroo, Christchurch.

If it should be decided not to attempt any measure of activity other than the character numbers, it would be an improvement to have five classes instead of three, and to assign numbers for periods of 12 hours instead of 24.

R. L. Faris.

United States Coast and Geodetic Survey,
Washington, D. C.

ABSTRACT OF MEMORANDUM ON MAGNETIC CHARACTERIZATION OF DAYS.

Having read with care the papers by Dr. Bauer and Dr. Chree submitted to the Rome Conference of 1922, and having discussed the matter with the chief members of the National Committee of Japan, I have come to the conclusion that the present system of characterizing days is insufficient, and should be replaced by a system of greater scope, free from all possible bias, but keeping in view the necessity for saving labour in its application.

With regard to Dr. Bauer's paper, I have taken the figures given in his comparative table and reduced them to pure numbers by dividing the monthly means by their respective annual means. When these pure numbers are represented graphically, the prominent maximum in the solar activity curve is approached most nearly by the curves from Bidlingmaier's method and from that based on ΣR^2, the sum of the squares of the absolute daily ranges (Chree). All the others fall short, especially when not squared, and this is no doubt due to the smoothing of outstanding disturbances. It is also evident from this graphical representation that the curve of character numbers indicates a lack of weight assigned to large disturbances.

The matter may be approached from a different point of view as follows: Treating the character numbers as quantitities which express the sense of perception of disturbance of the curves, they may be taken to be proportional to logarithms of the activity calculated on an energy basis. Thus, taking the example dealt with by Ono in a recent paper, the logarithms of the activities, in terms of $(\gamma/\text{hour})^2$, in 5 days (21st-25th September, 1915), less their lowest value, were respectively 0.8, 0.7, 0.0, 2.6, 2.0 corresponding to the assigned character numbers 1, 1, 0, 2, 2 respectively. But for large disturbances, it is evident that the scale of character numbers would have to be increased to 5. On the other hand, this scheme reduces the quietest day character number to zero. In practical application of the method, a certain standard degree of disturbance corresponding to the character figure 0 would have to be fixed by agreement.

This scheme has, however, one grave defect in that the numbers obtained by it are proportional to the logarithms of the geometric mean. Hence an improvement of the system of character number by extending the scale from 2 to 5 as the maximum, appears to be of little avail. It would appear that the true function of the present system is to act more as a counter of days of large magnetic disturbance than as a measure of magnetic disturbance.

With regard to the different formulae compared by Dr. van Dijk and further discussed by Dr. Bauer, their general agreement suggests that they may be looked upon as methods of expressing variability of a natural phenomenon as lately expounded by Dr. Ono. For example, HdH may be regarded as the variability of H^2, and therefore as one part of the joint energy integral of Prof. Chapman. But for any international arrangement, a careful consideration from different points of view is desirable, and in this direction I am in agreement with Dr. Chree's proposal as supported by Dr. Bauer.

The question of the amount of labour involved must be settled by what we are to get out of it. For example, Dr. Crichton Mitchell makes a systematic comparison of the daily ratios of the mean value of the square of the hourly range with the square of the absolute daily range. But this only shows that the latter is not far from 24 times the former. A. TANAKADATE.

[For Comments on Magnetic and Electric Characterization of Days, see pages 162, 163, 164, 165, 168, 171 and 172.]

REPORT OF CHAIRMAN OF COMMITTEE ON MAGNETIC SURVEYS AND INTERNATIONAL COMPARISONS OF INSTRUMENTS.[1]

MAGNETIC SURVEYS.

It is very gratifying to call the attention of the Section to the excellent progress made since the Rome meeting of 1922 by the various countries at present adhering to the Union, as well as by other countries, in the organization and execution of magnetic surveys or resurveys. The Section is to be congratulated on the stimulus it has given in the furtherance of magnetic surveys according to approved methods. The map accompanying this report shows approximately the present status of the magnetic survey of the globe.

Reports have been received from every member of the Committee, as well as from representatives of the National Committees, concerning magnetic surveys, magnetic observatories, intercomparisons of magnetic instruments, atmospheric-electric and earth-current observations. These reports at present comprise the following countries: Australia, Brazil, Canada, Denmark, France, Greece, Italy, Japan, Mexico, Norway, Portugal, Siam, Spain, Sweden, Switzerland, United Kingdom (Great Britain and Ireland), United States of North America (United States Coast and Geodetic Survey), and World Magnetic Survey by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. It is expected that the summaries of these reports will be given by the delegates of the respective countries, and be published in Bulletin No. 5. [See pages 57–124.]

COMPARISONS OF INSTRUMENTS.

The following resolutions (Nos. 4 and 5) were passed at the Rome meeting with regard to comparisons of magnetic instruments:

No. 4.—That National Committees be requested to designate, if possible, one observatory in their respective countries for international comparisons of magnetic instruments, and to secure intercomparisons of magnetic instruments within their own countries at least once within the course of three years.

No. 5.—That the Committee on Magnetic Surveys and Intercomparisons of Magnetic Instruments formulate a definite scheme for securing intercomparisons of magnetic instruments between countries, and especially contiguous countries.

Regarding *Resolution No. 4*, reports have been received from National Committees giving information of the following actions:

a. That the *American Geophysical Union* (*United States of North America*) designates the Cheltenham Magnetic Observatory of the United States Coast and Geodetic Survey and the Standardizing Magnetic Observatory of the Department of Terrestrial

[1]The Committee as constituted at the Rome Meeting consisted of the following members: U. de Azpiazu, J. M. Baldwin, Louis A. Bauer (chairman), A. Ferraz de Carvalho, C. Chree, D. Eginitis, N. H. Heck, A. Hermant, St. Kalinowski, O. Klotz, E. Mathias, H. Morize, L. Palazzo, and N. Watanabe.

Magnetism of the Carnegie Institution of Washington, working in conjunction, as the observatories of the United States to function in accordance with Resolution No. 4 of the Rome Meeting.

b. That in *Canada* the Agincourt Observatory, near Toronto, be the standard observatory for intercomparisons of magnetic instruments in Canada.

c. That in *France* the Val Joyeux Magnetic Observatory be the principal standardizing observatory.

d. That in *Great Britain* for the present the Kew Magnetic Observatory will function as the chief observatory for intercomparisons of magnetic instruments.

e. In *Spain* Señor D. Ubaldo Azpiazu, in connection with the magnetic survey of Spain has secured intercomparisons of magnetic instruments in his own country as well as in some other European countries, and it is expected that Spain will soon establish a central magnetic observatory under governmental auspices, namely at Alcalá de Henares, near Madrid, and also a secondary one at Teneriffe, in the Canary Islands.

f.—In *Italy* national intercomparisons of magnetic instruments are secured by the R. Ufficio Centrale di Meteorologia e Geofisica.

g.—In *Brazil* and *Mexico* the respective national magnetic observatories (Vassouras, Brazil; Teoloyucan, Mexico) act as the standardizing magnetic observatories.

h.—In *Japan* the Central Meteorological Bureau and the Hydrographic Office of the Imperial Japanese Navy attend to the national intercomparisons of magnetic instruments, the Kakioka Magnetic Observatory having been selected for the present as the standard observatory. The Hydrographic Office is equipped with an electromagnetic standard instrument.

i.—In *Australia*, intercomparisons of magnetic instruments are made at the Toolangi Magnetic Observatory near Melbourne, and at the Watheroo Magnetic Observatory, Western Australia, of the Carnegie Institution of Washington.

j.—In *Portugal*, the observatory for international and national comparisons of magnetic instruments will be the Magnetic Observatory of the University of Coimbra.

k.—Generally speaking the chief national magnetic observatories, or national magnetic services, are acting in full accordance with Resolution No. 4, as will be seen from the reports of National Committees given on pages 57–124.

Respecting *Resolution No. 5*, the following recommendations have been received by the Chairman of the Committee:

a.—*United States Coast and Geodetic Survey.*—"As to a definite scheme for securing intercomparisons of magnetic instruments between countries, and especially contiguous countries, it is hoped that the Department of Terrestrial Magnetism of the Carnegie Institution of Washington can continue to do the greater part of the work of this character, as it has in the past. It generally requires specific authorization for a government organization to do work outside the limits of the country."

b.—Dr. *Chree* has expressed the following opinions: "As to intercomparisons between countries, the simplest course might be for adjacent countries to intercompare, but until the Central European countries come into the Union, a satisfactory scheme would be difficult to promulgate. I do not know how far the Department of Terrestrial Magnetism is anxious or willing to intercompare the Carnegie instruments with those of foreign countries. My own feeling is that intercomparisons of instruments in Britain, France, Spain, Belgium, and similar adjacent countries ought to fall on these countries. In an isolated or poor country, the position is different."

The views of the Chairman of the Committee regarding the question of international intercomparisons of magnetic instruments, as based on experiences gained during a period of 30 years in all parts of the globe are expressed under *c*.

c.—Department of Terrestrial Magnetism, Carnegie Institution of Washington.—"It seems desirable that arrangements be made, as soon as possible, for the designation of some one organization suitably equipped to act as the intermediary for effecting reliable intercomparisons of standard instruments at the national observatories which have been designated by the different countries in accordance with Resolution No. 4 of the Rome 1922 Meeting. As the result of the extensive experience of observers of the Carnegie Institution of Washington, it is recommended further that magnetic observatories, or magnetic services, be urged to provide the necessary means for effecting an interchange of stations during comparison of instruments in order to eliminate any possible station difference between the piers on which are mounted the respective instruments compared."

In conclusion, the Chairman begs to call attention to the fact that the Central Bureau of the Section, acting in cooperation with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, obtained some international intercomparisons of instruments in 1922 in Italy, Spain, Portugal, France, Holland, Denmark, Finland and England. The expenses for these intercomparisons were borne jointly by our Section and by the Department of Terrestrial Magnetism.

LOUIS A. BAUER.

ACTIONS ON REPORTS OF SPECIAL COMMITTEES

ATMOSPHERIC ELECTRICITY.

Resolutions 2*b*, 2*c*, 5*b*, 8, 11, 13, 15, 16, 17, and 18, pages 27-32. Prof. *E. Mathias* was appointed Reporter for the subject "Phenomena of Thunderstorm Electricity," and Prof. *Ch. Maurain*, Reporter for the subject "Terminology in Terrestrial Magnetism and Electricity," page 36.

The following resolution was passed, in connection with the consideration of the topic of atmospheric pollution, by the Section of Meteorology at its fourth meeting at Madrid on October 7, 1924: "Qu'une petite commission soit nommée pour coordonner et conseiller tout ce qui regarde les investigations ultérieures, y compris la relation entre la poussière et la visibilité de même que le gradient potentiel de l'électricité atmosphérique."

EARTH-CURRENT OBSERVATIONS.

Resolutions 2*c*, 8, 10, 11, 14, 15, 16, and 17, pages 27-32.

POLAR LIGHTS.

Resolutions 2*c*, 8, 10, 11, 14, 15, and 16, pages 27-32. Prof. *Carl Störmer* was appointed Reporter for the subject "Crucial Phenomena of Polar Lights," page 36.

MAGNETIC SURVEYS AND INTERNATIONAL COMPARISONS OF MAGNETIC INSTRUMENTS.

Resolutions 2*a*, 5*a*, 7, 14, 15, 16, 17, 19, and 21, pages 27-32. Dr. *Louis A. Bauer* was appointed Reporter for the subject "International Comparisons of Magnetic Instruments," page 36.

SOLAR AND TERRESTRIAL RELATIONSHIPS.

The Committee appointed by the International Research Council for the Study of Solar and Terrestrial Relationships (see p. 19) held a meeting in Brussels on July 5 and 6, 1925. An advance copy of the typewritten report of the proceedings has been received from the Chairman, Dr. S. Chapman. As this Bulletin is passing through the press, it is possible to give only two of the resolutions of special interest here, namely:

The Committee wish to suggest that the Section of Terrestrial Magnetism and Electricity of the International Union for Geodesy and Geophysics should consider whether arrangements can be made for the co-operation, at some suitable epoch, of countries not territorially associated with the polar regions, in magnetic observation in high magnetic latitudes. By means of special expeditions to carry out simultaneous temporary programmes at selected polar stations, as in 1882-3, the work of the permanent observatories in high magnetic latitudes would be valuably supplemented.

The Committee recommend that solar observatories should make additional observations on the sun, as nearly continuous as possible, at or about the times when magnetic storms are in progress, or when they may be expected in accordance with the 27-day recurrence-tendency. This would necessitate the organization of a service for the supply of information to solar observatories as to magnetic storms, prospective or in progress. The Committee recommend that Dr. L. A. Bauer, the Secretary of the Section of Terrestrial Magnetism and Electricity of the International Union for Geodesy and Geophysics, be asked to formulate a scheme for this service.

PART III

REPORTS OF NATIONAL COMMITTEES

STATUS OF MAGNETIC SURVEYS, 1924

WORK IN TERRESTRIAL MAGNETISM IN AUSTRALIA, 1922-1923.

MAGNETIC SURVEY WORK.

The only magnetic survey work accomplished in Australia during the period has been that carried out by the Adelaide Observatory under the direction of Mr. G. F. Dodwell, the Government Astronomer. The observations were made by Mr. A. L. Kennedy, Chief Assistant at the observatory, with a dip circle belonging to the latter and a magnetometer loaned by the Carnegie Institution of Washington. Stations were occupied as follows, the classification being that adopted by the latter Institution: Class I, 1; Class II, 4; Class III, 4; and Class IV, 1. Seven of these stations were reoccupations.

At Cordillo Downs, special declination observations were made on the occasion of the *total solar eclipse of September 22, 1922.*

It may also be mentioned that declination observations according to the Carnegie Institution scheme were made by the Melbourne Observatory party at Goondiwindi, in Queensland. At Wollal, also, on the northwest coast of Western Australia, some records were obtained by a British expedition under Mr. J. Hargreaves. An exceptionally large amount of magnetic information is available from the area covered by this eclipse and valuable deductions should be possible.

OBSERVATORY WORK.

Two magnetic observatories were maintained in operation in Australia during 1922-1923, namely, the Carnegie Institution Observatory at Watheroo and the Melbourne Observatory's Magnetic Branch at Toolangi. Reports concerning these institutions will appear elsewhere. [See pp. 142, 143, and 172.]

ACTION ON RESOLUTIONS OF ROME MEETING.

Observer Donald G. Coleman of the Carnegie Institution was working in Australia during 1922-1923 and comparisons were secured between his instruments and those of the Melbourne and Adelaide Observatories.[1]

[1]In accordance with Resolution No. 10, urging magnetic services to make prompt publication of their data, the second Pan-Pacific Congress, which met in Australia in 1923, passed a resolution recommending to the Government of Australia that the necessary funds be provided for the reduction of the magnetic observations of the Melbourne Observatory. According to information received from the Director, Dr. Baldwin, funds were appropriated enabling him to employ a computing assistant.—*Sec.*

Some consideration has been given to the making of *atmospheric-electric observations*, but up to the present the necessary funds have not been available.

EDWARD KIDSON,
Secretary, Terrestrial Magnetism Committee,
Australian National Research Council.

Central Weather Bureau,
April 28, 1924.

WORK IN TERRESTRIAL MAGNETISM AND ELECTRICITY IN THE AZORES.

a. During 1922-1923 the Director of this Meteorological Service (in charge of the Magnetic Survey of the Azores) made some observations of D, H and I on different pillars erected for the purpose in the towns of Horta, Angra and Ponta Delgada, and in the Island of Santa Maria. The instruments employed were a theodolite and dip circle (medium size) of Mascart-Brunner (constructor Chasselon of Paris).

b. At the Magnetic Observatory of St. Miguel (latitude, 37°46′.4 N.; longitude, 25°39′.2 W. of Gr.; altitude, 175 meters) were made every week observations of D, H, and I in the pavilion for absolute measures. The instruments employed are: Theodolite of Mascart-Brunner (large size, constructor Chasselon of Paris) and an earth inductor of Töpfer (Potsdam). In a wooden pavilion (type of that of Cheltenham Observatory) unifilar, bifilar and balance variometers, all of the Mascart Pattern (constructor Carpentier of Paris), register photographically (at present, only the declination); and in another similar building a set of the same instruments is installed and eye-readings are made with them five times during every day.

c. The following resolutions in accord with Nos. 4 and 16 of the Rome Meeting were agreed upon at Lisbon last December:

The observatory of Portugal for international and national comparisons of magnetic instruments is the Magnetic Observatory of the University of Coimbra;

For systematic atmospheric-electric observations intercomcomparable amongst the observations made in Portugal, and comparable with similar observations made in other countries, the Metorological Observatory of the Universitv of Porto and the Radio Telegraphic Service of the Marine are charged with these services.

F. A. CHAVES,
Director, Meteorological Service.

Ponta Delgada, March 20, 1924.

TRAVAUX MAGNÉTIQUES AU BRÉSIL.

OBSERVATIONS DANS LE NORD-EST DU BRÉSIL, 1922.

Pendant le courant de l'année 1922, un levé géographique et magnétique dans les états de Parahyba et de R. Grande do Norte a été partiellement exécuté, mais n'a pu être complété à cause de difficultés d'ordre administratif. Les positions géographiques ont été obtenues, l'heure par la méthode de Zinger et son transport par le télégraphe, la latitude par celle de Sterneck et l'azimuth de la mire par les élongations d'étoiles de grande déclinaison, avec un théodolite à microscope, Heyde 3107, qui permet de lire sûrement 5 secondes d'arc.

Les observations, proprement magnétiques, ont été obtenues; la déclinaison et la force horizontale, avec le magnétomètre N. 20, du type Indian Pattern, par Cooke and Sons, et une boussole d'inclinaison Casella No. 8075. Les méthodes d'observations employées sont décrites dans le travail intitulé "Directions for Magnetic Measurements, by Daniel Hazard, Washington 1911."

Les observations de contrôle faites à Vassouras, après et avant le voyage accusent une différence assez considérable en déclinaison, mais, néanmoins, aucune correction correspondante n'a été faite aux valeurs locales, qui sont ce que l'observation a directement donné, ni non plus aucune tentative de réduction à une heure donnée, l'heure moyenne de la détermination étant du reste indiquée chaque jour.

CARTE ISOGONIQUE DE L'ETAT DE S. PAULO, BRÉSIL.[1]

Nous avons commencé, en 1915, l'étude systématique de la déclinaison magnétique, et la première carte de l'État de S. Paulo fut organisée en 1908, mais toutefois ne fut pas publiée. L'étude fut continuée, et en 1922, nous avions, déjà près de 700 observations, effectuées en 400 endroits. Pendant cette année des observations furent effectuées sur 258 points appartenant à 84 différentes localités dont 70 correspondaient à des répétitions.

Nous considérons comme de 1^er^ ordre, ceux de ces points où nous possédons des séries d'observations s'étendant sur plusieurs années, pendant que d'autres localités possédant moins d'observations sont classifiées comme de 2^e^ ordre.

C'est à l'aide de ce matériel qu'a été organisée la carte isogonique de S. Paulo qui correspond au 1^er^ juillet 1922 et qui fut publiée à l'échelle de 1/2,000,000. Les lignes isogoniques sont tracées de 30′ à 30′ et l'indication de la déclinaison aux points d'observation est faite en degrés et centièmes. Les méridiens astronomiques ont été déterminés par des observations de soleil ou d'étoiles. Les méridiens magnétiques se rapportent toujours à la même aiguille-étalon.

H. Morize,
Directeur de l'Observatoire National de Rio de Janeiro.

[1] Carta Izogonica do Estado de S. Paulo—Brasil, Organisada pela Commissão Geographica e Geologica do Estado de S. Paulo.

Comparaison des instruments employés en campagne, avec les étalons de Vassouras, avant et après le voyage.

Déclinaison (Ouest)				Composante horizontale				Inclinaison (Sud)			
Date	Magn. 20	Magn. 25	25−20	Date	Magn. 20	Magn. 25	25−20	Date	Incl. 8075	Incl. 221	221−8075
	° ′	° ′	′		*c. g. s.*	*c. g. s.*	*c. g. s.*		° ′	° ′	′
1921 24 Nov.	−11 31.2	−11 29.3	+1.9	1921 25 Nov.	0.24642	0.24461	−0.00181	1921 26 Nov.	−15 36.1	−15 36.8	−0.7
	−11 31.9	−11 29.3	+2.6		0.24653	0.24459	−0.00194		−15 38.1	−15 37.2	+0.9
	−11 31.7	−11 30.0	+1.7	26 Nov.	0.24672	0.24488	−0.00184	27 Nov.	−15 33.2	−15 39.3	−6.1
	−11 31.8	−11 29.8	+2.0								
	−11 31.6	−11 29.6	+2.0								
	−11 30.9	−11 29.1	+1.8								
Moyennes	....	....	+2.0	......	....	....	−0.00186	......	....	....	−2.0
1922 22 Nov.	−11 36.9	−11 37.6	−0.7	1922 24 Nov.	0.24655	0.24470	−0.00185	1922 25 Nov.	−15 41.7	−15 46.4	−4.7
	−11 37.0	−11 37.7	−0.7		0.24639	0.24434	−0.00205		−15 42.2	−15 47.3	−5.1
	−11 36.7	−11 37.2	−0.5		0.24633	0.24426	−0.00207		−15 41.2	−15 48.7	−7.5
	−11 36.9	−11 37.7	−0.8								
	−11 37.2	−11 37.8	−0.6								
	−11 37.0	−11 37.7	−0.7								
Moyennes	....	....	−0.7	......	....	....	−0.00199	......	....	....	−5.8

Résumé des éléments géographiques et magnétiques de plusieurs localités des états de Rio Grande do Norte, Parahyba et frontière de ce dernier avec l'État de Pernambuco.

Localité	Longitude Ouest de Gr.	Latitude Sud	Époque 1922	Heure locale moyenne	Décl'n Ouest	Incl'n Nord	Comp. Hor.	Notes
	h m s	° ′ ″		h m	° ′	° ′	c. g. s.	
Cabedello	2 19 21.3	6 58 04	13 Fév.	4 21.0	18 07.1	......	0.28212	Dans le fort de l'entrée du port.
			15 "	0 54.0	......	3 24.0	......	
Itambé	2 20 28.3	7 24 16	9 Mar.	1 39.0	18 00.7	......	0.28225	
			11 "	......	......	3 42.0	......	
Umbuzeiro	2 22 39.5	7 41 52	20 Mar.	3 09.0	......	2 46.4	......	
			23 "	2 22.0	17 44.1	......	0.28131	
Guarabira	2 21 37.3	6 51 11	5 Avr.	3 00.0	17 52.4	......	0.28357	
			9 "	3 40.5	......	4 24.5	......	
Natal	2 20 46.4	5 46 57	5 Mai	3 57.5	......	6 02.0	......	Plage "Morcegos" près du lieu dit Petropolis.
			8 "	1 54.5	18 06.6	......	0.28376	
Potengy Pequeno	2 23 26.6	5 54 46	25 Mai	1 38.5	17 40.8	......	0.28488	
			26 "	5 15.5	......	6 05.2	......	
Jardim de Angicos	2 23 58.2	5 39 12	5 Juin	4 46.0	......	6 33.0	......	
			6 "	2 57.0	17 46.8	......	0.28578	
Lages	2 24 59.3	5 41 55	14 Juin	5 14.0	......	6 59.7	......	
			16 "	4 12.5	17 42.4	......	0.28707	
Assú	2 27 38.0	5 34 19	24 Juin	12 40.5	......	7 26.4	......	
			26 "	0 25.0	16 29.9	......	0.28081	
Mossoró	2 29 22.5	5 11 30	21 Juil.	2 52.0	17 05.3	......	0.28708	
			21 "	23 48.0	......	8 39.0	......	

La position de Natal correspond à l'endroit où ont été exécutées les observations magnétiques. La position de la ville elle-même, déterminée sur la place Léon XIII est: $\phi = 5° 46' 41''$ et $\lambda = 2^h 20^m 49^s.0$.

Les longitudes de tous les points ont été déterminées télégraphiquement, moins pour Potengy Pequeno et Jardim de Angicos, où on a été forcé de recourir au transport de l'heure par chronomètres.

MAGNETIC SURVEY OF CANADA.

MAGNETIC SURVEY WORK ACCOMPLISHED BY THE TOPOGRAPHICAL SURVEY OF CANADA IN 1922-1923.

Starting with the year 1880 the Topographical Survey of Canada has made it a standing policy of equipping its numerous land, exploratory, and other survey parties with magnetic instruments, by means of which numerous magnetic data have been obtained.

This same policy has been continued during the years 1922-1923 during which nearly 2,000 observations have been obtained in districts not previously covered. In the West very many observations have been made along the Peace and Slave rivers, around Great Slave, Clinton-Colden and Artillery lakes, at Forts Rae and Reliance, etc.; throughout the whole length of the Mackenzie river, at Forts Resolution, Providence, Simpson, Wrigley, Norman, Hope, McPherson and Aklavik; along the Arctic coast eastward and westward of the Mackenzie delta; around a considerable part of Great Bear lake; at Fort Franklin; and along the interprovincial boundaries between Ontario and Manitoba and between Alberta and British Columbia; on Reindeer lake in northern Saskatchewan; in Northern Manitoba; etc., etc. Observations have been obtained in the East in the provinces of Quebec, New Brunswick and Nova Scotia. During the northward cruise of the *Arctic*, in the summer of 1923, observations were obtained at Craig Harbour, Strathcona Sound, Ponds Inlet and Cumberland Sound in the far north.

At Aklavik, which is below Fort McPherson on the lower Mackenzie, hourly readings of the declination were obtained from 7 a. m. to 5 p. m., ten days a month, from October, 1922, to June, 1923, both inclusive.

Repeat observations were obtained at several points.

The instruments were compared with the standards at the Magnetic Observatory, Agincourt, at the beginning and end of each season's work, through the courtesy of the Director of the Meteorological Service of Canada.

ACTIONS TAKEN WITH REGARD TO RESOLUTIONS OF THE ROME MEETING, AND ISOMAGNETIC MAPS.

In regard to *Resolution 4*, concerning the standardization of instruments, all instruments used on the magnetic surveys of the Topographical Survey of Canada were standardized at the beginning and end of each season's work by direct comparison with the magnetic standards at the Magnetic Observatory at Agincourt, Ontario, through the courtesy of the Director of the Meteorological Service of Canada.

In regard to *Resolution 10*, that the various magnetic services be urged to make prompt publication of their data, a new publication, Bulletin 52, "Magnetic Observations in Western Canada—II," is now in course of preparation. This publication will contain practically all our magnetic observations from 1880, the date of the inception of our magnetic surveys, to the end of 1922, comprising almost 19,000 observations, and results at more than 500 repeat stations with many other data. The observations are being reduced to the epoch 1922.0. Accompanying Bulletin 52 are the following *Isomagnetic Maps*.

1. Isomagnetic Maps of Western Canada for 1922.0 comprising three maps on one sheet, namely: *a*. Lines of Equal Magnetic Declination and of Equal Annual Change in Western Canada for 1922.0; *b* Lines of Equal Magnetic Inclination in Western Canada for 1922.0 and of Equal Annual Change between 1917.0 and 1922.0; and, *c*. Lines of Equal Magnetic Horizontal Intensity in Western Canada for 1922.0 and of Equal Annual Change between 1917.0 and 1922.0.

2. Lines of Equal Magnetic Declination and of Equal Annual Change in Canada for 1922.

These maps were compiled from our own data and those available from all other sources, and exhibit the magnetic state of the country in concise form.

E. DEVILLE,
Director General of Surveys.

Ottawa, January 9, 1924.

THE MAGNETIC SURVEY OF THE TOPOGRAPHICAL SURVEY OF CANADA.

A knowledge of the magnetic elements, especially the declination, is of such practical value that nearly all countries make magnetic surveys. This knowledge is particularly valuable in Canada for explorers, pioneers, settlers, prospectors, navigators, airmen and others.

On the numerous surveys made by this Department throughout Canada, bearings are determined with precision by observation on Polaris with high-class five-inch theodolites. It was evident, then, that a magnetic survey might be made at no expense by equipping the parties with magnetic instruments and utilizing the bearings already determined; and as these parties penetrated the more inaccessible districts, the survey might be carried into territory where magnetic survey parties could not be sent without great expense.

The theodolites were therefore equipped with delicate magnetic needles of precision, in the form of the Bausch and Lomb trough compass and the Cooke telescopic compass, in which the needle carries a jewelled bearing which sits upon a glass-hard steel pivot when readings are made, while the centre of gravity is considerably below the point of suspension. The compass when in use is attached to the theodolite standard by means of two milled-head screws passing through and tightly clamping the smooth bosses of the compass to the smooth bosses of the theodolite standard, and thus can always be attached rigidly when readings are required, and easily dismounted afterwards and stored in the instrument box for safety. No hand compasses or circular compasses are used. No magnetic material is used on the theodolites or tripods.

Through the cooperation of Sir Frederic Stupart, Director of the Metorological Service, the theodolites with their compasses are sent at the beginning and end of each season to the Magnetic Observatory at Agincourt, Ontario, to have the index corrections determined by comparison with the Standard Unifilar Magnetometer, thus all observations are reduced to International Magnetic Standard.

With reasonable care in the field, the probable error of a single declination determination involving ten separate readings is found to be less than one minute of arc.

The declination observations are corrected for daily variation by means of the photographic traces of the declinometers at Agincourt and Meanook and by means of tables derived from hourly readings made at Fort Rae, Fort Franklin and Aklavik, Northwest Territory; Uglaamie and Sitka, Alaska; and at other places.

Other survey parties are equipped with Dover Dip Circles for determining the magnetic inclination and total force by Lloyd's method. The horizontal force is then derived from the total force and the inclination. This method is found very appropriate in high latitudes.

The constants of these Dip Circles are determined at the beginning and end of each season's work at the Magnetic Observatory at Agincourt, by comparison with the standards. In every case the observer is required to determine the value of "log A constant" with a probable error of the mean of at least six observations not exceeding 0.00010 c. g. s. unit. Particular mention must be made of the valuable aid received from the Department of Terrestrial Magnetism of the Carnegie Institution of Washington in repairs and standardization of these instruments.

Maps of declination, inclination and horizontal force are published showing the survey results in concise form. The latest are for 1922.0.

Bulletin 46, published in 1921, showed all the observations reduced to 1917.0. Bulletin 52 showing all the observations reduced to 1922.0 is now in preparation.

Since 1880, the date of inception of the magnetic surveys of the Topographical Survey of Canada, more than 400 stations have been occupied for inclination and intensity, 200 for secular change and 18,000 for declination.

E. Deville,
Ottawa, January 31, 1924. *Director General of Surveys.*

MAGNETIC SURVEY WORK IN CANADA BY THE DOMINION OBSERVATORY, 1922-1923.

An account of the work accomplished by the Dominion Observatory in connection with the magnetic survey of the Dominion of Canada up to the early part of 1922 was presented by Dr. Klotz in a brief report[1] to the meeting of the Section of Terrestrial Magnetism and Electricty held at Rome, 1922.

During the seasons 1922-1923 two observers were in the field. The three magnetic elements, declination, dip and horizontal intensity were determined at 120 stations. With the exception of seventeen which are distributed fairly uniformly along the Mackenzie river between Great Slave lake and a point within 100 miles of the Arctic ocean, these are confined to the area lying between parallels 52°N and 61°N and meridians 92°W and 121°W. Included in these are a number of stations occupied previously by the Carnegie Institution of Washington and the Meteorological Service of Canada. The secular variation data to be derived from these results will apply to a mean epoch ranging between 1916 and 1918, as the earlier observations were taken between 1908 and 1912. As the survey develops it is hoped that repeat stations will be occupied at approximately five-year intervals.

For the observational work two universal magnetometers, one loaned by the Carnegie Institution of Washington and the other the property of the Dominion Observatory, were used. These instruments are of a type designed by the Department of Terrestrial Magnetism of the Carnegie Institution and were constructed in its instrument shop.

Comparison observations were made as in former years, in the spring and fall, at the standard magnetic observatory at Agincourt, near Toronto.

The results of the magnetic observations up to the end of 1920 are contained in Volume V, No. 5, of the Publications of the Dominion Observatory. Since then no results have been published. There is, however, in course of preparation a publication which will include the results obtained during the past three seasons, 1921-1923.

Dominion Observatory, Ottawa,
March 6, 1924.
C. A. French.

TRAVAUX MAGNÉTIQUES EN TCHÉCOSLOVAQUIE.

L'Institut de Physique du Globe de Prague (II, U. Karlova 3) dont le directeur est M. Láska, professeur à l'Université Charles est chargé du service magnétique en Tchécoslovaquie. On se sert de 2 stations pour des variations de la déclinaison, celle à l'observatoire de Prague et celle à l'observatoire de Starà Dăla.

La station de Prague est placée malheureusement au milieu de la ville. C'est pourquoi une station nouvelle près de Prague est en voie des préparations.[2]

Le dernier lever magnétique fut executé en 1889-1893 par M. Liznar. On recommence maintenant à exécuter un nouveau lever sous la direction du même professeur. Le nombre de stations sera beaucoup plus élevé qu'auparavant.

B. Salamon,
Professeur à l'Université de Prague.
2 octobre 1924.

[1] See Bull. No. 3, p. 34.
[2] Elle devra servir à l'enregistrement des variations de tous les éléments magnétiques.

MAGNETIC WORK IN DENMARK.

In Denmark magnetic observations were made as early as 1649 and 1672.[1] From 1840 to 1860 a magnetic observatory was established on a wall of the fortifications of Copenhagen, where direct eye-readings were taken. The results of these observations have been published yearly in the Proceedings of the Academy.

Under the direction of Adam Paulsen a new magnetic observatory, fitted with photographic self-recording instruments of the Mascart type, was built in 1889-1890 in the botanic garden of the university of Copenhagen. A description of the observatory and an account of its instruments is given by Adam Paulsen.[2]

After the year 1900 the observatory work was affected in some years very badly by disturbances due to currents from the new electric tramways, and a third observatory,[3] which is still in operation, was established in the forest Rude Skov, about 20 kilometers distant from Copenhagen. The building of the Rude Skov Observatory was in care of V. Hjort, chief of the magnetic section of the Danish Meteorological Institute.

Few years after the establishment of the Observatory in Rude Skov the instruments from the old observatory in the botanic garden were transferred to the new observatory. Since then the Rude Skov Observatory is equipped with two complete sets (*D*, *H*, and *V*) of photographic registering instruments (one set of the Mascart and one set of the Edelmann pattern), all of which are continuously working, and with two other complete sets of instruments for direct eye-readings. These instruments are for the matter of control read regularly three times every day.

The recording instruments of the Edelmann type are considered as the main apparatus of the observatory. One hour corresponds to a movement of the drums of 15 mm., and 1 mm. of the ordinate corresponds to respectively 1′ for *D*, 10γ, for *H* and 7γ for V.

The instruments for direct eye-readings are almost of the same type and have equal scale values as the recording instruments.

Absolute determinations of *D* are made with a theodolite originally constructed by Bamberg, but altered in several ways for obtaining more accurate values of *D*. The mean departure of a single determination of *D* from an almost linear base value of the recording Edelmann-instrument is since the model of 1923 reduced to 3″.

"Absolute" determinations of *H* are carried out after the methods described by Lamont. The determinations of the constants were originally made by Adam Paulsen and Hjort.[5] Later all possible care has been taken to avoid any change of the constants of the instruments and, as comparisons show (see p. 67), there is reason to believe that the base values of the Observatory do not differ more than 10γ from the international mean value. As to the ordinary weekly determinations of the base value of the

[1] *Bull, de l'Acad. Roy. des Sci. et des Lett. de Danemark*, 1892.
[2] *Ibid.*
[4] Description in "*Annuaire Magnétique*," Années 1907-1908, Copenhague, 1911.
[5] *Bull. de l'Acad. des Sci. et des Lett. de Danemark*, 1892.

recording Edelmann *H*-instrument, the mean departure of a single "absolute" determination is by several improvements brought down so as very seldom to exceed 2γ.

The absolute measurements of the dip are taken with an Edelmann earth-inductor. The mean departure of a single determination of *V* from the smoothed base value is 5γ, or nearly 0.0001 *V*.

The results obtained at the old observatory in the botanic garden of the University are published in two papers: Annales de l'Observatoire Magnétique de Copenhague" one of which (printed 1903) contains the hourly values of *D* and *H* in 1899 and 1900, while the other (printed 1906) gives the monthly means of *H*cos*D* and *H*sin*D* and of the hourly departures from the monthly means of *D*, *H*, *H*cos*D* and *H*sin*D* for the years 1892-1900. The results obtained at the observatory in Rude Skov are published in the "Annuaire Magnétique" of the Institute, the first volume of which (printed 1911) contains the results obtained 1907-1908, while the second volume (printed 1913) contains the results obtained 1909-1911. The results of the observations during the following years have been published in yearly volumes of the "Annuaire Magnétique" (volume 1922 being in press). Since 1908 the "Annales" and the "Annuaires" have contained some reproductions of the curves on disturbed days chosen very nearly in correspondence with the lists issued by the Royal Dutch Meteorological Institute.

As to the international comparisons of the instruments only rather few have been carried out. In September, 1908, M. Dubinsky of the Russian Magnetic Service visited the observatory in Rude Skov to make comparisons. In March, 1922, M. Egedal, in charge of the Rude Skov Observatory, made a comparison of the *H*-instruments of the Observatory with the standard at Potsdam, and in July, 1922, W. C. Parkinson of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington compared the instruments of the Observatory with the standards of the Carnegie Institution. The results of the mentioned three comparisons show the following differences:

	D	I	H
1908 Carnegie Institution[1]—Rude Skov	+0.'3	+1.'3	+0.0011H
1922 Potsdam—Rude Skov	.....	.....	0.0000H
1922 Carnegie Institution—Rude Skov	+0.'3	+0.'3	+0.00016H

Since 1922 the determinations of *D* at the Rude Skov observatory have been improved in such a way that the values obtained for *D* may be considered as absolute values.

The magnetic work other than that of the Observatory consists partly of field work in the kingdom itself, and partly of magnetic observations in Greenland and Iceland.

The field work in Denmark is not yet very complete and ought to be supplemented, or better renewed, to correspond with the demands of modern magnetic surveys. Most of the observations were made by Adam Paulsen during the years 1890-1896 and

[1]*Terr. Mag.*, vol XVI (1911), p. 161.

1900-1906.[1] In 1922 magnetic observations[2] were made by J. Egedal at 10 stations in the province of southern Jutland, which province was returned to Denmark after the war. The magnetic declination at sea around the island Bornholm in the Baltic was measured by Capt. R. Hammer in the year 1892.[3]

In the course of the last century a great many magnetic observations have been made on the coast of Greenland by the members of the numerous arctic expeditions visiting that country for a shorter or a longer period. The observations mainly consist either of determinations of the declination along the coast or of regular magnetic observations at temporary observatories established at the headquarters of some major expeditions. The results of the above mentioned determinations of the declination along the coast will be found in the reports of the different expeditions, most of which reports are reprinted in the "Meddelelser om Grønland." The results of the measurements at the temporary observatories are published in separate papers.[4]

The magnetic work in Denmark is controlled by the Geophysical Section of the Danish Meteorological Institute. The chief of that section is Dr. V. H. Ryd and the chief assistant for magnetic work is Dr. J. Egedal. I also take part myself in the work.

D. LA COUR.

Meteorologisk Institut, Copenhagen,
November 17, 1924.

MAGNETIC SURVEY OF FINLAND.

Referring to the report concerning the status of the magnetic survey in Finland, given at the Rome Meeting (see "Transactions," Bull. 3, p. 38), I shall only mention that magnetic observations have hitherto been made at 877 stations, of which 161 lie to the north of the Polar Circle. The distance between two neighboring stations has generally been about 20 kilometers, except for some stations in the northern part of Finland, where it has some times been impossible to choose regularly-distributed places. It will not be possible to make observations at 20 places lying in the new part of Finland until the year 1925. The magnetic survey of Finland will thus comprise about 900 stations, including 44 equally-distant and regularly-distributed repeat-stations. We hope to be able to cooperate with Sweden and Estland in the magnetic survey of the Baltic Sea. The magnetic observatory at Sodankylä is still in operation.

G. MELANDER,
Director, Meteorological Headoffice of Finland.

Helsingsfors, Finland.

[1] *Annuaire Magnétique*, 1909-1911, Copenhague, 1913.

[2] *Annuaire Magnétique*, 1922 (in press).

[3] *Tidsskrift for Søvæsen*, 1892.

[4] *Observations internationales polaires*, 1882-83, *Expédition Danoise; Observations faites à Godthaab*, Copenhague, 1886-1894; *Observations météorologiques, magnétiques et hydrographiques de l'Ile de Danemark*, 1891-92, Copenhague, 1895; *Observations astronomiques, météorologiques et magnétiques de Tasiusak*, 1898-99, Copenhague, 1904.

RAPPORT SUR LES TRAVAUX RELATIFS AU MAGNÉTISME TERRESTRE ET À L'ÉLECTRICITÉ ATMOSPHÉRIQUE EN FRANCE, 1922-1923.[1]

MAGNETISME TERRESTRE.

Les mesures relatives au *nouveau réseau magnétique de la France* ont été poursuivies en 1922 et 1923 sous la direction de M. Mathias. Comme pour la première campagne, les stations visitées en 1922 et 1923 comprenaient d'anciennes stations de Moureaux et des stations nouvelles, de plus en plus nombreuses, choisies avec soin par le promoteur du réseau de manière à combler les lacunes du premier travail par l'introduction de stations ayant un intérêt géographique, ou appartenant à des terrains peu étudiés, l'ensemble des stations donnant une répartition grossièrement équidistante.

La campagne de 1922 devait, primitivement, comprendre cinq observateurs, savoir:

M. M. Maurain, Directeur de l'Institut de physique du globe, de Paris;
Dongier, Physicien à l'Institut de physique du globe;
Eblé, de l'Institut de physique du globe;
Boutaric, Maître de Conférences à la Faculté des Sciences de Dijon;
Mathias, Secrétaire de la Sixième Section.

La maladie a empêché M. M. Boutaric et Mathias de prendre part à la campagne magnétique de 1922. M. Boutaric a été remplacé par M. Brazier, de l'Institut de Physique du globe. M. Mathias a été remplacé par M. Baldit qui, en fait, n'a pas opéré en 1922 mais en 1923.

La campagne de 1923 devait comprendre les observateurs suivants:

M. M. Maurain, Directeur de l'Institut de physique du globe;
Dongier, de l'Institut de physique du globe;
Eblé, de l'Institut de physique du globe;
Brazier, de l'Institut de physique du globe;
Tabesse, Directeur de l'Observatoire du Petit-Port, à Nantes;
Baldit, Inspecteur de l'Office national météorologique;
Mathias, Secrétaire de la Sixième Section.

La campagne magnétique de 1923 fut fortement gênée par la mort imprévue de M. Dufour, Directeur de l'Observatoire du Parc Saint-Maur, que ses collègues, M. M. Brazier et Eblé durent remplacer au pied levé. D'autre part, M. Dongier, retenu par la collaboration importante qu'il devait donner à la sixième section au titre de l'Electricité Atmosphérique et par la mort de son frère, s'est trouvé également dans l'impossibilité de faire la campagne de 1923.

Le Service géographique de l'armée, de son côté, a étudié dix stations, qui sont nouvelles, sauf une.

[1]Extrait du rapport du secrétaire de la Sixième Section du Comité Français de l'Union Géodésique et Géophysique Internationale. (Voir aussi pp. 76, 77.)

Les fonds nécessaires aux dépenses des observateurs ont été obtenus sur la demande de M. D. Berthelot, président de la 6e section, à qui ils ont été nominalement attribués: en 1922 par l'Académie des Sciences à l'aide du fonds Loutreuil, en 1923 par la Caisse des Recherches Scientifiques.

La somme de 2000 fr. attribuée en 1921 et 1922 à chaque observateur a été un peu élevée en 1923, à cause de la progression de la cherté de la vie.

La suite de ce rapport donne un résumé des stations visitées par chaque observateur:

CAMPAGNE DE 1922.

M. Maurain.—40 stations en Bretagne, dont 22 nouvelles.
M. Dongier.—40 stations dans le S-E de la France, du côté de la rive gauche du Rhône, dont 21 nouvelles.
M. Eblé.—Il a continué l'étude de l'anomalie du bassin de Paris. 17 stations, dont 6 nouvelles, appartenant à la campagne de 1921 ont été faites au printemps de 1922.
La campagne de 1922 proprement dite a complété l'étude du bassin de Paris; en tout, 40 stations dont 13 nouvelles.
M. Brazier.—43 stations en Normandie, dont 27 nouvelles.

CAMPAGNE DE 1923.

M. Maurain.—43 stations en Bretagne, dont 26 nouvelles.
M. Tabesse.—41 stations en Bretagne, dont 26 nouvelles. (Elles complètent l'étude approfondie de la Bretagne.)
M. Baldit.—47 stations se rapportant au S-E de la France, mais à la rive droite du Rhône en général, dont 14 nouvelles.
M. Eblé.—26 stations se rapportant au Bassin de Paris prolongé du côté de l'Yonne, dont 13 nouvelles.
Service Géographique de l'Armée.—10 stations se rapportant à des départements très divers, dont 9 nouvelles.
M. Mathias.—23 stations appartenant à la région toulousaine, dont 6 nouvelles.
M. Baldit.—Ses stations nouvelles ne sont pas encore connues.

CAMPAGNES, 1922-1923.

Nombre total des stations, 1922-1923: 370 dont 183 nouvelles.

Le rapport de 1922 mentionnait 112 stations dont 50 nouvelles. On arrive donc, en tout, au total de 482 stations, dont 233 nouvelles. Par station nouvelle, il faut entendre une station qui n'ait été visitée ni par Moureaux ni par Mathias.

Si on tient compte des mesures qui me restent à faire et des mesures de Baldit, qui doivent être terminées avant le Ier juillet prochain, les trois premières campagnes du nouveau réseau magnétique de la France compteront 540 stations environ. Il y a un léger retard sur les prévisions primitives dû à des événements impossibles à prévoir, mais qui ne compromet nullement le succès de l'entreprise. Il faudra seulement que, dans les trois dernières campagnes magnétiques, le nombre des observateurs ne descendent pas au-dessous de six chaque année.

Carte magnétique de l'Algérie.—Des difficultés de personnel, la maladie grave d'un fils, ont paralysé la première campagne de M. Lasserre, qui s'est réduite à six stations (Mascara, Nemours, Dellys et trois autres). M. Lasserre compte se rattraper par la suite, quand le temps deviendra favorable. Il sera probablement nécessaire d'aller aider M. Lasserre dans ses mesures du réseau algérien et tunisien.

Carte magnétique du Maroc.—Le Colonel Bellot, Directeur du Service géographique de l'Armée, a exprimé le regret de n'avoir pu encore faire commencer les mesures magnétiques dont il m'avait parlé lors d'une entrevue en 1922. Il reste toujours dans les mêmes dispositions et espère résoudre les difficultés qu'il a rencontrées et qui sont relatives, en particulier, à des questions d'instruments. Dès 1923, le service géographique sera en mesure de participer pour le Maroc à l'oeuvre entreprise par la 6e Section.

Le Colonel Perrier a, dans ce but, introduit dans les cours suivis par les officiers géodésiens du Service géographique des déterminations magnétiques. Les conséquences ont été les suivantes: la campagne de géodésie dans les Régions libérées (mai à octobre 1923) s'est traduite par 8 stations magnétiques nouvelles. Les mêmes officiers sont ensuite partis pour le Maroc pour une campagne qui durera d'octobre 1923 à mai 1924 et pendant laquelle les mesures magnétiques seront menées parallèlement avec les mesures géodésiques.

Carte magnétique de la Syrie.—La première brigade géodésique de Syrie (Capitaine Govin, lieutenant Delieune) a exécuté, de juillet à décembre, 1923, des mesures magnétiques en huit stations nouvelles, savoir:

	Stations visitées.	Observations.
Région d'Alep	Bab (30 Km N-E d'Alep)...	$4D + 2I + 2H$ + var. diurne de D
	Terme sud de la base de Bab	$3D + 2I + 2H$ + var. diurne de D
	Aviché..................	$2D$
	Tel el Hal................	$1D + 1I + 1H$
	Alep.....................	$1D$
Région de l'Euphrate	Ebou Kalkal..............	$1D$
	Kalet ed Nidjem..........	$1D$
Région du Liban:	Beyrouth.................	$1D$ + Var. diurne de D

Chaque détermination de la variation diurne de la déclinaison a compris environ 6 ou 7 observations de cet élément magnétique réparties du lever au coucher du soleil.

Carte magnétique de l'Indo-Chine.—Le Commandant Gleyzes, Chef du Service géodésique de l'Indo-Chine, se propose d'y organiser des mesures régulières de magnétisme terrestre: il s'est mis, dans ce but, en rapport avec l'Institut de physique du globe de Paris pour l'étalonnage des appareils Chasselon qu'il a dû acquérir. La 6e section fait des voeux pour le succès de son entreprise géodésique et magnétique.

Carte magnétique de Madagascar.—Le regretté R. P. Colin avait fait pendant de longues années des mesures magnétiques à Tananarive. Son successeur se propose de les étendre à différents points de l'île; dans ce but, des boussoles de voyage seraient nécessaires. M. D. Berthelot, président de la 6e section, a fait des démarches dans le but de lui faire attribuer des crédits suffisants pour l'achat de boussoles Chasselon, petit modèle.

Carte magnétique du centre de l'Afrique.—De nombreuses mesures magnétiques exécutées par un de nos officiers géodésiens les plus distingués ont été rapportées de nos possessions du centre de l'Afrique et seront publiées à bref délai dans les Annales de l'Institut de physique du globe de Paris.

Institut de Physique du Globe de Paris.—A l'Observatoire du Val-Joyeux sont faites: 1° des mesures absolues des trois éléments *D*, *I*, *H*, environ quatre fois par mois;—2° l'enregistrement photographique continu des trois éléments *D*, *H*, *Z;* 3°—la lecture chaque jour, à plusieurs reprises des déviations à une série d'appareils identiques à un appareil servant pour l'enregistrement photographique.

A l'Observatoire de Nantes sont faites les mesures absolues régulières et l'enregistrement photographique continu.

Depuis le début de l'année est en service au Val-Joyeux une méthode électrique (par induction) pour la mesure de *I*; on maintiendra la méthode magnétique conjointement avec la précédente pendant assez longtemps, et on compte ne laisser en service que la méthode électrique, plus précise et plus rapide, quand elle aura fait ses preuves.

On a commencé, à l'Institut de physique du globe de Paris, l'établissement de *Tableaux et Cartes magnétiques* pour l'ensemble des Possessions françaises; pour cela on rassemble toutes les données existantes et on les ramène à une même date (1er Janvier 1921) le mieux possible en utilisant les variations séculaires déduites des mesures multiples en une même station. C'est Mlle Homery qui exécute ce travail sous la direction de M. M. Maurain et Eblé. Les cartes de *D*, *I*, *H* pour l'Afrique du Nord ont été publiées dans l'Annuaire du Bureau des Longitudes pour 1924, et le travail paraîtra dans le tome II des Annales, dont l'impression sera bientôt achevée; les cartes de *D* pour l'Afrique occidentale française et l'Afrique équatoriale française vont aussi paraître dans ce tome II. Le travail concernant l'Indo-Chine et Madagascar est en cours, presque achevé.

Parallèlement, Mme de Madinhac a fait le report des valeurs des éléments magnétiques pour la France au ler Janvier 1921, continuant ainsi les Tableaux dressés de 10 en 10 ans, 1901, 1911, en attendant la nouvelle Carte basée sur le Nouveau Réseau magnétique français.

Voici l'indication d'autres travaux:

Ch. Maurain et Mme de Madinhac, Evaluation de l'intensité de courants électriques traversant verticalement le sol en France, C. R. t. 175, p. 1046, 1922, et Annales, t. II.

Mêmes auteurs, Variation séculaire de l'intensité du champ magnétique terrestre à Paris, C. R. t. 176, p. 1726, 1923, et Annales, t. II.

C. E. Brazier, Relation entre l'agitation magnétique au Val-Joyeux et la variation de l'intensité des tâches solaires, Annales, t. II.

Dans les Annales ont paru ou vont paraître d'autres travaux, mais qui ne concernent pas l'Institut de Physique du Globe. Ce sont:

F. Baldet, Observations magnétiques faites à l'Observatoire d'Alger Bouzaréa, Annales, t. I, p. 26.

A. Angot, Les variations périodiques du magnétisme terrestre à Paris Annales, t. I, p. 250.

M. de Rohan Chabot, Mesures magnétiques en Afrique, Annales, t. II.

ÉLECTRICITÉ ATMOSPHÉRIQUE ET TELLURIQUE.

Un premier rapport autographié sur l'électricité atmosphérique par le secrétaire de la 6e section avait été présenté au Congrès de Rome. Ce rapport, un peu amélioré, fut imprimé par M. Bouty dans les *Annales de Physique* sous le titre "Rapport sur l'état actuel de l'électricité atmosphérique, par E. Mathias."

Cette rédaction, uniformément approuvée par la critique scientifique, montrait indirectement une grosse lacune dans la littérature scientifique française; son auteur, d'accord avec M. D. Berthelot, président de la 6e section, résolut de la combler.—A cet effet, la partie permanente de la 6e section s'est réunie le vendredi 22 décembre 1922 à 17 h. chez M. D. Berthelot. Etaient présents: M. D. Berthelot, président, M. M. Bigourdan, Dongier, Dr Loisel, Maurain, Pérot, Mathias, secrétaire. Le général Ferrié et M. Deslandres s'étaient excusés par lettre de ne pouvoir venir.

L'ordre du jour appelait le projet de rédaction par les membres de la 6e section d'un Traité d'électricité terrestre. La parole fut donnée au secrétaire de la 6e section pour la lecture du Rapport préliminaire montrant l'enchainements des idées; les membres suivaient, ayant en mains le plan général du Traité divisé en chapitres et la Table des matières détaillée des différents chapitres rédigés par le secrétaire.

Le Rapport partage le Traité en trois parties bien distinctes, dont les deux premières sont relatives à l'*Electricité atmosphérique* et la troisième à l'*Electricité tellurique.*

L'électricité atmosphérique est partagée en deux; la première partie se réfère à l'étude de l'air en lui-même, c'est-à-dire aux formes de l'électricité atmosphérique qui ne sont pas apparentes et qui ne troublent pas la sérénité de l'air.

Les modes apparents de l'électricité atmosphérique s'appellent des *météores*, et leur étude constitue la deuxième partie du Traité.

Le Rapport montre ensuite pourquoi la première partie se scinde naturellement en six chapitres. Le potentiel électrique de l'atmosphère et la déperdition électrique correspondent à des études très anciennement poursuivies. Les notions des ions et de la radioactivité de l'air et des couches superficielles du sol modifient peu les chapitres précédents, mais elles introduisent des chapitres nouveaux qui leur font suite immédiatement:

Ionisation de l'air; sa mesure.
Conductibilité électrique de l'air.
Mobilité des ions dans l'air.
Radioactivité de l'air.

Cet ensemble, très logique et très homogène, constitue la première partie de l'électricité atmosphérique.

L'instrument de physique naturellement adapté à cette étude, c'est l'*électromètre* sous ses diverses formes. On aurait pu concevoir une exposition de l'électricité atmosphérique débutant par un chapitre consacré tout entier à l'étude physique des électromètres, qu'ils fussent à feuilles d'or ou d'aluminium, à aiguille, à fils de quartz ou à corde. Le secrétaire montre les inconvénients multiples d'une telle exposition. Il propose, au contraire, de décrire les électromètres à propos des problèmes à l'étude desquels ils sont spécialement adaptés, ce qui est leur place naturelle. On respecte ainsi, dans une certaine mesure, l'ordre historique et l'ordre naturel des choses, et l'ennui inséparable de toute énumération disparaît.

Pour ce qui est de l'étude des *météores électriques*, deuxième partie du Traité, une classification très naturelle les partage en trois chapitres:

les décharges électriques dans l'atmosphère;
l'étude électrique des précipitations;
et la télégraphie sans fil.

La télégraphie sans fil s'introduit tout naturellement dans une semblable étude parce qu'on peut la considérer comme une électricité atmosphérique *artificielle*, susceptible de réagir sur l'électricité atmosphérique *naturelle*, et sur laquelle sûrement celle-ci réagit sous la forme de *parasites*. On conçoit donc que les dispositifs expérimentaux de la T. S. F. puissent être utilisés pour l'étude de certains météores électriques (étude suivie des orages à distance).

L'électricité tellurique, dont l'écorce terrestre est le siège, se partage d'elle-même en deux parties:

l'électricité tellurique superficielle;
l'électricité tellurique profonde.

L'électricité tellurique superficielle peut être due, soit à des causes naturelles (courants telluriques), soit à des causes artificielles (courants vagabonds de l'industrie électrique). Ces deux sous-chapitres, fort différents, ont donné lieu à des recherches nombreuses et d'un intérêt pratique, à cause des inconvénients que les courants telluriques et les courants vagabonds présentent dans beaucoup de cas.

L'électricité tellurique profonde est due, en partie, aux rayonnements α et β des matières radioactives de l'écorce terrestre, rayonnements qui sont absorbés par les matières solides qui les entourent et dont l'énergie électrique est transformée intégralement en énergie calorifique. Il s'ensuit que la recherche de la cause de la chaleur terrestre est véritablement une question d'électricité terrestre et qu'elle est bien à sa place dans un Traité consacré à cette partie de la philosophie naturelle.

Le Secrétaire propose enfin à la 6e section une innovation consistant à faire un *livre collectif*, dont les différents chapitres seraient rédigés par des personnes aussi compétentes que possible. Une telle manière de faire n'a jamais été appliquée à la physique; elle est, au contraire, fréquente dans les livres d'histoire ou de littérature, ou dans les Traités collectifs de médecine ou de chimie.

Le général Ferrié, consulté sur cette procédure, s'y est montré entièrement favorable. En ce qui concerne le format et les dimensions du futur Traité, le Secrétaire pense qu'il convient d'adopter le format in $-8°$ d'une contenance de 500 pages environ.

Après discussion, l'assemblée adopte les propositions du Secrétaire. Le futur Traité aura pour titre: *Traité d'électricité atmosphérique et tellurique.*—La distribution de la rédaction est la suivante:

R. Dongier.—Etude du potentiel de l'air.
Ch. Maurain.—Déperdition électrique;
Ionisation de l'air: sa mesure;
Conductibilité de l'air.
E. Mathias.—Mobilité des ions dans l'air.
Dr Loisel.—Radioactivité de l'air et de l'écorce terrestre.
E. Mathias.—Etude des météores électriques.
E. Mathias.—Etude électrique des précipitations.
R. Mesny.—T. S. F.
J. Bosler.—Courants telluriques.
G. Girousse.—Courants vagabonds.
Dr Loisel.—Electricité tellurique profonde.

L'impression du Traité, *confiée aux Presses Universitaires*, est actuellement très avancée: on peut affirmer que le livre paraîtra au mois de mai prochain.

Mesures d'électricité atmosphérique.—M. Maurain a organisé, à l'Institut de physique du globe de Paris un service d'Electricité atmosphérique qui peut être proposé comme modèle aux autres Observatoires français.

A l'Observatoire du Val-Joyeux ont été établies, et fonctionnent depuis le 1er janvier 1923, les mesures régulières du *champ électrique* et de la *conductibilité* atmosphérique. Les appareils ont été étudiés et installés par M. Salles; M. Gibault assure le service courant.

Le *champ électrique* est enregistré à l'aide d'une prise de potentiel au radium et d'un électromètre à quadrants donnant un point toutes les minutes. La prise est à 2 mètres au-dessus d'un sol gazonné, fixée à un long fil parallèle au sol et bien isolé.

La valeur moyenne obtenue jusqu'ici est environ 98 volts par mètre; la variation diurne apparaît nettement, et les perturbations dues aux précipitations et aux nuages orageux sont très marquées.

La *conductibilité* est mesurée à l'aide d'un appareil à courant d'air à condensateur cylindrique. Les moyennes obtenues sont environ, $1, 13.10^{-4}$ pour les ions positifs et $1{,}02.10^{-4}$ pour les ions négatifs.

L'installation sera complétée par la mise en oeuvre d'un appareil compteur d'ions, qui est en préparation.

Des mesures seront faites régulièrement avec les perturbations observées dans les mesures radiogonométriques faites à Meudon par M. M. Pérot et Mesny.

M. Maurain a participé, à cet effet, aux travaux de la 2e sous-commission du Comité français de radiotélégraphie scientifique.

Les mesures d'électricité atmosphérique seront prochainement installées aux deux stations de l'Observatoire du puy de Dôme: dans ce but, M. Jacquet, aide-météorologiste, est allé faire un séjour de deux semaines à l'Institut de physique du globe de Paris.

E. MATHIAS,
Le Secrétaire de la Section.

OBSERVATIONS RÉGULIÈRES DE MAGNÉTISME TERRESTRE EN FRANCE.

Il existe en France deux Observatoires spéciaux dans lesquels sont faites des observations régulières complètes de magnétisme terrestre, l'Observatoire du Val-Joyeux, à Villepreux (Seine et Oise) près de Paris, et l'Observatoire du Petit-Port, à Nantes (Loire Inférieure). Ces deux observatoires font partie de l'Institut de Physique de Globe de l'Université de Paris, auquel est rattaché le Bureau Central de Magnétisme Terrestre. Les observations comprennent: 1° Mesures absolues des trois éléments, Déclinaison, Inclinaison et Composante Horizontale, quatre fois par mois environ. 2° Enregistrement photographique des variations des trois éléments Déclinaison, Composante Horizontale, Composante Verticale. 3° (au Val-Joyeux), Lectures régulières d'appareils de variation, identiques à ceux qui servent pour l'enregistrement photographique. Les personnes chargées de ces observations sont pour le Val-Joyeux, MM. Eblé et Itié; pour Nantes, M. Tabesse, Directeur de l'Observatoire.

C'est l'observatoire du Val-Joyeux qui est la Station Magnétique Central de France. C'est à l'aide des observations faites au Val-Joyeux que sont calculées les corrections relatives aux mesures en campagne exécutées dans les différentes régions de la France: et c'est là que sont étalonnés les appareils utilisés pour ces mesures. En 1922 et 1923 ont été étalonnés 23 théodolites magnétiques et 21 boussoles d'inclinaison. Les nouveaux observateurs chargés des mesures en campagne effectuent des stages préliminaires au Val-Joyeux.

Les appareils magnétiques du Val-Joyeux ont été l'objet de comparaisons avec les appareils de l'Institution Carnegie en 1921 (M. Parkinson) et avec ceux du Service Magnétique des Indes en 1923 (M. J. de Graaff Hunter).

Les résultats des observations du Val-Joyeux sont publiés dans les Annales de l'Institut de Physique du Globe et du Bureau Central de Magnétisme Terrestre: les résultats des observations de Nantes seront publiés aussi dans ces Annales. Les Annales publient aussi les résultats des mesures en campagne effectuées en vue de l'établissement du Nouveau Réseau Magnétique Français.

Des observations magnétiques régulières sont faites dans plusieurs autres observatoires Français:

Un enregistrement photographique des variations de la Déclinaison est fait à l'Observatoire d'Astronomie Physique de Meudon, dont le Directeur est M. Deslandres, et à l'Observatoire de Lyon (à Saint Genis-Laval, Rhône), dont le Directeur est M. Jean Mascart.

Des mesures absolues des éléments magnétiques sont faites régulièrement à l'Observatoire d'Alger, dont le directeur est M. Gonnessiat. Un mémoire d'ensemble sur les résultats de ces mesures a été publié par M. Baldet dans le tome I des Annales.

Des mesures magnétiques régulières sont faites à l'Observatoire de Tananarive (Madagascar); le fondateur et pendant longtemps directeur de cet Observatoire, le P. Colin, est mort l'an dernier; son successeur le P. Poisson continue les mesures et espère pouvoir reprendre l'enregistrement photographique régulier qui avait été fait pendant longtemps et a été interrompu en 1919 par suite de difficultés ma térielles.

Dans le tome II des Annales commence la publication d'un Travail qui comprendra des Tableaux et des Cartes des éléments magnétiques pour l'ensemble des Possessions Françaises; ce volume contient ce qui concerne l'Algérie, la Tunisie, le Maroc, l'Afrique Occidentale et l'Afrique Equatoriale Françaises. Le Travail sera continué dans le tome III.

CH. MAURAIN,
Directeur de l'Institut de Physique du Globe et du Bureau Central de Magnétisme Terrestre.

RELAZIONE SULL 'ATTIVITÀ ITALIANA NEL CAMPO DEL MAGNETISMO E DELL'ELETTRICITÀ TERRESTRE.[1]

A.—MAGNESTISMO TERRESTRE.

(a) *Osservatorii.*—L'Italia ha un solo osservatorio magnetico, quello di Pola, il quale oggidì è mantenuto in esercizio per cura della R. Marina. Dopo qualche periodo di assettamento dell'istituto, nel trapasso da una ad altra amministrazione, e per cui ebbero a verificarsi alcune lacune nella serie di osservazioni, l'Osservatorio ha ripreso la sua regolare attività. Le osservazioni assolute e le registrazioni del magnetografo procedono ininterrotte dal settembre 1922 in poi.

Intanto si è provveduto a raccogliere ed a pubblicare in un volume le osservazioni magnetiche di Pola del 1919, del 1921 e del 3° quadrimestre 1922, costituendo un supplemento al vol. 10° degli *Annali Idrografici* (Genova, 1923).

Si spera di fare uscire, nel corrente 1924, analogo volume con le osservazioni del 1923.

(b) *Rilevamenti magnetici in Italia.*—Fu continuato il lavoro intrapreso, fin dal 1921, dal R. Ufficio Centrale di Meteorologia e Geofisica per un nuovo rilevamento magnetico dell'Italia, con lo

[1]Estratto dal Bolletino N. 7, del Comitato nazionale italiano geodetico-geofisico. Venezia, 1924, p. 39-43.

scopo di ricercare le variazioni secolari magnetiche avvenute negli ultimi tempi, e di preparare i materiali per l'allestimento di una nuova edizione delle carte magnetiche italiane.

Nell'estate e nell'autunno del 1922 il prof. Palazzo eseguì i rilevamenti nella regione media tirrenica, con 17 stazioni, di cui 9 sono stazioni di ripetizione. I risultati di questa campagna sono già resi di pubblica ragione mediante una nota dal titolo: *Rilevamenti magnetici nel versante medio e nelle minori isole del Tirreno* (Rend. R. Accad. Naz. Lincei, marzo 1923).

Nel 1923 e nel 1924 il prof. Palazzo proseguì le misure di campagna nelle tre grandi isole: Corsica, Sardegna e Sicilia, comprendendo pure Tunisi e Malta, con 18 stazioni di ripetizione e 2 nuove. Si fa conto di distribuire alla riunione di Madrid gli estratti di una nota concernente il lavoro del 1923-24: *Determinazioni magnetiche nelle isole maggiori mediterranee* (Rend. Lincei, 1924).

(c) *Rilevamenti nel Mar Rosso.*—Dall'ottobre 1923 al giugno 1924, a mezzo della R. Nave *Ammiraglio Magnaghi* e col concorso del R. Istituto Idrografico e del R. Comitato Talassografico Italiano, fu svolta una importante e fruttuosa campagna idrografico-scientifica nel Mar Rosso. Nel programma della spedizione erano pure considerate le determinazioni magnetiche, ed invero il cap. di corvetta sig. Mario Cugia fece buon numero di misure sulle coste ed isole Eritree. I risultati ottènuti non tarderanno ad essere pubblicati; veggasi frattanto l' informazione data da Palazzo nel Bollettino del Ministero delle Colonie (Roma, 1923), sotto il titolo: *La presente campagna idrografico-scientifica nel Mar Rosso nei riguardi del magnetismo terrestre.*

(d) *Variazioni magnetiche secolari.*—Ad indagini siffatte, per l'Italia e sue Colonie, il prof. Palazzo ha cercato di contribuire con le pubblicazioni seguenti: *Valori degli elementi magnetici a Montecassino* (Subiaco, 1923); *Contributo allo studio delle variazioni magnetiche secolari nell'Eritrea* (Atti Pontif. Accad. Nuovi Lincei, giugno 1922); *Nuovi confronti magnetometrici e variazioni magnetiche secolari a Terracina* (ibidem, giugno 1923).

(e) *Confronti magnetometrici.*—Dopo la chiusura del Congresso a Roma, nel maggio 1922, delle Unioni internazionali astronomica e geodetico-geofisica, approfittando dell'occasione che era venuto fra noi il Direttore L. A. Bauer del Dipartimento magnetico della Istituzione Carnegie, accompagnato dall'osservatore magnetologo sig. W. C. Parkinson, fu deliberato di procedere a nuovi confronti fra gli apparati magnetici dell' Istituzione Carnegie e quelli dell'Ufficio italiano di Meteorologia. Le misure di comparazione furono compiute fuori di Roma, a Terracina, come già si era fatto in altre due volte precedenti. Dai confronti, esposti nell'ultima delle note di cui riportammo sopra il titolo, fu confermato l'ottimo accordo esistente fra il *campione magnetico internazionale* adottato a Washington ed il nostro magnetometro (differenze IMS−Roma: $\triangle D = -0.'1$; $\triangle I = -0.'1$; $\triangle H = -9\gamma$ a Terracina, e quindi $\triangle H = -0.00038H$).

Altri confronti magnetometrici ebbero luogo a Genova nel settembre 1923; e furono allora paragonati il magnetometro e l'inclinometro posseduti dall'Istituto Idrografico della R. Marina, e che si dovevano adoperare nella su menzionata campagna del Mar Rosso, coi corrispondenti apparecchi da viaggio del R. Ufficio Centrale Meteorologico.

(f) *Richerche speciali.*—Alla riunione che la Società Italiana per il progresso delle scienze tenne a Catania nell'aprile 1923, il prof. Palazzo fece un discorso di classe su: *La costituzione dell'interno della Terra ed il campo magnetico terrestre.* Dalle considerzioni ivi svolte sembra emergere la particolare importanza che avrebbe una ricerca estesa e sistematica sulle proprietà magnetiche delle diverse rocce costituenti la crosta terrestre. Queste conoscenze servirebbero sia per darci ragione dei disturbi magnetici locali e regionali che spesso si rendono manifesti nei rilevamenti di campagna, e sia anche per portar luce alle teorie riguardanti il magnetismo proprio della litosfera. Perciò il sottoscritto relatore Palazzo mette nel programma di studio siffatte ricerche—sulle rocce italiane—, ma in pari tempo intende promuoverle anche presso i colleghi.

Qui si tratta (oltre che di sperimentare sul magnetismo delle rocce *in situ*) di determinare, su campioni portati in laboratorio, le proprietà specifiche, che chiamiamo permeabilità e suscettività magnetica. Misure abbastanza esatte possono essere fatte con la bilancia ad induzione di Hugues, o col dispositivo adoperato da Rücker, o col metodo ideato da Curie. Il materiale di notizie finora raccolto su tale argomento, sebbene si abbiano buoni saggi (2), è molto scarso.

A questo campo d'indagini crediamo opportuno dirigere l'attenzione degli specialisti del geomagnetismo, ed anche dei fisici e dei mineralogi, invocando la collaborazione internazionale. Invero, è essenzialmente fra le rocce eruttive basiche che si riscontrano le qualità magnetiche, ma è noto che, per una medesima specie di roccia, vi possono essere delle varietà che sono magnetiche ed altre che lo sono poco o punto. Ciò può dipendere dalla presenza, anche in piccole quantità, di qualche elemento talora secondario (percentuale di sostanze ferromagnetiche) nella composizione litologica e chimica delle rocce stesse. Entrano in giuoco piccole differenze di composizione, le quali, mentre non bastano a mutare la specie della roccia, possono dare luogo a numerose varietà di una stessa roccia, che s'incontrano in punti diversi della superficie terrestre. È importante procurarsi cognizioni più estese, più concrete e precise su di ciò. Ogni paese ha le sue varietà petrografiche; e pertanto nasce l'idea che alle ricerche di laboratorio relative alla suscettibilità magnetica delle rocce rechino contributo gli studiosi delle diverse nazioni, ciascuno per la parte che concerne il proprio suolo.

[2] RÜCKER—On the Relation between the Magnetic Permeability of Rocks and Regional Magnetic Disturbances (Proceedings Roy. Soc. of London, Vol. XLVIII, 1890, p. 505); RÜCKER e WHITE, On the Determination of the Magnetic Susceptibility of Rocks (Proceed., Vol. LXIII, 1898, p. 460).

B.—ELETTRICITÀ ATMOSFERICA.

Come già per il passato, gli studi di elettricità atmosferica in Italia nel periodo 1922-24 si possono riassumere essenzialmente nella attività spiegata in questo campo dall'Ufficio Centrale di Meteorologia e Geofisica, e precisamente a mezzo dell'opera personale del Prof. D. Pacini che, come è noto, si è in modo paricolare dedicato a queste indagini.

Egli ha iniziato nell'estate del 1922, in un nostro Osservatorio di montagna, cioè a Sestola, alcuni studi sulla corrente elettro-atmosferica, studi che sfortunatamente, per forza maggiore, rimasero interrotti nell'anno 1923, ma che vengono ripresi e continuati nell' estate corrente.

Osservazioni sistematiche di elettricità atmosferica in Italia non se ne fanno ancora, mancando un Osservatorio appropriato per queste ricerche. La istituzione di un Osservatorio di elettricità terrestre, conformemente ai desideri espressi dalla Sezione internazionale di Magnetismo ed Elettricità terrestre nella riunione del maggio 1922 in Roma, è nei nostri voti; tuttavia non ci nascondiamo le difficoltà che si oppongono alla realizzazione di questo nostro desiderio in un tempo relativamente breve.

La soluzione di questioni isolate, come quella detta sopra, e come in generale finora si è fatto in quasi tutti i Paesi (donde la dottrina che noi possediamo intorno alla elettricità terrestre), si può considerare come in gran parte frutto di separate indagini condotte per iniziativa individuale. Ma queste iniziative, sia che partano dai geofisici dell'Ufficio Centrale Meteorologico, sia che provengano da altri studiosi, saranno ognora incoraggiate e favorite dall'Ufficio stesso, il quale può mettere a loro disposizione i mezzi necessari per sperimentare, nonchè concedere opportuna sede presso gli Osservatorii di montagna dipendenti.

Il Segretario,
D. Pacini.

Il Presidente della Sezione,
L. Palazzo.

THE STATUS OF MAGNETIC SURVEY AND OBSERVATORIES IN JAPAN.

(1) MAGNETIC SURVEY.

The magnetic survey of Japan has been carried out as planned and reported to the Rome Meeting (see "Transactions," Bull. No. 3, pp. 40-42) with electromagnetic field instruments of Prof. Watanabe. Observations with the Kew magnetometer were made at a few stations for the sake of controlling instrumental peculiarities, if there are any.

The survey was completed in due time and the reduction was going on when the great earthquake of September 1, 1923, destroyed all the original notes and other documents connected therewith. The only remnants of the undertaking are the post cards which the observers were instructed to send filled out with the results as soon as they obtained them in the field. These post cards were fortunately placed in a safer part of the city. They are complete only so far as declinations are concerned and they are now being reduced in the hope of presenting the results at Madrid.

(2) STANDARD MAGNETIC OBSERVATORY.

The National Committee of Geophysics has decided to make the Observatory at Kakioka the standard observatory for several years to come until more suitable place and means will be found.

The Observatory is now improved by making water tight the earth-covered mound inside which the Eschenhagen magnetographs are placed. There has been added a small substantial stone building where magnetographs for research purposes, and also electrometers for observations of atmospheric electricity are to be placed.

The room for simultaneous observations of magnetometers is found to be too small and a larger and better provided building is in view. A residence for the family of the observer-in-charge will be constructed during this year.

The road (about 15 km.) between the village and the nearest railway station (Isioka) is now being improved by the prefecture, and the Observatory may be provided with an automobile, if parliament permits the plan.

(3) TSINGTAU OBSERVATORY.

With regard to the observatory of Tsingtau, I regret not being able to give much information, except that the observations are carried out by Mr. Irumata, under the superintendence of the Director of the Central Meteorological Bureau of Tokyo, Dr. T. Okada, who was on a visit there when I was leaving Tokyo. I might have brought some information had I not been forced to take a steamer much in advance of my proposed plan.

A. TANAKADATE.

New York City, June 27, 1924.

MAGNETIC SURVEY WORK ACCOMPLISHED IN MEXICO, DURING JULY 1922 TO JUNE 1923.

In 1922, observations for magnetic survey work, were made at 8 places: Querétaro, San Luis Potosí, Matehuala, Saltillo, Monterrey, Monclova, Nuevo Laredo and Piedras Negras. The results were corrected for variation and comparison with the standard instruments used in Teoloyucan.[1]

Mr. Rosendo O. Sandoval was in charge of this work during the months June to August.

The instruments used were the Dover magnetometer No. 126 and the Negretti and Zambra dip circle No. 65. Before and after the survey, both instruments were duly compared at Teoloyucan.

Generally, the places chosen were free from local disturbances.

[1]They will be found published, with full details, in No. 1 of "Boletin" No. 7, Observatorio Astronomico Nacional de Tacubaya.

At Monterrey and Nuevo Laredo, where there are electric tramways, the observations were made at places as far as three kilometers.

The results agree with the deduced values from the Magnetic Charts and Tables, given by the Coast and Geodetic Survey, for 1915.

In August of 1923, after the rainy season, Mr. Sandoval continued the magnetic survey, making observations at 18 places; the results will be given in the next report.

Observatorio Astronomico Nacional, J. GALLO.
Tacubaya, D. F., March, 1924.

MAGNETIC SURVEY OF NORWAY.

Up to the present time no complete magnetic survey of Norway has ever been made. Hansteen's numerous and highly valuable measurements from the first half of the past century have not been systematically continued, and only a few isolated series of survey-measurements have been performed during the last 60 years. Among such series, I may mention the measurements made in 1902 at stations along the coast from Trondhjem to the Russian border, by the late Director Aksel Steen and Captain Amundsen with the instruments used by the latter on his expedition to the magnetic pole; measurements by the present writer in 1904 and 1905 in the north of Norway with the instruments now at Haldde; and finally recent measurements by the directors of the said observatory, Krogness and Köhler in the vicinity of the observatory.

A complete survey of the country is at present in preparation under the auspices of the Norwegian Geophysical Commission, and if the necessary funds shall be available, we hope to have this work finished in five to ten years.

Physical Institute A, University, Oslo, SEM SAELAND.
December 17, 1924.

THE MAGNETIC WORK IN POLAND, 1923-1924.

The work of the Magnetic Observatory at Swider during the first years of its existence was, as I had already the honor of communicating to the Rome Meeting,[1] extremely difficult on account of my having at that time but one assistant. Magnetographs, absolute measures, field magnetic observations—all this (considering moreover the lack of funds for journeys) had been too much for two persons, the more so that, besides the Observatory, I had a number of other, pedagogic and social, obligations. On account of this I had to give up entirely for the time field magnetic observations, and as concerns publications I was unable, besides taking part in the international bulletin and preparing few short publications on general subjects, to prepare any longer report. Only in the middle of 1922 did I succeed in getting a second assistant, and a third one at the end of 1922, so that in the years

[1]Bulletin No. 3, pp. 44-46.

1923 and 1924 the work was advancing more rapidly, and it was necessary to turn our attention, first of all, to the work which has been left over from previous years.

Fearing that the publication of annual reports, beginning with the year 1921, would result in causing continual delay in publishing the reports for following years, I have conducted the work in such a way as to have computations for the year 1925 prepared systematically from the beginning of the year and, consequently, to have the report for the year 1925 appear in print already at the beginning of 1926. Further work will be conducted in the same manner, and thus it will be possible to have annual reports printed immediately after the year will be over. The years 1921-1924, I shall have to treat together and to publish the report covering the entire period partly at the beginning and partly at the end of 1925.

For practical reasons, it will be necessary to start with the declination, and the first part of the reports for the years 1921-1924, which will appear in January 1925, will be devoted to this element. I shall do my best to have the second part concerning the horizontal and vertical components appear, according to the announcement, at the end of 1925, and in this way the whole period will be dealt with.

I resumed in the summer of 1923 magnetic surveys in various parts of Poland. Those researches are being continued also in the current year. I have chosen the points in such a way as to obtain, already in the current year, a general view concerning the distribution of the magnetic elements in Poland, and also to be able to make this net gradually denser. In spite of very limited funds, I have made, to the present date, magnetic observations at over 100 points; those surveys will be continued and I will try to extend the above-mentioned number as much as possible, if the weather permits. I shall be able to publish, already in the fall of the current year, a *first provisional map of isogonics for Poland*, and such a map is very much needed. I can only state here that my conclusions concerning the abnormal course of isomagnetic lines in the northwestern part of Poland[2] apply also to other parts of this country.

I would like to add to the above that I was enabled also to give some consideration to my old plan of broadening the sphere of our researches so as to cover *atmospheric electricity*. At the present time we are building on the grounds of the Swider Magnetic Observatory a new pavilion for electric registering instruments. I expect that from the beginning of 1925 this kind of work, which is still new for us, will be conducted systematically.

ST. KALINOWSKI,
Director.

Swider, near Warsaw,
September 20, 1924.

[2]See *Terr. Mag.*, vol. 28 (1923), pp. 141-142.

REPORT ON TERRESTRIAL MAGNETISM IN SIAM.[1]

Observations of terrestrial magnetism in Siam consist entirely of field observations with a unifilar magnetometer by Cooke (No. 16) and a Dover dip circle (No. 180). The elements observed are declination, horizontal intensity and dip. There is no base station, nor magnetic observatory, in Siam.

The first magnetic work of the department was done with these instruments in 1906 when two stations were occupied. The average number of stations occupied per year until 1915 was only 2, but in 1915, 10 stations were occupied and since that time an average of 10 stations has been occupied once each year. No observations were made in 1923 as the magnetometer had been sent to Kew Observatory to be tested.

Since 1915 the observations have been made during the months of August and September, this being the period of recess from field work, when officers from the major triangulation parties are available as observers. The methods adopted are in general those detailed in the "Instructions for making magnetic observations for the Survey of India Department 1896."

The declination is observed with one magnet at the time of maximum declination and with the second magnet at the time of minimum declination.

For the determination of the daily variation, a needle is left swinging and half-hourly readings are taken of its position with respect to a referring mark. This gives the daily variation and the times of maximum and minimum declination. The daily variation has been found to vary from 3′ to 6′.

Observations for vibration and deflection are made with two magnets in the interval between the ordinary declination observations. The dip is observed when convenient, either between the declination observations, or after them.

In general one day is spent at each station except when the daily variation is required, or where it is thought expedient to duplicate the observations.

An analysis of the results shows that the secular change in declination has diminished during the last 18 years. The observations between 1906 and 1912 are not numerous, but they give a mean value of about $-4'.0$ per year. The observations between 1912 and 1918, numbering 45, give a mean value of $-3'.5$ ($\pm 0'.2$), whilst the observations between 1918 and 1922, numbering 52, give a mean value of $-2'.0$ ($\pm 0'.1$).

The average of the observed declinations (reduced to mean daily value) for central Siam for August–September 1922 (mean latitude 14°15′, mean longitude 100°43′) is 4′.4 W. A declination observed at Lat. 11°40′ and Long. 99°40′ in the peninsula was found to be 10′.4 W and one observed at Lat. 10°29′ and Long. 99°11′ to be 17′.1 W.

[1]Prepared by Royal Survey Department of Siam and transmitted by the Assistant Director, Lieut. Col. Phra Saburdhan Aab.

The observations for horizontal force and dip are determinations uncorrected for daily variation of these elements. The dip shows a general tendency to diminish by about 2′ per year and the horizontal intensity to increase by about .00030 c. g. s. units, but as these observations cannot be reduced to mean daily values, and as the mean time of observation of dip is not the same as that of horizontal intensity, it is not possible to compute the total or vertical components, except approximately from the data at our disposal.

Nor is it possible on account of the paucity of stations and the small area covered by them to draw Isogonal and Isoclinic Lines for a map of Siam.

In February 1912, Dr. C. K. Edmunds, an observer from the Carnegie Institution of Washington, visited Siam and took observations at nine stations between the latitudes of 12°34′ and 17°56′. His observations yielded values for declination ranging from 24′E to 30′E, except at Lopburi, in latitude 14°48′, where he took five sets ranging from 40′.3 E to 42′.0 E. The discrepancy has not been explained, and it is interesting to compare the observations made by the Royal Survey Department at the same places in later years with those of Dr. Edmunds. The following are a few data:

Authority and year	Bangkok	Lopburi	Nagorn Sawarn (Paknampo)	Korat
Dr. Edmunds, 1912	28′.0 E (Sen Seb near Bangkok)	41′.2 E [Sta. A, E40′.7 (3) Sta. B, E42′.0 (2)]	26′.6 E	25′.8 E
Royal Survey Dept., 1916	11 .5 E	17 .3 E	6 .3 E	......
" " " 1917	9 .3 E	14 .4 E	2 .8 E	......
" " " 1918	5 .0 E	11 .7 E	1 .0 W	3 .6 E
" " " 1919	2 .6 E	8 .8 E	3 .7 W	3 .5 E
" " " 1920	2 .4 E	7 .5 E	4 .6 W	1 .5 E
" " " 1921	0 .7 W	3 .2 E	9 .5 W	3 .8 W
" " " 1922	3 .7 W	3 .0 E	9 .9 W	4 .3 W

An analysis of the above table shows that the average difference of declination between Bangkok and Lopburi from the observations of 1916-1922 is 5′.6, no single difference being greater than 6′.7, whereas the difference obtained by Dr. Edmunds was 13′.2. A similar result is found in the case of Korat, where the observations by the Royal Survey Department give a mean difference from those at Lopburi of 6′.7 compared to Dr. Edmunds' value of 15′.4.

The area in question requires investigation. As early as the year 1685, in the time of Louis XIV, magnetic observations were made in this district by the Jesuit fathers who accompanied the Chavalier de Chaumont, the first French Ambassador to the Court of Siam. The account of their astronomical and magnetic observations is to be found in two books of travels written by Père Tachard and published in 1686 and 1689.

These observers found the magnetic deviation at Louvo (Lopburi) by means of the "Astronomical ring of Monsieur Butterfield" to be 2°20′W, and by means of the "parallactic instrument of Sieur Chapotot" to be 16′W, 31′W, 35′W, and 38′W on four separate occasions. Later at another place near Lopburi the results with "the parallactic instrument" were 28′W, 33′W and 21′W, and by a small half circle 4°42′W.

There is a note later in the record that the value as obtained by the "large Astronomical ring" might require a deduction of 2° or 2°.5, as this difference had been observed between observations taken with it and with the mariner's compasses at the Cape on the voyage to Siam. The value of the declination at Lopburi in 1685-1686 may therefore be taken as approximately 30′W.

Again, these astronomers were informed of a magnetic mine to the northwest of Louvo, near a mountain called Khao Lem, and on visiting the neighborhood, their compasses registered variations of as much as 80°30′ E. and 50°30′ W. At Chainat, about 22.5 kilometers to the southwest of the mine, a deviation of 40° W was observed, and at various other positions in the district, both north and south of that mine, they observed deviations of 2° W, 4° W, 8° W, 10°W and 0°. This mine was visited in 1916 by Mr. P. R. Kemp, Superintendent of this Department, and two Siamese military officers and was found in the position described by Père Tachard, but when observations were taken at Muang Chainat and at Hnohng Bho (a village about 5 kilometers N. N. E. of the the mine) the magnetic declinations at these two places were found to be 3′.6 E and 0′.4 W. It would appear therefore that the observations of the fathers at Muang Chainat were in error. Iron ore is to be found outcropping over this area even to the east of Hnohng Bho, but this is the only spot where the local inhabitants know of its being magnetic. If opportunity offers, a closer magnetic survey of the district will be made.

It might be stated that hitherto the magnetic work of the department has been carried out mainly for survey purposes and that with the limited equipment and allocation at our disposal, immediate development cannot be looked for.

ROYAL SURVEY DEPARTMENT,
Bangkok, June 30, 1924. MINISTRY OF WAR.

ESTUDIOS DE MAGNETISMO TERRESTRE Y DE ELECTRICIDAD ATMOSFÉRICA EN ESPAÑA.

Sin tener en cuenta en este momento, por ser bien conocida, la contribución histórica aportada por España a los estudios de Magnetismo terrestre, que bien puede decirse tuvieron su origen en la Nación donde se reune la segunda Asamblea de nuestra Unión, y en ella encontraron la primer base de su desarrollo actual, nos limitamos por el momento a indicar los trabajos que recientemente se han efectuado en España, los que ahora mismo están en curso y los proyectados para el porvenir.

En 1841 se fundó en España el primer *Observatorio Magnético* por la Marina de Guerra, en la ciudad de *San Fernando* (Cadiz), instalándose los siguientes aparatos para la medida directa de los elementos magnéticos:

Un magnetómetro de variación; otro de fuerza horizontal y otro de fuerza vertical, todos ellos construidos por la casa Grubb.

En 1878 fueron substituidos estos instrumentos por otros más modernos construidos por la Casa Elliot, para medida de declinación e intensidad horizontal y por Dover para la medida de la inclinación. Con estos aparatos se empezaron observaciones regulares al año siguiente durante el cual comenzó tambien a funcionar un magnetógrafo registrador de Adie, habiéndose coleccionado los resultados. Con esta serie de instrumentos se han continuado las observaciones hasta el mes de abril de 1922 en que fueron reemplazados por otros del mismo tipo, pero de nuevo modelo.

En 1891 se empezó la publicación del resultado de las observaciones magnéticas (declinación, fuerza horizontal e inclinación) en los Anales que publica el Observatorio de la Marina de San Fernando, cuyo personal bajo la inmediata dirección e inspección de los sucesivos Subdirectores del establecimiento, ha venido haciendo las observaciones directas así como la traducción de las curvas de los magnetógrafos.

Desgraciadamente la instalación de una línea de tranvias eléctricos muy próximo al edificio del Observatorio ha venido a perturbar notablemente los trabajos que allí se hacen.

El *Observatorio Astrónomico de Madrid* comenzó el año 1879 a hacer diariamente observaciones de declinación, efectuando cada dia dos determinaciones a las horas correspondientes a los valores mínimo y máximo, y publicándose los resultados en los tomos correspondientes de los Anales de dicho Centro. El aparato empleado para las medidas de declinación fué un teodolito magnético de Brunner y para la inclinación un aparato del mismo autor, manejados ambos por el personal científico del Observatorio. Las observaciones de inclinación se suspendieron el año 1892 a consecuencia de una avería en el inclinómetro, y las de declinación continuaron hasta el año 1901 en que hubieron de suspenderse a consecuencia de las perturbaciones producidas por una línea de tracción eléctrica que se instaló en las proximidades del Observatorio.

En 1904 el P. Ricardo Cirera fundó el *Observatorio del Ebro en Tortosa*, dividiéndolo en tres secciones, solar, magnética y eléctrica. La Sección magnética fué provista de dos series de aparatos de variaciones de Mascart, cada uno de los cuales consta deun ifilar, bifilar y balanza magnética. Para las observaciones absolutas se emplea un magnetómetro Dover Kew Pattern y un inductor terrestre con su correspondiente galvanómetro, ambos según el modelo de Potsdam. Se efectuan periodicamente observaciones absolutas de declinación, componente horizontal e inclinación y se registran continuamente la declinación, componente horizontal y componente vertical.

En 1905 toma ya parte el Observatorio del Ebro en los trabajos internacionales efectuados en España para estudiar el problema de la influencia de los eclipses sobre el campo magnético terrestre. En Enero de 1910 empieza la publicación de su Boletín mensual en el que se consignan los resultados de todas las observaciones efectuadas durante el mes, y continua funcionando sin interrupción la Sección magnética, que por su excelente situación en terreno absolutamente libre de toda clase de influencias exteriores ha servido de base para la construcción del Mapa Magnético español.

Este Observatorio, declarado en España oficialmente de utilidad pública, es uno de los más completos y mejores del mundo estando clasificada su Sección magnética por el Dr. Schering como de primera clase. Actualmente está dirigido por el P. Luis Rodés, ocupándose especialmente de la Sección de Magnetismo el P. Ramón Sostres, auxiliado por el Hermano Carlos Ubach y el oficial Tomás Princep.

Entre las interesantes investigaciones llevadas a cabo por el Director de este Observatorio deben señalarse:

1. El promedio de las oscilaciones diurnas de todos los dias de calma desde la fundación del Observatorio; la curva obtenida se relaciona de una manera evidente con la de la actividad solar;

2. El promedio de las oscilaciones diurnas de todos los dias de calma y tempestad magnética registrados durante todos los años de vida del Observatorio;

3. Estadísticas de las tempestades y dias de calma registrados durante cada año, de las cuales se infiere la influencia de la posición de la tierra con respecto al Ecuador solar;

4. Investigación referente al problema de si el comienzo de una tempestad magnética de carácter brusco, es o no simultáneo en toda la tierra. Para continuar esta labor, cuyos resultados preliminares se han publicado en el "Terrestrial Magnetism" de Diciembre de 1922, e Observatorio del Ebro se ofrece como Centro para recibir y coordinar los datos de los demás observatorios;

5. En un terreno algo distinto, pero afin al del Magnetismo terrestre, este Observatorio ha estudiado, en más de 3,000 placas, la acción moderadora que ejerce nuestro planeta sobre las manchas solares habiéndose publicado los resultados por la Asociación Española para el Progreso de las Ciencias.

Actualmente el Gobierno español tiene el propósito de construir en *Alcalá de Henares un observatorio Magnético central*, con aparatos muy modernos que está terminando de construir la casa Bamberg de Berlín, bajo los auspicios del Prof. Adolfo Schmidt, que ha tenido la bondad de proyectar especialmente para dicho observatorio tales aparatos. Es propósito del Instituto Geográfico español que la instalación quede terminada muy proximamente, y será una de las más completas, ya que se compondrá de dos variometros registradores de la declinación, dos de la componente horizontal y dos de la componente vertical, un aparato especial para observación de las oscilaciones, uno para la determinación galvánica de la sensibilidad, un teodolito magnético normal y un inductor terrestre, estos para las medidas de los valores absolutos.

Es propósito asimismo del Instituto Geográfico español el montar inmediatamente en el *Observatorio del Teide* (*Islas Canarias*) una Sección magnética cuyos aparatos ya adquiridos están preparados para su montaje y son los siguientes: Un variómetro horizontal para la declinación, otro para la componente horizontal y otro vertical para la medida de esta componente, un aparato registrador, y un equipaje magnético, con inductor terrestre, para las medidas absolutas. La situación especial de este Observatorio en la Costa occidental de Africa y muy próximo al Ecuador magnético, hacen fácilmente comprender su gran importancia.

En lo que se refiere a observaciones de campo, las primeras efectuadas en España fueron hechas por el Dr. Lamont, quien con ocasión de la expedición científica que llevó a cabo en 1857 por la Europa Central, hizo 28 estaciones distribuidas por la Península, que han constituido una excelente base para el estudio de la variación secular.

En 1887 vino a España M. Th. Moureaux, quien encargado por el Gobierno francés de publicar el Mapa magnético del Mediterráneo occidental, hizo observaciones en diversos puntos de la costa española mediterránea desde Barcelona a San Fernando.

La Marina de Guerra española hizo tambien una serie de medidas de la declinación en las costas españolas utilizando un teodolito magnético de Brunner y un magnetómetro de Lamont, efectuando numerosas observaciones en la Costa española mediterránea de 1877 a 1885, en las islas Baleares de 1890 a 1896, en la costa cantábrica de 1898 a 1902, y en las gallegas de 1904 a 1915.

El *Instituto Geográfico español* empezó en 1905 a planear la construcción del *mapa magnético de España,* cuyos trabajos de observación comenzaron en 1912 con dos equipajes magnéticos de campaña modelo Eschenhagen, modificado por Tesdorpf y construidos por Sartorius, sirviendo de base el Observatorio del Ebro y siendo los observadores los Sres. Azpiazu, Gil y Fort, del Servicio Magnético español.

Se hicieron medidas de declinación, inclinación y componente horizontal de la fuerza en 286 estaciones distribuidas por todo el territorio español, y en la actualidad están terminados los cálculos correspondientes y en periodo de publicación el mapa, que se dividirá en cinco partes, una correspondiente a la declinación y las otras a la componente horizontal, componente vertical e intensidad total. Muy próximamente el Instituto Geográfico tendrá el honor de remitir a todos los interesados en estos trabajos, ejemplares de estos mapas, a los cuales acompañará una Memoria en que se haga constar las particularidades de la observación y cálculo.

Se proyecta conservar este mapa haciendo observaciones periódicas de variación secular en 50 estaciones principales convenientemente distribuidas, que han de quedar forzosamente repetidas cada periodo de 10 años.

Para el estudio de las anomalias y perturbaciones locales el Instituto Geográfico ha adquirido los novisimos variómetros del Prof. Schmidt, Director del Observatorio de Potsdam, con los que en breve se empezará el estudio de la distribución de las componentes horizontal y vertical en las zonas perturbadas, tan minuciosamente como la naturaleza de la pertubación lo requiera.

Tambien ha adquirido el Instituto Geográfico un inductor terrestre para medidas en el campo de la inclinación, absolutamente original puesto que ha sido calculado y construido expresamente para poder montarse en la base común del equipaje Eschenhagen, y provisto de un galvanómetro de magneto fija e hilo móvil que facilita las observaciones al aire libre constituyendo asimismo una aplicación original.

Para contribuir a los trabajos de *comparación de instrumentos* de los diversos Observatorios europeos España dispuso que los observadores Sres. Azpiazu y Gil provistos de sus equipajes de campaña, hiciesen la comparación partiendo de Tortosa (Observatorio del Ebro) y estacionando en Val Joyeux (Francia) Kew (Inglaterra) Uccle (Bélgica), De Bilt (Holanda) Potsdam (Alemania), Rude Skov (Dinamarca), Swider (Polonia, Pola (Italia) y Coimbra (Portugal) para cerrar el ciclo con una nueva observación en el del Ebro. Están terminados todos los trabajos de observación y pendiente el cálculo del envío de datos que faltan y se han solicitado de alguno de los observatorios citados. Muy próximamente se esperan estos datos y en seguida se terminarán los cálculos y se publicarán los resultados de esta importante investigación.

Esta es la contribución pasada, presente y futura de España al estudio del Magnetismo terrestre, que tanta atención debe merecer a todos que podrán ver que la nación donde se ha reunido la segunda Asamblea de la Unión, hace cuanto le es posible en favor de esta importante rama de la Geofísica.

En lo que se refiere a investigaciones sobre *electricidad atmosférica y corrientes telúricas*, podemos citar las efectuadas en el *Observatorio del Ebro*, cuyo elogio ha sido hecho por el ilustre Dr. Bauer en el "Terrestrial Magnetism."

Para el estudio de la electricidad atmosférica posee el Observatorio del Ebro los siguientes instrumentos: aparato de Elster y Geitel; Lámpara de Exner, colector de llama para las observaciones absolutas; colector de Lord Kelvin de vena líquida para el registrador; dos electómetros de diferente sensibilidad del tipo Thomson modificado por Mascart.

Para el de las *corrientes telúricas* cuenta con una instalación de dos líneas aereas en las direcciones N-S y E-W de 1280 metros la primera y 1415 la segunda; dos galvanómetros con sus correspondientes shunts del tipo Despretz d'Arsonval y un puente inversal de Kohlrausch y microamperímetro de precisión, ambos construidos por la firma Hartmann y Braun de Frankfurt.

Con este instrumental el Observatorio del Ebro verifica los siguientes trabajos: Observaciones para determinar el coeficiente de dispersión eléctrica del aire, su conductibilidad y la corriente vertical; observaciones a un metro sobre el suelo del potencial atmosférico; registro del mismo en un pabellón; registro continuo de la diferencia de potencial de dos puntos situados en cada uno de los extremos de las dos líneas aereas antes citadas.

Los resultados de estas observaciones son publicados periodicamente por el Observatorio del Ebro.

En el plan del *futuro observatorio de Alcalá de Henares* figura tambien, como intimamente ligado con el magnetismo, el montaje de una instalación para el estudio de la electricidad atmosférica y otra para el de las corrientes telúricas, ya que el terreno elegido se presta admirablemente para estas investigaciones.

UBALDO DE AZPIAZU.

MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES EN SUÈDE.

Le Plan d'un levé magnétique détaillé de la Suède, répondant aux exigences de la science moderne, est actuellement discuté par le Comité National suédois de Géodésie et Géophysique. En 1919, le feu professeur Ekholm et moi, furent chargés par le Gouvernement, d'élaborer un plan pour l'organisation des travaux magnétiques en Suède. La densité des stations, dans ce plan, est d'une station sur 340 km², ou distance moyenne des stations, 18 km, ce qui comporterait 1300 stations pour toute la Suède. On choisira, en outre, certaines stations de référence, et l'étude des stations de ce réseau sera suivie périodiquement, pour tenir compte des variations séculaires.

Le *nouveau réseau magnétique de Suède* doit comprendre un nombre aussi grand que possible des mesures anciennes. Parmi celles-ci il faut citer, en première ligne, celles faites par A. J. Ångström. Ce sont les premières observations magnétiques en Suède faites d'après un plan d'ensemble. Ces observations, faites depuis l'année 1844 jusqu'en 1860, ont porté sur la déclinaison, la composante horizontale, et l'inclinaison. Elles comprennent une centaine de stations, dans toutes les parties de la Suède, sauf la Laponie, depuis Kengis, au Nord, à 67°11′ de latitude, jusqu'à Malmö, au Sud, à 55°36′ de latitude. Les observations d'Ångström n'ont jamais été publiées; l'auteur du présent Rapport a entrepris de les calculer.

Il convient donc de tirer parti des observations anciennes, qui comprennent plusieurs centaines de stations. On suppose alors que la variation séculaire des éléments magnétiques n'est pas sujette à des variations locales de même espèce que celles qui affectent leurs valeurs absolues. On a dû s'assurer qu'il en était ainsi. Dans mon Mémoire sur le Magnétisme Terrestre dans la Suède méridionale, publié dans le Tome XXVII des Mémoires de l'Académie de Stockholm, je me suis occupé de cette question. Toutes les anciennes observations faites en Suède depuis le XIXe siècle ont été ramenées à une date commune, en recourant à des formules empiriques

$$H = a_0 + a_1\tau + a_2\tau^2,$$
$$D = a_0 + a_1\tau + a_2\tau^2 + a_3\tau^3 + a_4\tau^4,$$
$$I = a_0 + a_1\tau + a_2\tau^2 + a_3\tau^3,$$

les a_1 étant des fonctions linéaires de la latitude et de la longitude du lieu. Ces formules représentent très bien les observations faites en Suède. Les valeurs des éléments magnétiques qu'on en déduit, pour les séries d'observations différentes, ont été comparées ensuite entre elles. Il en résulte que, chaque fois qu'il a été possible de retrouver, pour mes observations, exactement les points où avaient observé mes devanciers, la variation observée ne diffère de la variation théorique, que d'une faible quantité, imputable aux erreurs d'observation, ou à l'incertitude qui affecte la réduction pour la variation diurne. C'est ainsi que j'ai comparé les observations de Lundquist en 1869 et celles de Thalén en 1870 et 1872, avec les miennes, de 1886 et 1892. Pour la déclinaison, il en est de même; on a eu recours aux observations faites au lac Venern par l'auteur en 1892, comparées avec celles faites par le Bureau de météorologie nautique 24 ans plus tard. Ici encore, les influences locales subies par la variation séculaire sont insensibles. On peut donc tirer parti, pour la construction des cartes magnétiques, d'observations faites à des époques différentes, ramenées à une époque commune à l'aide de formules empiriques.

Depuis le 24 mars 1922, le Service Hydrographique de la Marine a été chargé de faire des observations magnétiques, principalement de nos côtes et des voies navigables à l'intérieur. Le Service Hydrographique poursuit ces recherches, et en publie les résultats. Le 3e fascicule de ce Receuil, contenant les observations faites dans le Sud-Est de la Suède, en 1914, 1915, 1917 et 1922, vient de paraître.

La Suède ne possède aucun observatoire magnétique avec instruments enregistreurs. Or, dans le Nord de la Laponie, un observatoire magnétique temporaire a été établi depuis le 1er juillet 1921, à la station géophysique et biologique d'Abisko, pour prendre part aux travaux internationaux, en collaboration avec l'expédition polaire d'Amundsen. Cet observatoire est muni de variomètres enregistreurs, de Toepfer, à Potsdam, appartenant à l'Institution de Physique de l'Académie des sciences de Stockholm, et qui avaient déjà servi, avec trois autres séries d'appareils semblables, aux observations pendant l'éclipse totale de Soleil en 1914. La sensibilité des appareils a été réglée de manière à ce que, même pendant des perturbations très fortes, l'image ne sortira pas de l'échelle. Une déviation de 1 mm correspond à une variation de 10γ, dans les composantes horizontale et verticale, et à 1.′5 dans la déclinaison. Voici la position géographique de l'observatoire: Latitude: 68°49′ N.; Longitude: 18°49′ E. de Greenwich. Les valeurs des éléments magnétiques ont été déterminées le 28 juin 1921; on a trouvé: déclinaison, 3°52′ W.; composante horizontale, 0. 1230 unités C. G. S.; inclinaison, 76°01′.

Pour étudier les *aurores boréales* à l'aide de la méthode photogrammétrique, une station secondaire a été établie à Kiruna, à environ 70 km de distance dans la direction du Sud-Est. En 1922, on a obtenu 240 photographies parallactiques de l'aurore boréale. Cependant, les aurores boréales étaient très rares pendant l'automne de 1922, et les essais n'ont pas eu beaucoup de succès.

En ce qui concerne *l'électricité atmosphérique*, il n'y a, en Suède, aucun observatoire faisant des observations systématiques, bien que, temporairement, le gradient du potentiel, la conductibilité, le nombre et la mobilité des ions, aient été enregistrés, comme à Abisko, en 1911, et pendant l'éclipse totale de Soleil de 1914, à Strömsund, Åvike, Haparanda, Fiskebäckskil, Upsala. L'Administration en Suède entreprit, en 1918, des recherches systématiques du champ électrique terrestre pendant les orages. L'Administration des Télégraphes a organisé un réseau de *courants telluriques* en Suède. M. Pleijel, le savant recteur de l'École polytechnique de Stockholm, prépare un Rapport sur les travaux Suédois concernant l'électricité terrestre, avec, une étude critique des meilleures méthodes d'observer l'électricité terrestre et les courants telluriques. V. CARLHEIM-GYLLENSKÖLD.

MAGNETIC SURVEY WORK BY THE HYDROGRAPHIC SERVICE OF SWEDEN.

The following papers have been published pertaining to land magnetic surveys:

1. Observations of *D* on the island of Gotland in 1919 (by Ljungdahl).
2. Observations of *D* at Vänern in 1914, 1916 and 1917 (by Ljungdahl).
3. Observations of *D* in 1917 and of *D*, *I* and *H* in 1922 in Southern Sweden (by Ljungdahl), and Observations of *D* in 1914-1915 in Blekinge (by Odelsiö).

During the summer 1923 *D*, *I* and *H* were determined at 55 stations in Southern Sweden.

The material of observation of the old Nautisk-Meteorologiska Byrån comprises observations of *D* at some 700 stations, of *I* at 150, and of *H* at about 200 stations, distributed along the Swedish coast. A certain number of these observations will probably be published. GUSTAF REINIUS,

Stockholm, May 17, 1924. *Director, Kungl. Sjökarteverket.*

MAGNETIC SURVEY WORK IN THE UNITED KINGDOM (GREAT BRITAIN AND IRELAND).

The magnetic survey work in Great Britain and Ireland will in the future be conducted by the Ordnance Survey, of which Col. Jack is now the director.

Regarding comparisons of magnetic instruments and the work at magnetic observatories, see Dr. Chree's reports, pp. 111 and 133.

MAGNETIC SURVEY WORK OF THE UNITED STATES COAST AND GEODETIC SURVEY.

As reported to the Rome Meeting,[1] a general magnetic survey of the continental part of the United States has been practically completed and many observations have been made in the outlying possessions and adjacent waters. Additional stations have been occupied in a number of localities where local disturbances in excess of one degree in declination were indicated, with a view to determine the extent of the disturbed area. A sufficient number of repeat stations have been occupied at intervals of about five years to determine the secular change of the magnetic elements over the whole country and make it possible to reduce the results of the magnetic survey to any desired epoch.

Since January 1922, the work has been devoted largely to the occupation of the needed repeat stations and the replacement of old stations which have become no longer suitable for the use of local surveyors. In many parts of the United States the compass is still in use as a surveying instrument, particularly in the retracing of lines of old surveys run originally by compass. It is important therefore to provide the local surveyor with a marked station at which the magnetic declination and true meridian are known, so that he can standardize his instrument from time to time.

During the past two years a systematic effort to find out from the local surveyor the present condition of the magnetic stations in his county has brought out the fact that many of them have disappeared, and numerous requests for replacement have been received. It has not been possible to keep pace with these requests so attention has been given first to the states of California, Florida, Georgia, North Carolina, Tennessee and Texas, in each of which the work has been state wide.

Twenty-five years ago this Bureau, in cooperation with the State authorities, made a magnetic survey of the State of North Carolina, and established a meridian line at every county seat, so that the local surveyor could conform to the state law requiring him to test his compass at regular intervals. As a result of further co-operation there is now in progress a resurvey which will involve the inspection of every old station and the replacement of those found defective.

For the greater convenience of the local surveyor, a beginning has been made in publishing separately for each state the available data regarding the magnetic declination in that state, including tables showing the change of declination at each county seat from the time of the earliest observations to the date of publication, an isogonic chart for that date, and descriptions of the stations at which observations have been made. Such publications have already been issued for Arkansas and Florida.

In California a detailed declination survey was made along a

[1]See Bull. No. 3, pp. 47-49.

part of the Coast where the general survey had indicated some local disturbance, to make sure that these disturbances are adequately represented on the isogonic chart. It is planned to extend this work to other parts of the coast as opportunity offers. Special observations were made at Lompoc, Calif., at the time of the solar eclipse of September 10, 1923.

During the summer of 1922, an investigation was undertaken near Birmingham, Alabama, to determine whether deposits of non-magnetic iron ore could be detected by means of magnetic observations. A loaded dip needle was used. The results failed to show any definite relation between the iron ore deposits and the observed small variations in dip.

In Alaska declination observations were made at a large number of triangulation stations along the southern and southeastern shores of the territory which developed in more detail the areas of local disturbance known to exist. Observations on board some of the ships served to extend the development over the adjacent water areas. In 1922 an officer of the Bureau accompanied the Coast Guard steamer *Bear* into the Arctic Ocean and made complete observations at several places on the shores of Bering Sea and the Arctic Ocean, a region where no observations had been made for many years.

An observer is under instructions to make observations at repeat stations in the Hawaiian and Philippine Islands during 1924 and 1925.

The use of a small motor truck for the transportation of the observer and his outfit has resulted in a material decrease in cost and increase in rate of progress in field work, particularly where successive stations are not very far apart.

During the past two years an earth inductor of the type designed by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington has been used in the field with very satisfactory results and it is planned to substitute instruments of that type for dip circles as rapidly as possible. The magnetometers of the Coast and Geodetic Survey pattern have been improved by the substitution of better theodolites and the placing of the scale in the reading telescope instead of in the magnet. One has been equipped with a small electric light for illuminating the scale on dark days.

The field instruments are standardized at the Cheltenham Observatory at the beginning and end of each field season.

The results of field observations made in 1922 were published as Serial No. 235, those for 1923 as Serial No. 268. Special Publication No. 90, "Magnetic Declination in the United States for January 1920," contains an isogonic chart of the country for 1920, and tables showing the change of the magnetic declination in all parts of the country since the earliest observations. Special Publication No. 96, "Instructions for the Compensation of the Magnetic Compass," gives the rules for making the compensation in practice and explains the underlying principles on which the rules are based. It is intended primarily for the use of the officers of the Coast and Geodetic Survey, but will be found useful by other navigators.

UNITED STATES COAST AND GEODETIC SURVEY.

Washington, D. C.

WORLD MAGNETIC SURVEY[1]

Since the report presented in May 1922 at the Rome Meeting[2] there has been great activity in magnetic surveys all over the globe. Plans have been reported for magnetic resurveys and extension of magnetic surveys in various European countries and in Argentina, Brazil, Mexico, New Zealand, South Australia, Soviet Russia, Siberia, and Turkestan. A considerable amount of magnetic-survey work was accomplished, through the cooperation of the Department of Terrestrial Magnetism in the loaning of instruments, also by the Canadian Government through its Dominion Observatory and its Meteorological Service at a large number of stations in high northern latitudes and within the Arctic circle, regions where additional magnetic data are greatly needed for the analysis of the Earth's magnetic field. Other cooperative work in Arctic regions is outlined below. It is a pleasure to acknowledge the stimulus afforded by the continued cordial and valuable aid received from magnetic institutions everywhere, as well as from government officials and diplomatic representatives of the countries visited by the observers of the Department of Terrestrial Magnetism.

LAND WORK.

The land magnetic work of the Department during the past two years has been mainly concerned with the problem of secular variation, and with obtaining at the same time additional data regarding diurnal variation of all three elements at places remote from observatories. During 1922 to 1923 the observers were at work in Australia and the southwest Pacific, in the basin of the Amazon River in South America, and in the Bahamas and the West Indies. The South American party continued throughout 1924 to the present in Brazil, Peru, and Ecuador. An observer of the Department accompanied the MacMillan North Greenland Expedition, which spent the winter of 1923-1924 on the west coast of Greenland, and cooperative relations were maintained with Captain Amundsen's *Maud* Arctic-drift Expedition north of eastern Siberia, the Liberian Boundary Survey, and the South Australian Observatory. During June to August 1924 one party occupied stations in western and northwestern

[1]From the reports on the work of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, January, 1, 1922 to June 30, 1924.

[2]See Bull. No. 3, pp. 50-56.

Mexico, and beginning in June 1924 a second party began extensive secular-variation work in Mexico and South America.

The distribution of localities at which observations have been made more than once by the Department is shown on the submitted chart. This chart is divided into various areas to show the distribution of the work, and the number of C.I.W. repeat localities are indicated in each. On the ocean areas both the island localities and the number of intersections of the tracks of the *Galilee* and of the *Carnegie*, from which the annual changes have been deduced, are shown. Many of the repeat localities, counted but once, were visited more than once so that the actual number of reoccupations exceeds the number of repeat localities. The number of stations occupied also greatly exceeds the number of localities, since it is the practice to establish more than one station in each locality to avoid the danger of choosing a station not representative of the distribution within the region, and for the purpose of assuring, as far as possible, the continuity of the secular-variation series.

For each half-decade of the Department's work, the number of reoccupations and the ratio of such reoccupations to the whole number of localities where observations were made may be summarized as follows:

1905–1909	1910–1914	1915–1919	1920–1924
55	141	156	327
0.05	0.10	0.15	0.50

The ratios would be considerably larger if there be included also those stations which were reoccupations of places where observations had been made previously by other organizations. To mention only the stations most recently reoccupied these were in the East Indies, New Zealand, Mexico, Brazil, and Argentina.

Beginning in 1922 the Department's program at land stations has included observations for diurnal variation of all three elements at selected stations, designated "Class I" stations, using for the purpose the ordinary field magnetometer and earth inductor, usually the combined C.I.W. magnetometer-inductor. Localities for Class I stations are chosen so that together with the existing observatories they may form a net with approximately 500-mile intervals. Such a system has been planned for Mexico, Central America, and South America, and observations have been secured at most of the points. A beginning has been made in Australia, and at scattered points elsewhere. The results so far amply justify the plan, though there is room for improvement. This will come with increased experience of the observers, and ultimately with the development of instruments better adapted to that particular form of land work.

Between January 1, 1922, and June 30, 1924, a total of 532 magnetic stations were occupied, making a grand total of 4,781 C. I. W.

stations established on land during 1905 to June 30, 1924. The distribution of the new land stations during 1922-1924 and of the total number of land stations during the twenty years ending June 30, 1924, in each geographical division was respectively as follows: Africa, 9 and 1,074; Asia, 27 and 837; Australasia, 89 and 715; Europe, 17 and 113; North America 87 and 584; South America, 126 and 825; islands of the Atlantic ocean, 143[1] and 246; islands of the Indian ocean, 1 and 115; islands of the Pacific ocean, 33 and 242; Antarctic regions, 0 and 30.

The tabulations and manuscript covering the land results obtained by the expeditions of the Carnegie Institution of Washington during 1921-1923 are completed and will be published as a volume of the "Researches of the Department of Terrestrial Magnetism." The general methods followed, both for the observational and computational work, are those described in volumes I, II, and IV of the "Researches." Detailed particulars regarding instrumental equipments are also given in these volumes.

OCEAN WORK.

The *Carnegie* has been out of commission since the completion of Cruise VI in November 1921. The opportunity has been taken to complete the final computations and summaries of ocean magnetic results from 1915 to 1921 and the accompanying manuscripts to be published in Volume V of "Researches of the Department of Terrestrial Magnetism." In order that all observations made on the *Carnegie* during the period 1915 to 1921 might be included in the same volume, the publication of this volume was delayed pending the final revision of the extensive ocean atmospheric-electric and associate meteorological observations.[1] The final determinations and reductions were made for the constants and corrections of the atmospheric-electric instruments used on board the *Carnegie* during cruises IV, V, and VI. Certain theoretical considerations that had arisen in the preliminary reductions of the work made necessary extended experimental observation to determine the best methods and safeguards for eliminating errors of capacities and other fundamental quantities not only for the work done at sea, but also for field and observatory procedure and methods. There were incorporated in the final tabulations, results of recomputations for the electric observations already published in Volume III for Cruise IV (1915-1916) on the basis of the new and improved constants.

The magnetic work accomplished by the *Galilee* on her three cruises and by the *Carnegie* on her six cruises is given in detail on pages 53 to 54 of "Transactions of the Rome Meeting, May 1922" (Bulletin No. 3). The atmospheric-electric tabulations

[1]Of which 9 were primary stations and 64 were stations at which the three elements were determined in connection with the investigation of the magnetic anomaly in the Bermudas.

[1]It is expected that the volume will be issued by the Carnegie Institution of Washington at the close of 1925.

showing geographic positions, dates, local mean times, values of potential gradient, negative and positive ionic content, conductivity, and ionic mobility, penetrating radiation, radioactive content, and accompanying detailed meteorological data for cruises IV, V, and VI from March 1915 to November 1921 may be summarized as regards stations at which one or more elements were observed and as regards diurnal-variation series for one or more elements as follows: Atlantic ocean, 224 and 11; Pacific ocean, 537 and 61; Indian ocean, 118 and 10; and Southern ocean, 76 and 14. The total number of stations was 955, and there were 96 diurnal-variation series extending over four hours or more.

The reductions and analyses of the ocean data, necessary in the preparation of the volume referred to above, emphasize that, in order to reap the full benefit from the work already accomplished at sea, plans should be considered to resume soon the ocean surveys of the *Carnegie*, and thus to take advantage of the remaining useful life of a vessel specially adapted for magnetic and electric surveys at sea. While more information concerning the secular variation of the Earth's magnetism is required for navigation, yet future ocean magnetic work is far more necessary for the advancement of theoretical studies. Similarly a discussion of the ocean electric results shows the urgent need for the comprehensive study of the Earth's electric field of additional widely distributed electric data. A point of first importance in considering the continuation of the ocean survey by the *Carnegie* is that of the resulting enhanced theoretical value of the work already accomplished. It is therefore to be hoped that in the near future means may be provided to continue cruises of the Carnegie for observations and studies of the magnetic and electric conditions over the oceans.

SPECIAL WORK.

As opportunity offered, the problem of determining effects of change in the magnetic elements with change in altitude was considered and some time was given to the study of conditions under which upper-air investigations must be made, of the possibility of obtaining absolute measures of requisite accuracy, and of possible information that might be derived from a study of relative differences in the variations as determined simultaneously through continuous registrations at stations differing greatly in elevation, but at relatively small distances apart. The establishment of one or two temporary magnetic and electric observatories at sea-level, for example, one near Lima and another in the Amazon country, in connection with the Huancayo Magnetic Observatory in Peru, seems a promising method of gathering data for the problem.

Extensive special magnetic and electric observations were made by the Department and, in accordance with its program of observation, by many cooperating observatories and organizations during the total solar eclipses of September 21, 1922, and of September 10, 1923.

PUBLICATIONS.

The publications of the Department of Terrestrial Magnetism may be classified under three heads: (*A*) Annual or progress reports; (*B*) special reports and scienti c journals; and (*C*) "Researches of the Department of Terrestrial Magnetism," published by the Carnegie Institution of Washington, of which 4 volumes have thus far been issued.

Since the Rome meeting the "Annual Report of the Director" has been published in the "Year Book of the Carnegie Institution of Washington" for the years ending with October in 1922 and in 1923, while the report covering the period November 1923 to June 1924 is now in press. Nearly 100 miscellaneous papers by members of the Department have been published in journals and proceedings of learned societies during 1922 to date. Some of these papers are:

Bauer, L. A. Chief results of a preliminary analysis of the Earth's magnetic field for 1922. No. I: Zonal harmonics and uniform magnetic field. Terr. Mag., vol. 28, 1-28 (Mar.-June 1923).

————. Regarding measures of magnetic characterization of days. Terr. Mag., vol. 28, 41-44 (Mar.-June 1923).

————. Some physical aspects of a recent analysis of the Earth's magnetic field. Science, n. s., vol. 58, 113-115 (Aug. 17, 1923).

————. The Earth's magnetic field for 1922. Nature, vol. 112, 295-298 (Aug. 25, 1923).

Gish, O. H. A general description of the earth-current measuring system at the Watheroo Magnetic Observatory. Terr. Mag., vol. 28, 89-108 (Sept. 1923).

Mauchly, S. J. On the diurnal variation of the potential-gradient of atmospheric electricity, Terr. Mag., vol. 26, 61-81 (Sept. 1923).

Peters, W. J. Results from magnetic east-west paths around the earth. Terr. Mag., vol. 28, 83-88 (Sept. 1923).

Ault, J. P. Report on magnetic observations by the Carnegie Institution of Washington, during the total solar eclipse of September 10, 1923. Terr. Mag., vol. 29, 1-12 (Mar. 1924).

Bauer, L. A. Relations between the diurnal and annual variations of earth currents, terrestrial magnetism, and atmospheric electricity. Terr. Mag., vol. 28, 129-140 (Dec. 1923).

————. Correlations between solar activity and atmospheric electricity. Terr. Mag., vol. 29, 23-32 (Mar. 1924).

————. Correlations between solar activity and atmospheric electricity. —Concluded. Terr. Mag., vol. 29, 161-186 (Dec. 1924).

Duvall, C. R., and C. C. Ennis. Note on a graphical method of computing diurnal variations by differential formula. Terr. Mag., vol. 29, 121-123 (Sept. 1924).

Fisk, H. W. Preliminary lines of equal annual change of the magnetic elements in 1915, for Latin America and adjacent waters. Terr. Mag., vol. 29, 139-148 (Dec. 1924).

Fleming, J. A. Latest annual values of the magnetic elements at observatories. Terr. Mag., vol. 27, 157-160 (Dec. 1922).

LOUIS A. BAUER, *Director*,
J. A. FLEMING, *Assistant Director*.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
September 10, 1924.

MAGNETIC INSTRUMENTS, CONSTANTS, AND COMPARISONS[1]

VALEURS DES DIFFÉRENCES SYSTÉMATIQUES ENTRE LES RESULTATS OBTENUS ENTRE LES INSTRUMENTS DE LA CARNEGIE INSTITUTION ET CEUX DE LA STATION MAGNETÍQUE DE VASSOURAS (BRÉSIL), SUCCURSALE DE L'OBSERVATOIRE NATIONAL DE RIO DE JANEIRO.

M. J. W. Green, observateur envoyé par la "Carnegie Institution" pour déterminer les différences constantes existant entre les résultats obtenus à l'aide des instruments employés à Vassouras et ceux de l'Institution Carnegie, a été, en compagnie de M. Gualter de Macedo Soares, Assistant de l'Observatoire de Rio, le 30 Juin, ainsi que le 1er et le 2 Juillet 1923, à Vassouras, où des observations comparatives simultanées, ont été realisées. Les divergences entre les valeurs de la déclinaison obtenues par les deux observateurs ayant paru excessives, M. Gualter de Macedo Soares, est retourné à Vassouras, après le départ de M. Green, afin de rechercher l'explication de ces divergences. De nouvelles observations ayant été exécutées sur les deux piliers *A* et *B*, et ayant fourni des différences de l'ordre de celles entre les valeurs obtenues antérieurement par MM. Green et Macedo Soares, il a paru que la cause des divergences était à rechercher dans l'azimut de la mire vue du pilier *B*. M. Macedo Soares entreprit alors une longue série d'observations de la mire, vue successivement des piliers *A* et *B*, en tenant compte de la distance *AB*, ainsi que de son azimut. La conclusion a été que l'azimut de la mire vue du pilier était réellement erroné, et que sa valeur réelle était de 148°04′07″.1, au lieu de 148°05′44″ (valeur erronée), différence 1′.6. La cause de cette divergence provient de ce que la plaque de marbre coiffant le pilier *B*, s'est déplacée, quelque temps après le séjour à Vassouras de M. Sterling, les données antérieures étant justes, par conséquent.

MESURES ABSOLUES.

Déclinaison.—Les observations faites sur le pilier *B*, entre le 30 Juin et le 2 Juillet ont dû être recalculées avec le nouvel azimut de la mire, et le nouveau résultat est très satisfaisant, comme on va voir. Quelques petites erreurs dans les calculs ont été trouvées et corrigées et les déclinaisons déterminées avec le Magnétomètre Cooke Vassouras, et le Magnétomètre 25 C.I.W., sont devenues:

[1]For Report of Chairman of Committee on Magnetic Surveys and International Comparisons of Instruments, see pp. 51-53. Some additional reports on comparisons of magnetic instruments will appear in a later bulletin.

Magn. Cooke 25 sur le pilier *A*	Magn. C. I. W. 25 sur le pilier *B*	Différences (Cooke 25 – C. I. W. 25)
° ′	° ′	′
–11 44.4	–11 43.7	–0.7
42.6	42.9	+0.3
43.0	44.3	+1.3
45.3	45.0	–0.3
42.9	43.3	+0.4
42.9	43.2	+0.3
Moyenne—11 43.52	Moyenne —11 43.73	

Magn. Cooke 25 sur le pilier *B*	Magn. C. I. W. 25 sur le pilier *A*	Différences (Cooke 25 – C. I. W. 25)
° ′	° ′	′
–11 44.6	–11 43.8	–0.8
45.2	44.4	–0.8
42.7	41.8	–0.9
42.5	41.5	–1.0
42.1	42.0	–0.1
45.6	46.8	+1.2
Moyenne —11 43.78	Moyenne –11 43.38	

Moyenne générale de la déclinaison: Sur le pilier *A*, –11° 43′.45; sur le pilier *B*, –11° 43′.76; difference (*A* – *B*), +0′.31.

Moyenne générale de la déclinaison:	° ′
Avec le Magnétomètre Cooke 25..........	–11 43.65
" " " C. I. W. 25........	–11 43.56
Différence (Cooke 25—C. I. W. 25).......	–0.09

(I. M. S. – C. I. W. 25)=–0′.3;∴ (I. M. S. – Cooke 25)=–0′.2 valeur finale, inférieure aux erreurs d'observation avec les instruments employés.

Composante Horizontale.—L'erreur commise sur l'azimut de la mire, vue du pilier *B*, n'intervient pas sur la valeur de la composante horizontale. Néanmoins les calculs ont été refaits, et donnent les résultats suivants:

Magn. Cooke 25 sur le pilier *A*	Magn. C. I. W. 25 sur le pilier *B*	Différences (Cooke 25 – C. I. W. 25)
γ	γ	γ
24365	24303	+62
354	300	+54
340	282	+58
317	279	+38
397	335	+62
393	350	+43
Moyenne 24361	Moyenne 24308	

Magn. Cooke 25 sur le pilier *B*	Magn. C. I. W. 25 sur le pilier *A*	Différences (Cooke 25 – C. I. W. 25)
γ	γ	γ
24413	24331	+82
401	328	+73
412	330	+82
404	329	+75
391	329	+62
397	334	+63
Moyenne 24403	Moyenne 24330	

Moyenne générale de la composante horizontale: Sur le pilier *A*, 24345γ; sur le pilier *B*, 24355γ; différence (*A* – *B*), –10γ.

Moyenne générale de la composante horizontale:
Avec le Magnétomètre Cooke 25 . . . . 24382γ
" " " C. I. W. 25 . . . . 24319γ

Différence (Cooke 25 − C. I. W. 25) . . . . +63γ
(I. M. S. − C. I. W. 25) = −7.3γ; ∴(I. M. S. − Cooke 25) = −70.3γ = −0.00288*H*.

Inclinaison.—L'inclinaison définitive, faite par M. Macedo Soares, sur l'inclinomètre 221 avec les aiguilles neuves No. 5 et 6, et pour le cas de M. Green avec un inducteur terrestre C.I.W. 25 a donné les résultats suivants:

Inclinomètre 221 sur le pilier *C*		Inducteur terrestre C. I. W. 25 sur le pilier *B*		Différences (221 − C. I. W. 25)
°	′	°	′	′
−15	51.9	−15	54.3	+2.4
	47.8		54.5	+6.7
	54.0		54.8	+0.8
	52.8		54.8	+2.0
	55.1		55.1	0.0
	49.8		55.4	+5.6
Moyenne −15	51.90	Moyenne −15	54.82	

Inclinomètre 221 sur le pilier *B*		Inducteur terrestre C. I. W. 25 sur le pilier *C*		Différences (221—C. I. W. 25)
°	′	°	′	′
−15	53.0	−15	56.8	+3.8
	52.1		56.9	+4.8
	50.9		56.1	+5.2
	50.6		56.6	+6.0
	55.0		56.7	+1.7
	52.3		57.6	+5.3
Moyenne −15	52.32	Moyenne −15	56.78	

Moyenne générale de l'inclinaison: Sur le pilier *C*, −15° 54′.34; sur le pilier *B*, −15° 53′.57; différence (*C*−*B*), −0′.77.

Moyenne générale des deux inclinomètres: ° ′
Avec le Inclinomètre 221 . . . . −15 52.11
" " Ind. ter. C. I. W. 25 . . . . −15 55.80

Différence (221 − C. I. W. 25) . . . . +3.69
(I. M. S. − C. I. W. 25) = 0′.0; ∴(I. M. S. − 221) = −3′.7.

VALEURS POUR LES MAGNÉTOGRAPHES.

Dans le but de comparer les résultats obtenus par MM. Green et Gualter de Macedo Soares, voici les valeurs des lignes de bases déduites pour les magnétographes, de chacun des résultats des deux observateurs.

Déclinaison.—Les valeurs des lignes de bases déduites sont devenues:

	Magn. Cooke 25				Magn. C. I. W. 25			
	Pilier *A*		Pilier *B*		Pilier *B*		Pilier *A*	
	°	′	°	′	°	′	°	′
	−12	38.4	−12	38.5	−12	37.7	−12	37.7
		37.6		38.9		37.9		38.1
		37.6		37.8		38.9		36.9
		38.9		38.0		38.6		37.0
		37.9		....		38.3		....
		37.9		38.9		38.2		40.1
Moyennes	−12	38.1	−12	38.4	−12	38.27	−12	37.96
	−12° 38′.2				−12° 38′.1			

La valeur qui était employée pour la réduction des diagrammes de Vassouras était de 12°38′.1.

Composante horizontale.—Les valeurs des lignes de bases déduites sont devenues:

	Magn. Cooke 25		Magn. C. I. W. 25	
	Pilier *A*	Pilier *B*	Pilier *B*	Pilier *A*
	γ	γ	γ	γ
	24409	24437	24347	24355
	409	426	355	353
	403	427	345	345
	387	417	349	342
	427	...	365	...
	418	421	375	358
Moyennes	24409	24426	24356	24351
	24417γ		24353γ	

La valeur employée à Vassouras à cette époque était de 24422γ.

Composante verticale.—Lignes de base déterminées pour chaque paire d'aiguilles:

	Inclinométre 221		Inducteur terrestre C.I.W.25	
	Pilier *C*	Pilier *B*	Pilier *B*	Pilier *C*
	γ	γ	γ	γ
	6843	6854	6875	6882
	887	843	875	883
	859	858	879	884
Moyennes	6863	6852	6876	6883
	6858γ		6880γ	

La valeur employée à l'époque était de 6867γ.

H. MORIZE,
Directeur de l'Observatoire National de Rio de Janeiro, Brésil.

RESULTS OF COMPARISONS, RIO DE JANEIRO OBSERVATORY AT VASSOURAS, BRAZIL,[1] 1913-1923.

The comparisons in 1923 were obtained, following the method of simultaneous observations with exchange of stations, by Gualter de Macedo Soares, Assistant at the Observatory, and Observer J. W. Green of the Carnegie Institution of Washington. The stations used were concrete piers *A*, *B*, and *C* in the non-magnetic house for absolute observations at Vassouras which had been used for previous intercomparisons.[2] At *A* and *B* the center of pin on the Observatory azimuth mark was used, its azimuths from the two stations as supplied by Dr. Morize, Director of the Observatory, being 146°40′.7 and 148°04′.1 west of true south, respectively.

The Observatory instruments used in the comparisons were magnetometer No. 25 by Cooke and Son and dip circle No. 221 by Dover, using new needles 5 and 6. The same magnetometer was used in the intercomparison observations of 1915 and 1919[2]; dip

[1]From Mr. J. A. Fleming's report to appear in full in Vol. VI, "Researches of Department of Terrestrial Magnetism."

[2]See *Res. Dep. Terr. Mag.*, Vol. II, pp. 253-254, and Vol. IV, pp. 448-451.

circle No. 221 was used for the work of 1919 but with different needles. The C. I. W. instrument used in 1923 was magnetometer-inductor No. 25.

The I. M. S. values given depend upon the constants finally adopted for the C. I. W. instruments. When magnetometer-inductor No. 25 was returned to Washington in September 1923, after having been used for 15 months in the West Indies and South America, it was found that there had been an appreciable decrease in the moment of inertia for magnet 25*L* and its suspension. The intercomparisons at Washington preceding and following and those at the Huancayo Magnetic Observatory during the work in the field showed the decrease had taken place practically as a linear function of the time during which the instrument was in field service.

TABLE A.—*Results of declination comparisons at the Rio de Janeiro (Vassouras) Observatory, 1923.*

Date	Local mean time		Declination obtained[1]		I. M. S. − Rio de Janeiro	Remarks
	From	To	I. M. S.	Rio de Janeiro		
1923	h m	h m	° ′	° ′	′	
June 30	11 09	11 16	−11 43.7	−11 44.4	+0.7	C. I. W. magnetometer-inductor No. 25 at *B*; Rio de Janeiro magnetometer No. 25 at *A*.
30	12 31	12 38	42.9	42.6	−0.3	
30	14 30	14 37	44.3	43.0	−1.3	
30	16 13	16 22	45.0	45.3	+0.3	
July 1	8 55	9 04	43.3	42.9	−0.4	
1	10 42	10 49	43.2	42.9	−0.3	
1	14 48	14 57	44.1	44.3	+0.2	C. I. W. magnetometer-inductor No. 25 at *A*; Rio de Janeiro magnetometer No. 25 at *B*.
1	16 25	16 34	44.7	44.9	+0.2	
2	9 04	9 12	42.1	42.4	+0.3	
2	10 46	10 54	41.8	42.2	+0.4	
2	11 05	11 13	42.3	41.8	−0.5	
2	13 22	13 30	47.1	45.3	−1.8	
Mean value of (I. M. S. − Rio de Janeiro)					−0.2	

[1]All values are referred to *A*; *A* = *B* + 0′.3.

TABLE B.—*Results of horizontal-intensity comparisons at the Rio de Janeiro (Vassouras) Observatory, 1923.*

Date	Local mean time		Hor. int. obtained[1]		I. M. S. − Rio de Janeiro	Remarks
	From	To	I. M. S.	Rio de Janeiro		
1923	h m	h m	γ	γ	γ	
June 30	12 55	14 15	24284	24360	−76	C. I. W. magnetometer-inductor No. 25 at *B;* Rio de Janeiro magnetometer No. 25 at *A*.
30	14 48	16 06	263	328	−65	
July 1	9 13	10 35	325	395	−70	
1	15 04	16 15	322	397	−75	C. I. W. magnetometer-inductor No. 25 at *A;* Rio de Janeiro magnetometer No. 25 at *B*.
2	9 20	10 36	322	398	−76	
2	11 20	13 15	324	384	−60	
Mean value of (I. M. S.—Rio de Janeiro)					−70.3γ or −0.00288*H*	

[1]All values are referred to *A; A*=*B*—9.9γ.

Table C.—*Results of inclination comparisons at the Rio de Janeiro (Vassouras) Observatory, 1923.*

Date	Local mean time: From	Local mean time: To	Inclination obtained[1]: I. M. S.	Inclination obtained[1]: Rio de Janeiro	I. M. S. − Rio de Janeiro	Remarks
1923	h m	h m	° ′	° ′	′	
July 1	11 28	11 58	−15 55.2	−15 49.8	−5.4	C. I. W. magnetometer-inductor No. 25 at *B*; Rio de Janeiro circle 221 at *C*.
1	13 02	13 29	55.6	53.4	−2.2	
1	13 46	14 13	56.0	52.4	−3.6	
2	13 59	14 28	56.8	53.3	−3.5	C. I. W. magnetometer-inductor No. 25 at *C*; Rio de Janeiro circle 221 at *B*.
2	14 39	15 07	56.4	51.6	−4.8	
2	15 19	15 50	57.1	54.4	−2.7	
Mean value of (I. M. S. − Rio de Janeiro)					−3.7	

[1]All values are referred to *C*; *C*=*B*—0′.8.

SUMMARY.

Dr. Morize, in a report on the results of the intercomparisons at Vassouras, states that about the time of Mr. Sterling's visit at Vassouras (September 1919) the marble cap of pier *B* apparently had been misplaced, resulting in a change in the value of the azimuth of the Observatory mark; the value previously used had been 148°05′.7, while the value determined as a result of the test made by Assistant Macedo Soares, subsequent to Mr. Green's work in 1923, is 148°04′.1. In view of the uncertainty thus introduced as concerns the 1924 comparisons, the results of that work for declination are rejected in Table D summarizing the chief results as already published[1] and as given above.

Table D.—*Summary of results of comparisons at the Rio de Janeiro (Vassouras) Observatory, 1913-1923.*

Date	(I. M. S. − Rio de Janeiro): Declination	Horizontal intensity	Inclination	Observatory instruments: Magnetometer	Dip circle and needles
	′		′		
1913, May.....	+0.5	−0.00029H	−4.2	Cooke 20	114.2
1915, Mar.-Apr.	−0.8	−0.00315H	−0.7	Cooke 25	8075.1,2
1919, Sept.....	.....	−0.00355H	−0.7	Cooke 25	221.1,2,2(of 8075)
1923, June-July	−0.2	−0.00288H	−3.7	Cooke 25	221.5,6

[1]See *Res. Dep. Terr. Mag.*, Vol. II, pp. 253-254, and Vol. IV. pp. 448-451.

PORTABLE ELECTRIC MAGNETOMETERS IN JAPAN.

I am forwarding a reprint of a paper, just published,[1] entitled "The Measurement of the Horizontal Intensity of the Earth Magnetic Field with Portable Electric Magnetometers," by N. Watanabe and T. Kawamura. This paper includes the results of the

[1]In "Japanese Journal of Astronomy and Geophysics," Vol. I, No. 6, 1924, pp. 191-206.

comparison of some magnetometers in Japan (see Table on p. 204). We made other comparisons regarding the declination and inclination, but those records were lost in the earthquake of September 1, 1923. So, I have nothing to add concerning the comparisons of the magnetometers in Japan besides that given in our paper.

The conclusions drawn from our results are as follows:

(1) Electrical constants of the coil and the current standard of our traveling instruments have a precision of 1 or 2 gammas;
(2) Correction due to the theodolite is quite negligible;
(3) Systematic errors of the instruments of a few gammas seem to be due to some fault in galvanometric connections in the field work;
(4) Accuracy of observations is about 1 gamma; and
(5) Observations are consistent.

If sufficient precautions are given to the galvanometer connections, and the standardization of the current standard be possible once or twice a year, the horizontal intensity may be measured with the precision of 1 gamma even in field work; and the corrections of the instruments are negligible.

As to the standard cells, we propose to use unsaturated cells so as to minimize temperature effects, but these cells should be compared with a saturated cell in the field by measuring the horizontal intensity with each cell. We further propose that the *international comparison of magnetometers should be made with electric magnetometers.*

Our standard electric magnetometers at Tokyo were not damaged during the earthquake, except the current standard, the factory of which was destroyed. Furthermore the Electrical Laboratory, where the electrical instruments are calibrated, was burnt. So, the recovering of our current standards of the magnetometers is impossible in the near future.

N. WATANABE.

No. 53 Myoogadani, Koishikawi, Tokyo,
March 15, 1924.

STANDARDS AND COMPARISONS IN MEXICO.

With regard to Resolution No. 4, of the Rome Meeting, I must say that we have not good instruments for international comparisons; but all the instruments of the Teoloyucan Observatory are at the disposition of the Section of Terrestrial Magnetism and Electricity. A new magnetometer, according to the design of the Carnegie Institution, will be made, by an American Factory, very soon, which will be compared at Washington by the Department of Terrestrial Magnetism, and then we shall be able to compare instruments.

J. GALLO,
Director, Observatorio Astronomico Nacional.

Tacubaya, D. F., March, 1924.

COMPARISONS IN PORTUGAL AND THE AZORES.[1]

COIMBRA OBSERVATORY, PORTUGAL.

The comparisons of April 17 to 21, 1922, at the Coimbra Observatory, through the courtesy of Professor A. Ferraz de Carvalho, director, were obtained at the joint expense of the International Section of Terrestrial Magnetism and Electricity and the Carnegie Institution, by Observer W. C. Parkinson, of the latter Institution, with the assistance of Senhor A. Lopes and Senhor A. Pratas of the Observatory staff.

The method of simultaneous observation with exchange of station was employed. Stations *A* and *B* were occupied for declination and horizontal intensity, and stations *B* and *C* for inclination. Stations *A* and *C* are the observing piers in the absolute house regularly used for the control of the magnetograph; *C* is 3.15 meters due south of *A*. Station *B* is a stone pier outside the absolute house, in line with stations *A* and *C* and 4.85 meters from station *C*; it is surrounded by a stone wall about one-half meter thick and one meter high. The true bearing of the Observatory azimuth mark, namely, a painted stone on a hill 1.6 kilometers distant, is 283°49′.8 west of south from station *A* and 283°34′.6 west of south from station *B*, these values being as supplied by the Observatory authorities.

The standard instruments at the Observatory are Elliott magnetometer No. 40 for declination and horizontal intensity and Dover dip circle No. 31 for inclination, the values with needle No. 5 being accepted as Needle No. 6 gives erratic results and is to be replaced later.[2] Senhor Lopes observed with magnetometer No. 40 and Senhor Pratas with dip circle No. 31. The C.I.W. instrument used was magnetometer-inductor No. 27; the corrections on provisional International Magnetic Standards[3] applied to results obtained with it were those finally adopted as based upon comparisons with C.I.W. standard instruments made at Washington before and after its field use.

The nearest point of the Coimbra electric tramway system is about 600 meters distant from the Observatory, but very little magnetic effect is produced by it at the observing stations. The Director of the Observatory states that the magnetograph curves show calm conditions from April 17 to 21 with some disturbances beginning after 17^h on April 21.

[1]From Mr. J. A. Fleming's report to appear in full in Vol. VI, *Res. Dep. Terr. Mag.*

[2]In his letter of June 6, 1924, Professor Ferraz de Carvalho says needle No. 6 was sent later to the makers for repairs, but although it gave good results at Kew after the repairs it was found to be unsatisfactory at Coimbra when returned.

[3]See *Res. Dep. Terr. Mag.*, Vol II, pp. 270-278; also Bull. No. 3, 84-91.

TABLE A.—*Results of declination comparisons at the Coimbra Observatory, 1922.*

Date	Local mean time		Declination obtained*		I. M. S.—Coimbra	Remarks
	From	To	I. M. S.	Coimbra		
1922	h m	h m	° ′	° ′	′	
Apr. 17	9 05	9 12	−14 59.1	−14 59.8	+0.7	C. I. W. magnetometer-inductor No. 27 at *B;* Coimbra magnetometer No. 40 at *A*.
17	11 47	11 54	−15 07.0	−15 09.2	+2.2	
17	12 09	12 16	−15 08.2	−15 09.1	+0.9	
17	14 32	14 39	−15 08.1	−15 09.1	+1.0	
18	8 49	8 56	−14 58.2	−14 58.0	−0.2	
18	11 21	11 23	−15 03.5	−15 04.3	+0.8	
18	11 37	11 44	−15 05.6	−15 05.0	−0.6	
18	11 49	11 56	−15 06.2	−15 06.0	−0.2	
18	12 06	12 13	−15 07.2	−15 06.1	−1.1	
18	12 38	12 45	−15 10.9	−15 10.4	−0.5	C. I. W. magnetometer-inductor No. 27 at *A;* Coimbra magnetometer No. 40 at *B*.
18	15 44	15 51	−15 09.3	−15 11.3	+2.0	
19	8 48	8 55	−15 01.4	−14 56.1	(?)†	
19	11 36	11 43	−15 04.5	−14 59.3	(?)†	
19	11 57	12 04	−15 05.7	....	.....	
19	14 06	14 13	−15 06.4	−15 10.3	(?)†	
19	14 15	14 22	−15 05.9	−15 09.4	(?)†	
19	14 30	14 37	−15 05.7	−15 09.5	(?)†	
21	13 49	13 56	−15 05.5	−15 05.9	+0.4	
21	14 08	14 15	−15 05.5	−15 06.1	+0.6	
21	14 31	14 38	−15 05.3	−15 05.4	+0.1	
21	14 41	14 48	−15 05.5	−15 05.6	+0.1	
Mean value of (I. M. S.−Coimbra) omitting values marked (?)........					+0.4	

*All values are referred to A; $A = B + 3'.5$, as determined from values not concerned with differences marked (?).

†Only one reading of the mark was possible for the Coimbra observations, and this was made at the beginning of the day's work and under bad conditions of light; therefore, the results on April 19 are rejected.

TABLE B.—*Results of horizontal-intensity comparisons at the Coimbra Observatory, 1922.*

Date	Local mean time		Hor. int. obtained**		I. M. S.—Coimbra	Remarks
	From	To	I. M. S.	Coimbra		
1922	h m	h m	γ	γ	γ	
Apr. 17	9 33	11 24	23072	23076	−4	C. I. W. magnetometer-inductor No. 27 at *B;* Coimbra magnetometer No. 40 at *A*.
17	12 20	14 14	074	078	−4	
18	9 17	11 03	075	076	−1	
18	13 32	15 28	091	094	−3	C. I. W. magnetometer-inductor No. 27 at *A;* Coimbra magnetometer No. 40 at *B*.
19	9 08	11 16	073	069	+4	
19	12 26	13 48	090	086	+4	
21	8 55	10 38	086	072	+14	No. 27 at *B;* No. 40 at *A*.
21	11 16	13 22	091	090	+1	No. 27 at *A;* No. 40 at *B*.
Weighted mean value of (I. M. S.−Coimbra)					+1.4γ or +0.00006H	

**All values are referred to A; $A = B - 2.8\gamma$, as determined from this series.

TABLE C.—*Results of inclination comparisons at the Coimbra Observatory, 1922.*

Date	Local mean time		Inclination obtained††		I. M. S.—Coimbra	Remarks
	From	To	I. M. S.	Coimbra		
1922	h m	h m	° ′	° ′	′	
Apr. 20	9 02	9 12	+58 17.2	+58 13.5	+3.7	C. I. W. magnetometer-inductor No. 27
20	10 44	10 54	18.3	15.6	+2.7	
20	11 12	11 22	17.9	14.6	+3.3	at *B;* Coimbra dip circle No. 31 at *C.*
20	13 38	13 48	16.2	12.8	+3.4	C. I. W. magnetometer-inductor No. 27
20	14 02	14 12	18.1	14.9	+3.2	
20	15 38	15 50	19.2	16.4	+2.8	at *C;* Coimbra dip circle No. 31 at *B.*
Mean value of (I. M. S.—Coimbra)....					+3.2	

††All values are referred to *C*; $C = B + 0'.4$.

PONTA DELGADA, SAN MIGUEL, AZORES.

Director F. A. Chaves of the Meteorological Service of the Azores made intercomparisons on July 19, 1920 between his field magnetometer, No. 28 of the Brunner-Mascart type, constructed by Chasselon, and the standard instruments of the Coimbra Observatory. He has kindly communicated the results as follows:

(Coimbra—San Miguel) = $-0'.95$ in declination;

(Coimbra—San Miguel) = $-37\gamma = -0.00160H$ in horizontal intensity.

The corrections on provisional International Magnetic Standards (I.M.S.), as determined from the observations of April 17-21, 1922 at Coimbra (see p. 109) were:

(I.M.S.—Coimbra) = $+0'.4$ in declination; and

(I.M.S.—Coimbra) = $+0.00006H$ in horizontal intensity.

Thus we have indirectly:

(I.M.S.—San Miguel) = $-0'.5$ in declination; and

(I.M.S.—San Miguel) = $-0.00154H$ in horizontal intensity.

A. FERRAZ DE CARVALHO, F. A. CHAVES,
AND J. A. FLEMING.

NOTA DE LOS OBSERVATORIOS EUROPEOS COMPARADOS POR LOS OBSERVADORES ESPAÑOLES.[1]

Nombres	*Nacionalidad*	*Fechas*
Val Joyeux	Francia	del 19 al 25 Febrero 1921
Kew	Inglaterra	del 29 Marzo al 6 Abril 1921
Bruselas	Belgica	del 3 al 9 Mayo 1921
De Bilt	Holanda	del 21 al 31 Mayo 1921
Potsdam	Alemania	del 22 Junio al 14 Julio y del 16 al 28 Septiembre 1921
Rude Skov	Dinamarca	del 10 al 18 Noviembre 1921
Swider	Polonia	del 29 Diciembre 1921 al 7 Enero 1922
Coimbra	Portugal	del 11 al 15 Marzo 1923
Pola	Italia	del 4 al 8 Mayo 1923
Tortosa	España	del 23 al 28 Enero 1923

U. DE AZPIAZU,
Ingeniero Geógrafo.

Castelló, 12, Madrid.

[1]The results from this series of comparisons have not become known at the time Bulletin No. 5 is passing through the press.—*Sec.*

COMPARISONS OF INSTRUMENTS OF GREAT BRITAIN, IRELAND AND INDIA.[1]

In view of the artificial disturbances at the more accessible magnetic observatories, Kew and Greenwich, and the uncertainties as to the future, provision as regards the intercomparison of instruments was made only for immediate wants. The Director of the Meteorological Office agreed that any necessary intercomparison work prior to the meeting at Madrid should be undertaken by the staff at Kew Observatory. The following is an account of the comparisons actually made, up to the date of writing. It is hoped comparisons at Stonyhurst and Eskdalemuir may prove possible in the current year.[2]

The *Kew standard magnetometer* by Jones was compared with the *Schuster-Smith coil magnetometer* belonging to the National Physical Laboratory, at Teddington, during April 1922 and July 1923. In each case the comparison was not direct, but through the intermediary of the magnetometer Dover 140 belonging to Kew Observatory. The Dover instrument was transported to Teddington, and observations were taken with it on a pier a few feet from that occupied by the coil instrument—which is practically a fixture—and in the same room. The pier was that occupied during the comparisons made in 1921. It is not, however, the pier used by Mr. Parkinson, which stands close to the south window. The observations with the coil magnetometer were interpolated between the (much longer) observations taken with Dover 140, a comparison being effected through the records of a very delicate magnetograph run temporarily in the next room.

On each occasion a number of observations were taken at Kew with Dover 140, before and after the observations at Teddington. No certain change was detected in the relation between the Jones and Dover instruments during the visits of the latter to Teddington.

In 1922 eight complete observations of H were made by myself at Teddington, four on April 10, and four on April 11. On April 21 further observations were taken by a member of the Kew staff. A large difference, however, presented itself between his forenoon and afternoon results, which could not be accounted for, so the observations of April 21 were discarded. Those taken on April 10 and 11 showed a fair agreement.

In 1923 observations were made at Teddington by myself on July 20, 23, and 24. The observations on July 20 did not agree with the later ones, and as there was reason to fear they had suffered from the presence of a strongly magnetized screw driver, they were discarded. This left unfortunately only four complete observations with Dover 140.

The mean (algebraic) excess of the value of H derived from the Jones instrument over that derived from the coil magnetometer on the three occasions of intercomparison are as follows:

[1]Conducted in accordance with Resolution No. 4 of Rome Meeting.

[2]According to Dr Chree's letter of August 19, 1924, comparisons were obtained at Eskdalemuir and Stonyhurst, and again at Kew on his return.—*Sec.*

Year	A	B
1921	-10γ	-5γ
1922	$+1\gamma$	-1γ
1923	$+8\gamma$	$+4\gamma$

The results in column *A* were obtained by assigning to the "distribution constants" *P* and *Q* of the Jones unifilar the mean values derived from the single year of observation. Those in column *B* were obtained by assigning to *P* and *Q* mean values based on the seven years 1917 to 1923. There are various reasons, dealt with elsewhere, for considering the results in column *B* the more probable. They might represent a real progressive shift in the relation of the two instruments. But they could also be explained, and with perhaps greater probability, by an uncertainty of the order $\pm 5\gamma$ in the results of intercomparisons of this kind.

In 1923 a comparison was made of *Kew and Greenwich instruments* at Greenwich on eight days between October 19 and November 2. The comparison was effected through the intermediary of unifilar Dover 140 and dip circle No. 74, the latter belonging to Eskdalemuir. Numerous comparisons between these instruments and the Kew standards (Jones magnetometer and Barrow dip circle) were made at Kew before and after the comparisons at Greenwich, and no certain change in the interrelation of either pair of instruments was detected. The *H* and dip observations with the Kew instruments at Greenwich were taken by myself, on the S. E. pier in the magnetic pavilion. It was not possible to observe on the piers occupied by the Greenwich instruments, but the piers are all in one room. In the case of declination, to obtain a distant mark, observations had to be taken with Dover 140 some distance outside the pavilion. These observations were taken by one of the Greenwich staff, who had no previous experience of the instrument, and as they proved much less accordant than a subsequent series taken with another instrument, they were discarded. It may, however, be mentioned that they made the difference between the Dover and Greenwich instruments quite small, only 0′.5, the former giving the larger westerly declination.

The subsequent series was also taken by the Greenwich staff, employing a new unifilar Casella 181 belonging to Greenwich, which had been compared shortly before with the Kew standard at Kew.

Eleven complete observations of *H* were made at Greenwich in 6 days. The last two of these, taken on the last day somewhat hurriedly, appeared discordant between themselves and have been discarded, though their retention would have affected the final mean by only 1γ. The mean derived from the other 9 observations made the Greenwich standard read *higher* than the Kew standard by 9γ. The individual differences observed varied only from 6γ to 13γ; but the first four observations gave differences of 6γ, 6γ, 7γ and 6γ, while the last four gave 12γ, 13γ 11γ, and 12γ.

The close agreement between results on the same day, and the difference between results on different days—the variation in temperature being small throughout—are phenomena which encourage a certain reserve in one's attitude to the results of the intercomparison of instruments.

Twelve complete sets of dip observations were made at Greenwich, on seven days, six with the needles belonging to the circle used, Dover 74, and six with the needles of a much more recently constructed circle, Dover 239. The results obtained for the difference between the Greenwich dip inductor and the Kew Barrow circle via the two pairs of needles in Dover 74 were not identical, the difference being 0′.3. The final mean from the four needles made the dip from the Greenwich inductor the *higher* by 0.′15.

As regards declination, observations made at Kew on November 16 and 19, 1923, between the Jones magnetometer and Casella 181, the positions of the instruments in the two observation huts being interchanged and the two positions not being assumed identical, made the declination from the Jones the larger (i. e. more westerly) by +0′.5. Observations made at Greenwich on February 6, 7, 8, 12, and 16 between Casella 181 and the Greenwich standard made the instruments agree to 0′1. We should thence obtain Kew standard—Greenwich standard = +0′.5 (or 0′.5 more *westerly*). The differences in declination and dip between the Greenwich and Kew standards can hardly claim to exceed the probable errors of observation. Also, in the case more especially of declination, the non-identity of the stations occupied at Greenwich should be borne in mind.

An intercomparison was made at Kew Observatory from March 5 to 12, 1924, between the *Kew and Valencia instruments*. The latter were brought over from Ireland by the Superintendent of Valencia Observatory, Mr. C. D. Stewart, who took the observations made with them at Kew. The results of this comparison are not yet available.

A comparison between the *dip inductors at Greenwich and Eskdalemuir and the standard dip circle at Kew* is being effected through the intermediary of the Dover dip circle No. 74. The final comparison of this instrument with the Eskdalemuir dip inductor is still incomplete.[1]

At various times during 1922, Dr. de Graaff Hunter, of the Indian Trigonometrical Survey, observed at Kew Observatory with one of the Survey's magnetometers. This instrument was compared as regards both declination and horizontal force with the Kew standard, and on its return to India it was compared with the *standard magnetometer of the Trigonometrical Survey.*

CHARLES CHREE.

Kew Observatory, Richmond Surrey,
March 25, 1924.

[1]In his letter of August 19, 1924, Dr. Chree states that he also made comparisons at the Stonyhurst Observatory and again at the Kew Observatory on his return.—*Sec.*

NOTE ON DISTRIBUTION CONSTANTS OF MAGNETOMETERS.

Difficulties in connection with the distribution constants P and Q in the deflection formula $2mr^{-3}(1+Pr^{-2}+Qr^{-4})$, where r is the distance between the centers of the two magnets.

The first trouble is that it does not seem possible in an individual case to calculate the values of P and Q for a pair of magnets from their dimensions only. The theoretical expressions for P and Q, on the elementary theory that the force due to a magnet may be calculated by regarding it as composed of equal + and − charges collected on the longitudinal axis, at equal distances from the center, makes

$$P=2\lambda_1^2-3\lambda_2^2; \qquad Q=(3/8)\ (8\lambda_1^4-40\lambda_1^2\lambda_2^2+15\lambda_2^4);$$

where $2\lambda_1$ and $2\lambda_2$ are the pole distances for the deflecting and deflected magnets.

Börgen has obtained small corrections—depending in the case of P on the squares of diameters of the cross sections—to represent the improved hypothesis that the magnetic matter is not on the axis, but on rings centered on the axis. These corrections are small for ordinary magnets, at least in Kew-pattern instruments.

If, as a first approximation, we neglect Börgen's correction, we can calculate P and Q if we know the values of λ_1 and λ_2. This we could of course easily ascertain if the pole distance were a known invariable fraction, p, of the magnet's length. For instance, in the case of the Kew standard instrument by Jones, in which the lengths of the deflecting and deflected magnets are respectively 9.35 cms. and 7.60 cms., we should have

p	P	Q
0.80	+0.25	− 872
0.90	+0.32	−1396

Börgen's correction would in either case reduce P by 0.10. Now the values of P and Q for the Kew standard have been calculated from each year's observations from 1910 to 1923, and the means—omitting the year 1916, when an accident befell the magnet—were +1.16 for P, and −1402 for Q. No value for p gives anything like the actually observed value of P, and the mean value obtained for Q calls for a much higher value of p than is generally conceded. Thus in this case it is clearly impossible to deduce P or Q satisfactorily from the dimensions of the magnet.

The magnets of this particular magnetometer may of course be exceptional, and it would be desirable to have results from a number of pairs of magnets. But the trouble, as every one who has had practical experience knows, is that it is useless to think of deriving P and Q from observations, unless the number of these observations is very large.

A way out of the difficulty, which may have suggested itself to others, is to calculate a value for P', the value obtained for P from observations at two distances assuming Q to be negligible, and then to derive a value for p and so for P and Q from the result. A smaller number of observations may appear sufficient to determine P'. The theoretical relationship between P', P, and Q is

$$P' = P + Q\ (r_1^{-2} + r_2^{-2}),$$

where r_1 and r_2 are the two distances employed for the evaluation of P'. Now, if we take the two distances 30 and 40 cms. most commonly in use, we find for the Kew pair of magnets

$$P' = -1.27, \text{ when p} = 0.80;$$

and, curiously enough, we get the same value for P' when we take the mean values actually observed, viz, $P = +1.16$, $Q = -1402$. The inference from the observations is obviously that p really equals 0.80; but, as we have found above, this does not fit in the least with the values actually obtained separately for P and Q from numerous observations made at 22.5, 30, and 40 cms.

The formulae for the separate evaluation of P and Q are a little laborious to apply. But the direct determination of m/H from the first approximation values m'_1/H'_1, m'_2/H'_2, m'_3/H'_3, derived from the deflections at the three distances r_1, r_2, and r_3, neglecting P and Q, is very simple. Thus, for the three distances 22.5, 30, and 40 cms. we have

$$m/H = (729/1225)\ m'_1/H'_1 - (3600/1225)\ (m'_2/H'_2) + (4096/1225)\ (m'_3/H'_3).$$

Again, assuming no large difference between the three values of m′/H′, we have

$$\log m/H = (\text{mean value of } \log m'/H') \div \text{mean value of } \log (1 + Pr^{-2} + Qr^{-4}).$$

This gives the mean value (i. e., mean of values for $r = 22.5$, 30, and 40 cms.) of log $(1 + Pr^{-2} + Qr^{-4})$.

The practice at Kew has been to calculate P and Q separately from the complete formulae in the first instance, and then check the result in the way indicated. But if one wishes to obtain corrected values of m/H or mean values of the correction factor $1 + Pr^{-2} + Qr^{-4}$ in a short time, with little expenditure of labor, the check method is preferable. In it one can without appreciable sacrifice of accuracy assign a convenient approximate value to, say, m'_1/H'_1, and utilize the mean observed differences log $m'_2/H'_2 - \log m'_1/H'_1$ and log $m'_3/H'_3 - \log m'_1/H'_1$.

These methods were applied to the observational results for each of the twelve months of the year at Kew for the two groups of years 1910 to 1915, and 1917 to 1923. The year 1916 was omitted, as the results during it for some time after an accident to one of the magnets appeared too erratic.

During any one month of the year the climatic conditions vary comparatively little, so that any variability in P and Q due to such a cause as erroneous temperature corrections would naturally be small. The results obtained for the mean value of $\log_{10}(1+Pr^{-2}+Qr^{-4})$ for the three observation distances 22.5, 30, and 40 cms. were as follows:

Mean value of $\log_{10}(1+Pr^{-2}+Qr^{-4})$.

Month	1910–1915	1917–1923	Whole 13 years	Difference from mean
January	$\bar{1}.99946$	$\bar{1}.99957$	$\bar{1}.99952$	+.00002
February	33	24	29	− 21
March	50	72	61	+ 11
April	57	41	49	− 1
May	24	40	32	− 18
June	60	53	56	+ 6
July	40	67	54	+ 4
August	42	26	34	− 16
September	26	64	45	− 5
October	38	54	46	− 4
November	71	65	68	+ 18
December	54	90	72	+ 22
Year	45	55	50	
Winter	51	59	55	+.00005
Equinox	43	58	50	.00000
Summer	41	48	45	−.00005

Here winter includes November to February, summer May to August, and equinox the remaining four months.

Both periods suggest a slight difference between winter and summer; but, if it is real, it is clear from the final means that it must be very small. It arises from the somewhat high values for November and December, and the somewhat low values for May and August. Arguments for the difference being purely accidental may be derived from the fact that a winter month, February, supplies the lowest value of all, while the two mid-summer months June and July have values in excess of the mean.

However this may be, the irregularities in the values derived for the individual months of the year for the two sub-periods and even for the whole 13 years, certainly suggest that 6, 7, or even 13 months is too short a period from which to derive values for P and Q, at least under the conditions prevailing of late years at Kew Observatory. The inference that has been drawn is that the preferable course is to derive P and Q from the observations of a long series of years, always provided no accident has intervened likely to affect the distribution of magnetism in either the deflecting or the deflected magnets.

CHARLES CHREE.

Kew Observatory, March 25, 1924.

COMMENTS ON DISTRIBUTION FACTORS OF MAGNETOMETERS.[1]

The following table is in continuation of the one given on page 131 of Bulletin No. 3 (Transactions of Rome Meeting).

Data regarding apparent reliability of the distribution factors of magnetometers.

Year	Qr.	CHELTEN-HAM Mag'r 26			TUCSON Mag'r 30			PORTO RICO Mag'r 31			HONO-LULU Mag'r 36			SITKA Mag'r 37		
		(1)	(2) 2.97	(3)	(1)	(2) 2.92	(3)	(1)	(2) 2.92	(3)	(1)	(2) 2.80	(3)	(1)	(2) 2.88	(3)
1922	I	24	151	+ 3.1	52	367	+ 2.7	52	370	+ 1.4	52	458	+ 8.8	52	021	− 9.2
	II	26	148	+ 7.2	52	350	+ 8.4	48	357	+11.7	52	453	+ 8.1	56	008	− 8.1
	III	26	141	+12.7	54	321	+ 3.0	50	354	+ 6.9	52	449	+ 2.0	52	004	− 0.2
	IV	24	145	+ 3.0	40	333	− 9.0	52	346	+ 9.4	52	448	+ 8.3	52	012	− 1.3
1923	I	26	150	+ 3.7	52	331	− 6.3	52	343	+10.2	52	444	− 2.2	52	015	− 4.3
	II	26	141	− 1.3	48	319	−12.1	52	341	+10.1	48	434	+ 1.3	52	*007*	+ 0.2
	III	26	136	+ 9.9	52	293	−11.6	58	334	+ 9.8	52	427	+ 2.8	52	*995*	+ 1.5
	IV	26	139	+12.2	56	305	− 6.6	56	331	+ 8.6	56	418	+ 1.0	44	995	− 0.6

The table gives for each instrument (1) the number of sets of deflections in each quarter of the year specified; (2) the average value of the logarithm of the magnetic moment of the magnet, reduced to a standard temperature, and (3) the average difference between the values, at the two distances, of log H expressed in units of the fifth decimal place of the logarithm. The third quantity represents the apparent variability of the distribution factors. Assuming Q constant, a change in P to correct for a value of 10 would produce a change in H of one part in 5,000. The same values of P and Q were used as in previous years. *In spite of the variability indicated, even when mean values for three months are considered, it is believed that a more homogeneous series of results has been secured by assuming P and Q constant and controlling the instrumental correction by means of comparisons with some standard instrument, than would have been the case if an attempt had been made to redetermine the distribution factors from time to time.*

The usual method of deriving values of P and Q from deflection observations at three distances is so sensitive to small errors of observation that a large number of observations is needed to secure reliable results. In the magnetometers of the Coast and Geodetic Survey pattern the magnets are of such dimensions as to make Q zero, theoretically, and P has been determined from deflections at two distances, assuming Q to be zero. In the case of the magnetometers of the India Survey pattern (Cooke) in use at four of the observatories, an average value of Q for that type of instrument has been adopted and P has been derived from deflections at two distances.

[1]Communicated by the Director of the United States Coast and Geodetic Survey, Col. E. Lester Jones.

It is considered a decided advantage to derive the various constants of a magnetometer individually, even though an instrumental correction must be applied, for they furnish a control on the accuracy of the results and the behavior of the magnets and show to some extent where improvements in observing may be made. In the case of the magnetometers at the observatories of the Coast and Geodetic Survey, other than Cheltenham, it is believed that the difficulty of making accurate readings of the horizontal circle, now somewhat worn with use, has a serious effect on the accuracy of the results and new circles will be supplied in the near future.

D. L. HAZARD,
Assistant Chief of Division of Terrestrial Magnetism.

United States Coast and Geodetic Survey,
Washington, D. C., 1924.

ON MAGNETIC STANDARDS AND COMPARISONS OF THE DEPARTMENT OF TERRESTRIAL MAGNETISM.[1]

It was stated in Volume II, pages 270-271, "Researches of the Department of Terrestrial Magnetism," published in 1915, that in the absence of any agreement among nations as to the international magnetic standards, it was necessary for the Department of Terrestrial Magnetism to adopt at the very beginning of its field work in 1905 some standards to which the magnetic elements, observed in all parts of the Earth, could be referred with sufficient accuracy not to vitiate, from a practical standpoint, its published results.

The provisionally adopted standards were based on all available data respecting the results of intercomparisons of magnetic instruments, made the world over by various organizations, observatories, and the Carnegie Institution of Washington. Posible sources of error and corrections on account of appreciable changes of instrumental constants received careful consideration, as well as the results from various types of instruments and from various methods of determining instrumental constants.

Additional data obtained during 1915 to 1922 (see pp. 395-475, vol. IV, "Researches of the Department of Terrestrial Magnetism" and pp. 84-97, Bull. No. 3, "Transactions of Rome Meeting") have shown that our provisionally selected "International Magnetic Standards" (I.M.S.) have amply fulfilled the practical requirements above stated and that, in consequence, any possible corrections in our published magnetic survey results would be well within the observational errors.

Since under the present conditions the prospect of the adoption of magnetic standards by international agreement appears still somewhat remote, the Carnegie Institution of Washington, as a matter of practical necessity, will be obliged to continue to use its provisional standards which seem to approximate closely to abso-

[1]Abstract of report communicated by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

lute standards on the basis of the most reliable information available from all sources. The evidence now at hand would further seem to indicate that any magnetic standards, adopted with equal care and based on equally extensive data, will not be found to differ materially from these provisional ones. The Department of Terrestrial Magnetism will heartily cooperate in any serious attempt to establish, confirm, and control standards.

As heretofore all instruments used by observers of the Department have been compared before and after field work with the standard C. I. W. magnetometer No. 3 and C.I.W. earth inductor Schulze No. 48 and corrections derived on the provisional International Magnetic Standards of the Department. Control of the instrumental constants has been carefully maintained. The results again indicate the great necessity of close control on the moment of inertia of the oscillating magnet and its suspension arrangements; in every case of change in correction, independent observations of the moment of inertia have shown that the entire change arose because of some alteration in the moment of inertia. A summary of the results of the continued investigation of standards shows, as reported to the Rome Meeting in 1922, that the absolute precision of the standards adopted is of the order 0′.2 in declination and inclination and 0.0002 H in horizontal intensity.

The program was continued of comparisons of observatory standards with standardized C.I.W. field magnetometer-inductors at the observatories visited by observers of the Department in the course of their field work. Since the extensive series covering such work through 1922 reported upon in Bulletin No. 3, the Department has secured intercomparisons at Apia (Western Samoa), Batavia (Java), Cheltenham (United States), Huancayo (Peru), Pilar (Argentina), La Quiaca (Argentina), Teoloyucan (Mexico), Tucson (United States), Washington (United States), and Watheroo (Western Australia).

The work at the Cheltenham Observatory of the United States Coast and Geodetic Survey was done in accordance with a resolution passed by the American Geophysical Union at its annual meeting in April 1923, namely:

> "That the American Geophysical Union designate the Cheltenham Magnetic Observatory of the United States Coast and Geodetic Survey and the Standardizing Magnetic Observatory of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, working in conjunction, as the observatories in the United States to function in accordance with resolution No. 4 adopted by the International Section of Terrestrial Magnetism and Electricity at its Rome meeting in 1922."

It is gratifying to note that these comparisons indicate little or no change in the relation of the standards of the United States Coast and Geodetic Survey and the Department's provisional International Magnetic Standards since the previous comparisons in February to March 1918 and the six earlier series obtained during 1908 to 1917. The series at the Pilar (Argentina) Observatory obtained in July 1923 also shows how well standards may be maintained for long periods, with suitable control and care; thus the corrections on the provisional International Magnetic Standards for the standard Pilar instruments, namely, magnetometer Dover No. 175 and earth inductor Eschenhagen No. 3, as obtained from four series during 1913 to 1917, were $-0'.6$, $-0.00033H$, and $-0'.1$ for $\triangle D$, $\triangle H$ and $\triangle I$, whereas the 1923 values were $-0'.4$, $-0.00009H$, and $-0'.1$, respectively.

The final observatory values received to replace the provisional ones originally supplied for the comparisons of 1922, as indicated in the summary of results on pages 93-96 of Bulletin No. 3, all tend to reduce the differences on standards.

Since the report of the Department on comparisons of the electric magnetometers from August 1922 to March 1923, submitted at the Rome Meeting (Bull. 3, p. 91), N. Watanabe and T. Kawamura have published the final results of the data obtained from comparisons between Watanabe's electric instruments and magnetic instruments.[1] The agreement of his electric magnetometer with the provisional International Magnetic Standard (I.M.S.) of the Carnegie Institution of Washington, the Schuster-Smith magnetometer, and the Carnegie Institution of Washington sine-galvanometer, is improved by correcting for the difference between the international ampere and the absolute ampere, the correction thus derived for his instrument being $0.00009H$ less the basis of the others. Dr. Chree, reporting upon comparisons between the Schuster-Smith magnetometer and the Kew Observatory standard magnetometer from three series in 1921, 1922, and 1923, shows the average difference (Kew—Schuster-Smith) to be only $-0.00004H$ (applying for 1922), although there is apparently a slight proprogressive change with time. Utilizing the 1922 C.I.W. comparison data at Kew, the resulting value for (I.M.S.—Schuster-Smith) is $+0.00008H$, which is in fair agreement with the value directly determined by C.I.W. comparisons at Teddington in 1922, namely, $-0.00015H$.[2] Dr. Watanabe's comparisons at Lukiapang, China, in November 1922 between his electric magnetometer and the Observatory magnetometer Elliott No. 49 also give an excellent check on values of (I.M.S.—Watanabe electric magnetometer) through comparisons on I.M.S. at Lukiapang in 1917, the resulting correction on I.M.S. being $-0.00021H$, as against the actual value observed at Kakioka in 1922 of $-0.00031H$. Thus it would again appear that the agreement between magnetic and electric instruments is well within the limits of all practical requirements. Unfortunately the earthquake of September 1, 1923 in Japan made it impossible, because of the destruction of certain of the electrical equipment, to obtain a second series of comparisons at Kakioka with the Watanabe standard electric magnetometer using a stand-

[1]N. Watanabe and T. Kawamura: The measurement of the horizontal intensity of the Earth's magnetic field with portable electric magnetometers, *Jap. Jour. Astron. Geophys.*, vol. 1 (1924); *cf.* this Bulletin, p. 106.

[2]The question as to any possible station-difference between the piers used at Teddington for the various comparisons has not yet been settled, though Mr. Smith is inclined to the belief that it may be negligibly small.

ardized C.I.W. field magnetometer-inductor, as was to have been made late in 1923 by an observer of the Department.

All results with the electric instruments of the three countries (Great Britain, Japan, and the United States) have been based now on absolute units.

Continued extensive field use of the C.I.W. magnetometer-inductor for the determination of declination and horizontal intensity by magnetic methods and of the inclination by the inductor method shows this type of instrument, because of its compactness, portability, and precision, to be very satisfactory even under the most severe conditions. The superiority of the inductor for determination of inclination was again emphasized by extensive field use. *The time required for complete determinations of the three magnetic elements using the magnetometer-inductor is somewhat greater than would be required by a suitably designed electromagnetic instrument, but it is feared that the difficulties of maintaining electric batteries and appurtenances on long journeys under severe and variable field conditions may offset any gain in time by the electromagnetic method. It may be remarked that, in any case, the actual time required for the magnetic observations is but a small part of the total time required for all the work at a field station.*

In view, however, of the desirability of developing portable designs of electromagnetic instruments for observatory and special field work it is planned to construct in the instrument-shop of the Department an electric magnetometer to determine not only declination and horizontal intensity but, by suitably mounting the coil-system on a horizontal axle so that it may be oriented at any desired angle, to determine also vertical intensity and total intensity, as well as inclination.

LOUIS A. BAUER, *Director;*
J. A. FLEMING, *Assistant Director.*

A DIFFERENTIAL METHOD FOR DERIVING MAGNETOMETER DEFLECTION-CONSTANTS.[1]

Abstract.

For the computation of the horizontal component of the Earth's magnetic field from the observed angle of deflection of one magnet by a second in Lamont's first position a factor, intrinsically a function of the dimensions of the magnets employed, is required to correct for these finite dimensions. The so-called "distribution-coefficients" concerned in this factor are generally determined through a rather tedious computation depending on the data observed at three deflection-distances. Theoretically the ratio of the sines (or the difference of the logarithmic sines) of the observed angles of deflection for any two distances is constant for a given instrument and pair of magnets; differential methods based on this theorectical condition are developed which simplify the computations required. [See page 161.]

Department of Terrestrial Magnetism,
Carnegie Institution of Washington.

H. W. FISK,
C. R. DUVALL.

[1]Published in full in *Terr. Mag.*, vol. 30 (1925), pp. 1-10.

ON PORTABLE ELECTRIC MAGNETOMETERS.

(1) There is little doubt but that with well-designed electric instruments for field use electric constants of coil and current standard may be determined with a precision of 0.0001*H*, or possibly less, for fields of 0.1 to 0.35 c.g.s. unit.

(2) As with magnetometers using the magnetic method, the constants of which are properly determined and controlled, strictly instrumental corrections would be of the order of less than 0.00015*H*, an amount negligible in field work.

(3) Systematic errors must be guarded against in the measuring system for an electrical instrument and the design and construction of the appurtenances for the determination of the electric measurements concerned must be carefully executed to prevent such errors.

(4) There is no doubt that an electric magnetometer and measuring galvanometer system may be designed which may give momentary values correct within 0.0001*H* or even less, although such accuracy is not warranted for field use unless the entire method and appurtenances are so devised as to be strictly portable and to provide for the determination of all three elements.

(5) There seems no reason why observations with different electric magnetometers should not be consistent, except for possible systematic errors in the current measuring appurtenances or devices.

(6) In field work the measurement of current with precision offers difficulties because of the rapid temperature changes to be expected at temporary tent stations; further the use of standard cells is restricted by the fact that they must not be subjected to temperatures lower than 4° C. (In this connection, see "Transactions of the Rome Meeting, May, 1922," Bulletin No. 3, page 139, giving comments from the Department of Terrestrial Magnetism on electrical methods.)

(7) So far as international comparisons of magnetic standards at base observatories is concerned, it may be desirable that these be made with properly designed electric magnetometers. It would be necessary that an instrument especially designed for this purpose be made as it is impracticable to transport together with necessary high-precision appurtenances, instruments such as the Schuster-Smith magnetometer and the C.I.W. sine galvanometer.

(8) The results of the intercomparisons of instruments, using magnetic methods, thus far obtained by the Department of Terrestrial Magnetism at the majority of magnetic observatories of the world, have been satisfactory and have certainly indicated a precision of adopted standard of at least 0.0002*H* in horizontal intensity and 0′.2 in declination and inclination.

J. A. FLEMING.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington.

ZUR PRAXIS MIT EINEM TRANSPORTABLEN SINUSGALVANOMETER.

Im Jahre 1915 gab ich die Beschreibung eines transportablen Siunsgalvanometers zur Bestimmung der Horizontalintensität des erdmagnetischen Feldes.[1] Dabei wies ich ausdrücklich auf den grossen Vorteil, ohne besonderes Galvanometer zur Abgleichung der richtigen Stromstärke nach der Kompensationsmethode auskommen zu können. Der durch den Strom in den Ablenkungsspulen (Helmholtz-Spulen) abgelenkte Magnet, empfindlicher als im unabgelenkten Zustand in der Meridiansebene, dient zugleich als Nullinstrument mittels eines zweiten Paares möglichst naher Galvanometerspulen, welche im Normalelementenzweig eingeschaltet sind.

In einer neulich erschienenen Arbeit,[2] welche denselben Gegenstand behandelt, beschreiben die Herren Watanabe und Kawamura ein ähnliches Instrument aber mit besonderem Galvanometer, und benützen meine Methode dadurch, dass sie die Galvanometerspulen an ihren Apparat befestigen, nur dann, wenn ein zweiter Beobachter nicht vorhanden ist. Dadurch erscheint bei ihnen diese Anordnung nur als Notbehelf und zwar als minderwertiger. Denn sie behaupten, sie könne unter Umständen zu falscher Stromabgleichung führen. Bei unrichtigem Hauptstrom in den Helmholtz-Spulen werde, beim Schliessen des Normalelementenzweiges, der Magnet aus zwei Gründen abgelenkt: (1) durch den durch die Galvanometerspulen fliessenden Normalelementenstrom, (2) durch die dadurch hervorgerufene Aenderung des Hauptstromes. Wenn nun diese beiden Wirkungen entgegengesetzt sind, sollen sie sich aufheben können, und desshalb soll ein Nullausschlag nicht notwendig Nullstrom im *N-E* Zweig bedeuten. Nur gleichgerichtete Wirkung beider Spulenpaare garantiren eine richtige Stromabgleichung. Die Verfasser setzen vor die Galvanometerspulen einen Kommutator, um jedesmal die richtige Stromrichtung herstellen zu können.

Es lässt sich nun leicht zeigen, dass ein gegenseitiges Aufheben dieser beiden engegengesetzten Wirkungen nicht zu befürchten ist. Es bedeuten:

E, e, die EMK der stromliefernden Akkumulatorenbatterie und des *N-E;*

R, den Normalwiderstand, an den das *N-E* angelegt ist;

A, Widerstand im Hauptstromkreis mit Ausnahme von R;

G, Widerstand des *N-E* Zweiges;

I_R, Strom im Normalwiderstand R;

I_g, Strom im *N-E* Zweig;

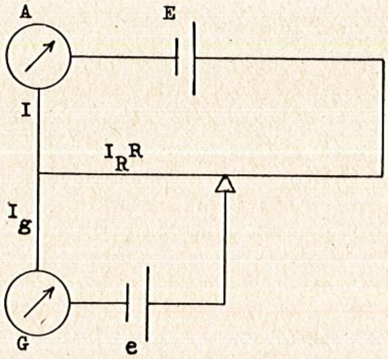
I, Ablenkungsstrom in den Helmholtz-Spulen;

I_o, derselbe bei geöffnetem *N-E* Zweig; und

[1] W. Uljanin, *Re.ueil de Geophysique,* 2, p. 51, 1915. (russisch, Resume franz.) *Cf. Terr. Mag.*, **22** (1917), p. 51, and **24** (1919), pp. 118-131.

[2] Watanabe, N. and T. Kawamura, *Japanese Journal of Astronomy and Geophysi.s*, Vol. 1, No. 6, 1924, 191-206; see this Bull., p. 106.

i_o, Wert des richtig abgeglichenen Stromes I_o, *d. h.* bei $I_g = 0$. Dann haben wir



$$I_o\,(A+R)=E;$$

$$IA+I_R R=E;$$

$$I=I_R \pm I_g; \text{ je nachdem } I_o \gtrless i_o$$

$$I_o(A+R)=(I_R \pm I_g).\,A+I_R R;$$

$$(I_o+I_R).(A+R)=\pm I_g A;$$

$$I_o-I_R=\pm I_g\,\frac{A}{A+R};$$

$$I-I_R=\pm I_g.$$

Dann wird die Aenderung des Hauptstromes beim Schliessen des N-E Zweiges

$$dI=I-I_o=\pm I_g\,(1-\frac{A}{A+R})=\pm I_g\,\frac{R}{A+R}=\pm I_g\,\frac{e}{E},$$

da offenbar $e=i_o R$ und $E=i_o\,(A+R)$.

Da nun immer $e<E$, ist notwendig $dI<I_g$. Die Ausschläge von diesen Strömen sind $\alpha_H=C_H dI$ und $\alpha_g=C_g I_g$, wo C_H und C_g die resp. Konstanten der Spulen bedeuten. Nun ist konstruktiv selbstverständlich immer $C_H<C_g$, somit desto sicherer $\alpha_H<\alpha_g$.

Da die Ausschläge von den beiden Spulenpaaren notwendig verschieden gross sind, können sie sich nicht aufheben. Also bedeutet Abwesenheit eines Ausschlages beim Schliessen des N-E Zweiges immer, dass $I_g = 0$ ist, *d. h.* dass der Ablenkungsstrom richtig abgeglichen ist, unabhängig davon, ob sich die Wirkungen addiren oder subtrahiren. Der einzige Unterschied besteht nur darin, dass im ersten Fall die Anordnung etwas empfindlicher ist, als im zweiten Fall.

Zum Schlusse möchte ich noch auf den in allen Fällen nicht zu vernachlässigenden Vorteil meiner Methode hinweisen gegenüber derjenigen mit besonderem Galvanometer. Ich halte es für prinzipiell vorteilhafter, wo es nur angeht, zwei besondere Wirkungen mit demselben Auge, durch dasselbe Fernrohr zu beobachten, als dieselben an zwei unabhängigen Instrumenten durch zwei sich verabredende Beobachter ablesen zu lassen. Langjährige Praxis mit meinem Instrument am Kasaner Magnetischen Observatorium hat vollauf die hohe Präzision und Bequemlichkeit der Beobachtungsmethode nachgewiesen. Besonders bei Feldarbeit ist die Verminderung des zu transportirenden Instrumentariums durch Wegfall eines besonderen Galvanometers mit Fernrohr und Aufstellstativ zu schätzen.[1]

W. ULJANIN.

Kasan (Observatoire Météorologique et Magnétique de l'Université de Kazan), Juni 1924.

[1]In 1922 Prof. Uljanin received a grant of 500 francs to assist him in his investigations.—*Sec.*

REPORTS ON OBSERVATORY WORK

ATHENS MAGNETIC OBSERVATORY, GREECE.

I have the honor to state, in reply to the Secretary's letters of December 24 and 31, 1923, that since 1904 the railway from Athens to Piraeus, passing by our magnetic station at a distance of 350 meters, has been replaced by an electric tramway. The current from this tramway greatly affects the curve of the registering instrument showing the vertical component, and a little also that of the bifilar. The curves of the vertical component thus become completely useless. Besides, towards the end of 1909 other electric traction lines were constructed very close to the Observatory, so that our magnetic service has been unable to continue the observatory work advantageously.

On account of these disturbing influences the magnetic observations made at the Observatory have been interrupted since that time and have been replaced by direct observations made outside of the city at irregular intervals.

In accordance with the Secretary's request, his circular letter of inquiry regarding status of magnetic work has also been forwarded to the Hydrographic Service of the National Navy, which is engaged in magnetic observations in Greece.

D. Eginitis,

Athens, February 28, 1924. *Director of the Observatory.*

MAGNETIC OBSERVATORIES OF CANADA.

It was on joint representation made by the Royal Society of London and the British Association for the Advancement of Science in 1838, that the British Government determined to place magnetic observatories in various points in the Overseas Dominions; Canada, Cape Colony and St. Helena were chosen.

The Canadian equipment, placed under Lieut. Riddell of the Royal Artillery, arrived in Canada in the autumn of 1839: the University of King's College granted a site for the new observatory.

The first observatory building at *Toronto* was erected under the direction of Lieut. Riddell, R. A. It was of logs, rough cast on the outside and plastered on the inside and was completed during the summer of 1840, observations both magnetical and meteorological being begun in September of that year. Lieut. Riddell returned to England in the spring of 1841, and Captain, afterwards General, Sir Henry Lefroy, who had meanwhile established an observatory of a similar character in St. Helena, was transferred to Toronto, in order that he might undertake a magnetic survey of British North America. Captain Lefroy remained as Director of the Observatory until the spring of 1853, when it ceased as an Imperial establishment.

The Observatory having been taken over by the general government of Canada, arrangements were made for retaining the military observers, and the institution was placed under the direction of Professor Cherriman, the Professor of Mathematics and Natural Philosophy, in University College, who continued in charge for two years. During this period a stone observatory was erected on the exact site of the old frame building, the pillars on which the magnetic instruments were placed being left standing and the walls built around them.

Professor G. T. Kingston, M. A. Cantab, was Director of the Observatory from 1855 to 1880 and Mr. Charles Carpmael, M.A., Fellow of St. John's College, Cambridge, from 1880 to 1894. The present Director, Sir Frederic Stupart, has been in charge since 1895.

Up to 1854 the observations comprised absolute determinations and hourly readings of the differential instruments; from 1854 to 1881 the differential instruments were read six times a day, except on international term days. Since 1881 the magnetic results have been obtained from the hourly measures of photographic records based on comparisons with absolute determinations made at frequent intervals.

Electric cars were first operated in Toronto during the summer of 1892 and it soon became obvious that the magnetic results were vitiated and by 1897 were well nigh worthless. It was then determined to remove the magnetic instruments to a point unlikely to be affected by the electric currents, and the village of *Agincourt*, nine miles distant in air line from the old Observatory, was chosen.

The new observatory, which was commenced in June and finished during the early days of September, consists of two parts, a circular stone cellar nineteen feet in diameter, the walls two feet in thickness, the floor concrete and the roof covered with felt and gravel in which, on stone piers sunk in concrete to a depth of six feet below the floor, are placed the self-recording photographic instruments, namely, the declinometer for recording changes in direction of the magnetic needle, and the bifilar and vertical force instruments for registering, respectively, changes in the horizontal and vertical components of the Earth's magnetism; above ground and connected with the cellar by a flight of steps is an erection which is divided into two portions, in the larger of which absolute magnetic determinations are made, piers being provided on which to place the necessary instruments, and an adjustable opening in the roof for transit work, and the smaller, an office which is heated by a copper stove. Observations were first made in the new building on September 10, 1898, and have been continued ever since

Records of the declination extend back to the founding of the Observatory in 1840. A westerly declination of 1°10′ in 1840 increased at an average rate of 3 minutes a year to 2°40′ in 1870. The movement from 1870 to 1898 shows an increased rate of change of nearly 5 minutes a year to 4°57′. In 1898 the change of site from Toronto to Agincourt, involved an increase in the declination of

29 minutes to 5°26′. Since then the yearly rate has been about 4 minutes, bringing the declination to 7°6′ in 1924. There is no sign as yet of any reversal in this secular trend.

In 1916, a second observatory for recording declination movements was established at *Meanook*, in Northern Alberta, and in 1925 a new observatory is being erected at this place, and a full equipment of magnetic instruments will be brought into operation in 1926.

R. F. STUPART.

Meteorological Service,
Toronto, Ontario.

OBSERVATORY WORK IN JAPAN.

(See page 80.)

TEOLOYUCAN MAGNETIC OBSERVATORY, MEXICO.

The Magnetic Observatory at Teoloyucan, a dependence of the Astronomical Observatory, is located 36 kilometers north of Mexico City, at a height of 2,265 meters. The geographical position is: latitude 19° 44′ 47″.5 N; and longitude 99° 10′ 53″.4 or $6^h\ 36^m\ 43.^s6$ W. Gr.

The Observatory was established in 1914, but owing to several causes definitive work did not begin until 1921, when the registering instruments and the absolute ones were installed. The instruments for the absolute observations are: a Dover magnetometer No. 123 and a Fauth dip circle No. 73. The registering set, Mascart type, is installed in a dark room near that for direct observations.

Calibrations of the registering variometers were made during the period of this report, the adopted values of one millimeter of ordinate on the magnetograms being as follows: Declinometer, 1′; Bifilar, 21γ; Vertical component, 17γ.

Generally, three absolute measurements are made monthly, and from these, the values of the base lines are deduced. The values of the magnetic elements are measured from the magnetograms, for every hour, and from these measurements the daily and monthly variations, and also the daily means are obtained, excepting when disturbance prevails. For the daily mean we prefer to deduce it from graphical measurement made with planimeter.

Shocks, or small earthquakes, are registered sometimes by the instruments, producing a displacement of the base line and thus giving some trouble when reducing the magnetograms.

In 21 days, absolute determinations were made with the aid of at least 2 complete observations separated by 3 hours. The base-line values are obtained from the absolute observations and the ordinate of the magnetogram at the same time. In the case of *H* and *Z*, temperature corrections are taken in account. Mr. Rosendo O. Sandoval, who is in charge of these observations, periodically determines the temperature coefficients and makes calibrations once a year.

Generally, disturbances begin or end with a decrease in the declination value. The amplitude is not more than four minutes, but is well defined always. The maximum is between 7 to 8 hours for the spring and summer, and between 8 to 10, in autumn and winter. The minimum occurs at 13 hours for the latter seasons and for summer and spring between noon and 13 hours. The hours for maximum and minimum for the other elements are very irregular, but there is a tendency, for maximum, between 8 to 10, and for minimum, between 13 to 17 hours.

Regarding the *Electricity Observations*, I am sorry to say that I have not yet succeeded in securing money enough to buy the instruments, but I believe that in the near future funds can be obtained for making these important observations at the Tacubaya Observatory, located at an elevation of 2,297 meters.

J. GALLO,
Director, Observatorio Astronomico Nacional.

Tacubaya, D. F., March, 1924.

OBSERVATORY WORK IN NORWAY.

Nearly all the magnetic work performed in Norway in the later years is in some way or other related to the polar-aurora researches, which were inaugurated by the late Professor Kr. Birkeland. The chief object of his aurora expeditions to Haldde in 1899-1900, and to Haldde, Nowaja Semlja, Spitzbergen and Iceland in 1902-1903 was the closer study of the magnetic perturbations and their possible connection with aurora. Registrations of all the magnetic elements were obtained at the said stations during the expeditions.

These registrations, and the other material collected, proving to be of an exceptional value, Prof. Birkeland proposed to establish a permanent observatory at Haldde, and in 1912 the Norwegian government made the necessary appropriations for such an observatory. As to the work performed at this observatory and at the subsequent Geophysical Institute of Tromsö, together with the Arctic stations founded and administered by the latter, I may refer to the more detailed report by its Director, Mr. O. Krogness (pp. 129–132).

Beside the magnetic work mentioned in Mr. Krogness's report the regular service at the old *magnetic observatory of the University of Kristiania* has been continued. This observatory was founded by Hansteen in 1841, and from 1843 eye-readings of the horizontal intensity and declination have been made *twice* (at 9 a. m. and 2 p. m.) every day.

Since 1894, electric tramway-lines pass the Kristiania Observatory at a distance of about 200 m., and the observations for the last thirty years have consequently only a limited value. Moreover, the observed data have not been finally reduced and published. From the preliminary results of the reductions, the observations, however, will, we hope, be of considerable interest for the study of the secular variations of H. The H-values have been observed with a very large bar magnet (1.2 m. long, weighing 13 kg.) bifilarly suspended in the central dome of the Observatory.

From direct experiments on the disturbances caused by passing tramway-cars performed in 1894, the late Director of the Observatory, Professor Geelmuyden, concluded that no perturbing effect of such a car can be detected 1 to 2 minutes after the passing of each car. The readings are consequently taken only in the intervals between two such passings.

The final reductions of the whole series of observations with this magnet are in preparation. SEM SAELAND.

Physical Institute A, University, Oslo,
December 17, 1924.

OBSERVATORY WORK IN NORTHERN NORWAY AND AT ARCTIC STATIONS.

The unique climatic conditions of the northern part of Norway and the neighboring Arctic districts make this part of the Earth an ideal place for the study of many important geophysical problems. Among such problems may be mentioned, in the first place, the extraordinary wind-and-weather conditions themselves, and secondly, the polar aurora and the magnetic storms connected with this splendid phenomenon. The very great interest connected with a regular weather-service for these northern districts on one hand, and, on the other hand, the importance of continuing the polar aurora and magnetic researches inaugurated by the late Professor Kr. Birkeland led to the founding of the *Haldde Observatory* as a permanent governmental institute in 1912.

Chiefly from meteorological reasons it was thought advantageous to choose as site for the observatory the northern end point of the long mountain chain, Kjolen, that stretches itself along the whole Scandinavian Peninsula.

The most important part of the work hitherto taken up at the Observatory has also been of a meteorological character and has resulted in the organization of a regular weather-service, by Mr. O. Devik, for these northern districts and the establishment of a central geophysical institute for the north of Norwat—the *Geophysical Institute of Tromsö.*

For auroral and magnetic work the conditions would theoretically be as favorable at Haldde as in any other place in the neighborhood. Practically, however, there will of course be some difficulties, especially regarding auroral observations and the absolute magnetic measurements caused by the exceedingly unfavorable and foggy weather-conditions.

In the winter time, it is true, it is often advantageous to observe from a high position such as this, as the clouds at that time frequently will lie underneath the level of the Observatory.

The auroral research-observation platforms are built on the roofs of both the two buildings at Haldde, and at the Geophysical Instititute at Tromsö. Both places have a free horizon in all directions.

A considerable number of auroral photographs, particularly parallactic ones, has been collected. A part of this work has been undertaken in collaboration with Professor Vegard, who also has undertaken an extensive research on the auroral spectrum at the Institute of Tromsö. In the most intimate connection with the auroral phenomena stand the magnetic storms, and for the investigation of these our institutes and polar stations have, as above mentioned, a most favorable position.

In order to get as reliable observations as possible, the magnetic registering house was built in the following manner: In the rock there was blown out a room about 4 x3 metres square, and in this room there was built an extra room of wood. The roof of this room lies about in the same heighth as the ground. An extra roof with a gable is built above, and this latter is thus the single part of the registering house that reaches above the ground. In the inner hut concrete pillars have been built directly on the rock, and in all there are two complete sets of registering apparatuses. The apparatuses have thus a very good and rigid position, and moreover the daily change of temperature is quite negligible. The arrangement has also proved to be very satisfactory, except during the snow-melting time, especially in the month of June.

During this time the thaw always produces a very disagreeable moistness in the inner hut. The only way in which one may get rid of this is by artificial warming of the room, but it has up to the present time not been possible to arrange for this.

Ordinarily, only one set of registering apparatus is in operation. This registering house is connected with the other houses by an underground passage blown out in the rock.

In order to be able to correct for sudden chance variations in the sensitivity of the apparatuses, especially in the vertical intensity, there is introduced an electric circuit in the room by the aid of which the sensitivity of all apparatuses is taken simultaneously each day, at the end and beginning of the registering-day sheets. The registering apparatuses are of the type Eschenhagen from Toepfer, and are the same ones which Professor Kr. Birkeland used on his auroral expeditions in 1902-1903.

For the absolute measurements a small hut with a cement pillar has been built at a little distance from the registering house. For these observations we have at our disposal a Tesdorpf universal theodolite, and a Schulze earth-inductor. It has, however, not been possible to get a satisfactory practical arrangement for observations with the latter. For this reason all inclination measurements have been undertaken with the Tesdorpf theodolite. This theodolite was also procured for the named expeditions of Birkeland.

The constants of this instrument have been determined by the writer in 1912 from comparative measurements at Potsdam. At the same time some improvements, especially with the declinatorium, were undertaken by the firm Toepfer, and the apparatus since that time has been in excellent working order.

The accuracy which may be obtained with this instrument is very satisfactory. As far as I can judge from the observations that have been taken, we may reckon with an uncertainty in the declination of about 0′.2, in the inclination a little more, perhaps about 0′.5 (?), and in H about 10γ. From a series of measurements taken in the field between Haldde and Kaafjord, it seems to be evident that there should not be considerable local disturbances near the Observatory.

As the origin of the magnetic storms according to the theory of Birkeland, by far the greater extent, is to be searched for in the auroral belts, the strength of the magnetic disturbances will undergo very great variations in the districts in which we are operating. For this reason I have found it very important to get a greater number of registering stations with the aid of which the character of the storms and storminess might be more fully studied.

The first step in this direction has been the establishment of a registering-magnetic station on Dovre under supervision of the astronomer, S. Enebo. This station is of special interest as it lies just in that region where the strength of the magnetic storms undergoes the greatest changes. From these districts we have no earlier observations of this kind. The registering at this station is performed with the apparatuses used by Roald Amundsen on the Gjöa Expedition to the magnetic pole.

The registering room is an underground chamber, and it is very satisfactory for its purpose. It had been a cellar of a house that now is torn down. The daily temperature variations are negligible and the moisture conditions are good. It was not possible, however, to mount the apparatuses on the solid rock, but the ground is very rigid and affords a satisfactory foundation. One absolute determination of the magnetic constants was undertaken in 1916 at the place. Since that time there has been no occasion to make a new measurement. (This will be done as soon as possible.) By the aid of the secular variations found at Haldde and at Kristiania, it is however possible to determine all constants necessary for the utilization of the curves—at any rate, with desirable accuracy, as regards magnetic storms and diurnal variations.

At the two stations, Quade Hook and Jan Mayen, magnetic registrations have been made. In the first place, a double wooden small house was built and some small instruments of a simple type (cf. "Geofysiske Publikationer," Vol. 1, No. 4, p. 12), have been used. One absolute measurement has been taken in 1921. The observations at Quade Hook are, however, now brought to an end. I hope it will be possible to take up these observations later at another place in Spitzbergen.

At Jan Mayen an attempt also has been made to get some registrations. Two horizontal variometers have been set up in a separate room in the dwelling house. The floor of the room is concreted on the ground. The conditions should be satisfactory enough to get results of some value; however, as yet, no satisfactory absolute measurement has been taken, and no professional magnetician has inspected the arrangement; thus, the station ought to be regarded only as a preliminary experiment as to the value of Jan Mayen for a permanent observatory. I hope that it will soon be possible to establish this station permanently in a satisfactory manner.

At last I may mention that we also once tried to obtain registrations on Bearen Island, a place of quite extraordinary interest in magnetic respects. The practical difficulties were at that time, however, too great, so that no registrations of any value were obtained.

Further, a series of *earth-current* registrations have been obobtained at Bosekop on some telegraph lines.

It will be seen from this report that different researches, partly of a comparatively extensive character, have been conducted as regards terrestrial magnetic problems. It has, however, not been possible to take up magnetic work in such a systematic manner as was desirable. The important practical problems of meteorology and weather-service have necessarily as yet required too much of our time and work. At present, the organization of the weather-service may be said to have come to such a satisfactory state that I hope to be able to take up systematic magnetic work.

By the establishment of the Geophysical Institute of Tromsö," it was presupposed that the researches in terrestrial magnetism for which the Haldde Observatory does not offer the most favorable conditions, should be taken up at Tromsö.

Now I hope to be able to undertake this work in collaboration with Professor Saeland, who will take up a similar work in South Norway.

O. KROGNESS,
Director, Geophysical Institute.

Tromsö, December 6, 1924.

PROPOSED MAGNETIC AND ELECTRIC OBSERVATORY IN SIAM.

According to information received from Lieut. Col. Phra Salwidhan, who represented his country at the Madrid Meeting, plans are under way for the establishment of a magnetic observatory in Siam. In accordance with his request, the Department of Terrestrial Magnetism of the Carnegie Institution of Washington sent him on March 10, 1925, desired information regarding suitable observatory buildings and instruments for magnetic and atmospheric-electric observations.

PROPOSED OBSERVATORY WORK IN SWITZERLAND.

Regarding the reports on work done in Switzerland during the years 1922 and 1923, I take pleasure in giving the following information:

a. Nothing has been done in the domain of terrestrial magnetism;

b. Prof. Gockel will eventually give you an account of his personal investigations;

c. We have no central observatory in Switzerland for terrestrial magnetism;

d. As to atmospheric electricity, we hope to establish an observatory in the near future under particularly favorable conditions. But so far it is only a scheme.[1]

RAOUL GAUTIER,
President, Comité Suisse de Géodésie et Géophysique.

Geneva, Observatory, February 25, 1924.

WORK AT MAGNETIC OBSERVATORIES IN GREAT BRITAIN AND IRELAND.

1. The observatories described in the Report to the Rome Meeting[1] still continue to function, but two of them, Kew and Greenwich are expected to cease in the course of the next year or two.[2] A new observatory under the Meteorological Office commenced recording at Lerwick, in the Shetland Isles, in 1923, and a new observatory to replace Greenwich is under construction in the uplands of Surrey, some 20 miles from London. A description of the design of this observatory, by the Astronomer Royal is appended.

2. *Greenwich* (lat. 51°28′N.; long. 0°0′; Director, Sir Frank Dyson, F. R. S., Astronomer Royal) is under the control of the Admiralty. The work remains the same as when described to the meeting at Rome. The following paper may be mentioned: The Earth's Magnetic Potential, by Sir Frank Dyson and Mr. H. Furner, "Monthly Notices Royal Astronomical Society, Geophysical Supplement," vol. I, No. 3, 1923.

3. *Kew* (lat. 51°28′N.; long. 0°19′W.; Superintendent, Dr. Charles Chree, F. R. S.) is under the control of the Meteorological Office. The routine work remains the same as described to the meeting of Rome. Since that meeting a good deal of work relating to the intercomparison of instruments in use at different stations has been undertaken by the Kew staff. The following publications relating to the work done at the Observatory may be mentioned: Absolute Daily Range of Magnetic Declination at Kew Observatory, Richmond, 1859 to 1900, by C. Chree, F. R. S., "Meteorological Office Geophysical Memoirs," No. 22, 1923; The 27-day Period (Interval) in Terrestrial Magnetism, by C. Chree, F. R. S., "Roy. Soc. Proc. A.," vol. 201, p. 368; Magnetic Phenomena in the Region of the South Magnetic Pole, by C. Chree, F. R. S. "Roy. Soc. Proc. A." vol. 104, p. 165; Atmospheric Pollution and Potential Gradient at Kew Observatory 1921 and 1922, by C. Chree, F. R. S. and R. E. Watson, B. Sc., "Roy. Soc. Proc. A.," vol. 105, p. 311; and A supposed Relationship between Sunspot Frequency and the Potential Gradient of Atmospheric Elec-

[1]See pp. 29 and 32, Resolution 22.
[1]Bull. No. 3, pp. 60-62.
[2]Kew, as regards magnetic work, was discontinued on January 1, 1925.

tricity, by C. Chree, F. R. S., "Physical Society of London Proc.," vol. 35, p. 129.

4. *Eskaldemuir* (lat. 55°19′N.; long. 3°12′W.; Superintendent, A. Crichton Mitchell, D. Sc., F. R. S. E.) is under the control of the Meteorological Office. The work continues to be carried on as described to the Rome Meeting. Discussion of the results for the current year and for previous years by Dr. Mitchell have appeared in the annual publications of the Meteorological Office. Reference may be made in particular to a discussion of criteria of magnetic activity, and the frequency of distribution of absolute daily ranges in "Hourly Values from Autographic Records," 1920, pp. 63 *et seq.*

5 *Stonyhurst* (lat. 53°51′N.; long. 2°28′W.; Director, Rev. A. L. Cortie,[1] S. J., F. R. A. S., F. Inst. P.) has for its governing body the Provincial of the English Province S. J. and the Rector of Stonyhurst. The electric light, having been introduced into the Observatory, has now been adopted for the magnetographs. A 2-minute time break every two hours is effected by means of a synchronous electric clock, operating a mercury switch. The error and daily rate of the clock are determined by the radio time signals from the Eiffel Tower. Since 1889 the magnetic character of each day has been given in the annual publication according to the following code letters, c=calm, s=small disturbance, m=moderate disturbance, g=great or marked disturbance, and $v.g$=very great disturbance or decided magnetic storm. From a comparison with the international daily character figures published at De Bilt for 1921 and 1922, the following mean equivalents have been found: $c=0.2$, $s=0.6$, $m=0.9$, $g=1.3$, and $v.\ g=1.5$. The routine work has remained as described to the Rome Meeting. As in the past research has been chiefly directed to the relation between solar activity and terrestrial magnetic disturbance. The following papers have been published during 1922 and 1923: Terrestrial Magnetic Disturbances and Sunspots, by Rev. A. L. Cortie, S. J., "Monthly Notices R. A. S." (Royal Astronomical Society), vol. 82, p. 170; Solar and Terrestrial Magnetic Phenomena 1913-1921, by Rev. A. L. Cortie, S. J., "Monthly Notices R. A. S.," vol. 83, p. 204; Sunspot Areas and Terrestrial Magnetic Horizontal Ranges and Disturbances 1921 and 1922, by Rev. A. L. Cortie, S. J., "The Observatory," vol. 45, No. 574, and vol. 46, No. 586; Series of Magnetic Disturbances, by Rev. A. L. Cortie, S. J., "The Observatory," vol. 46, No. 593 and "Report of the British Association 1923," p. 426; and Comparison of Sunspot Areas and Terrestrial Magnetic Horizontal Force Ranges 1911-1921, by Rev. B. G. Swindells, S. J., "Monthly Notices R. A. S.," vol. 83, p. 215.

6. *Valencia* (Cahirciveen, Co. Kerry, Ireland, lat. 51°56′N.; long. 10°15′W.; Superintendent, C. D. Stewart B.Sc.) has remained under the control of the Meteorological Office. The work remains as described to the Rome Meeting.

[1]It is with great regret that we must record the death of Father Cortie on May 13, 1925, at the age of 66.—*Sec.*

7. *Lerwick* (lat 60°9′N.; long. 1°11′W.; Officer-in-Charge J. Crichton, M. A., BSc.) is under the control of the Meteorological Office. The Observatory is provided with a unifilar magnetometer by the Cambridge and Paul Instrument Company and a Dip Circle by Dover. There are magnetographs recording declination, horizontal force and vertical force. The two former are the instruments once in use at Falmo ıth. The vertical force magnet in use at Falmouth has been replaced by a multi-needle magnet of the Watson pattern. Regular work began on January 1, 1923. It is intended to devote special attention to aurora.

8. *Abinger* (lat. 51°11′N.; long. 0°23′W.) is described in the following note by the Astronomer Royal.

9. Dr. C. T. R. Wilson, F. R. S., has contributed an article on Atmospheric Electricity to Vol. III of the "Dictionary of Applied Physics" (London, Macmillan and Co.) edited by Sir Richard Glazebrook, and a note on the Earth's Electric Charge to "The Observatory," vol. 45, 0. 390. His papers On Some α Rays Tracks, "Camb. Phil. Soc. Proc.," vol. 21, p. 405 and Investigations in X Rays and β Rays by the Cloud Method, Part I, X Rays, Part II, β Rays in "Roy. Soc. Proc. A.," vol. 104, p. 1 and p. 192, have a possible bearing on theories of terrestrial magnetism and electricity. Dr. Wilson has continued his observations on thunderstorm phenomena at the Solar Physics Observatory, Cambridge.

10. Prof. S. Chapman, F. R. S., has contributed a paper entitled the Motion of a Neutral Ionised Stream in the Earth's Magnetic Field to the "Camb. Phil. Soc. Proc.," vol. 21, p. 577.

Kew Observatory, 1924. CHARLES CHREE.

REMOVAL OF GREENWICH MAGNETIC OBSERVATORY TO ABINGER.

In 1921 the South-Eastern and Chatham Railway decided to proceed with the electrification of their suburban service. As one of the lines passes within half a mile of the Magnetic Observatory in Greenwich Park and as direct current was to be used in the electrification scheme, it was clear that the magnetic work could not be continued there unless suitable precautions were taken against interference. After discussion, it was decided that it would be better to move the Observatory than try to secure non-interference, and an arrangement was concluded with the Railway Company whereby they agreed to finance the removal of the Observatory.

The locality selected consists of 10 acres of land on the side of the valley known as Abinger Bottom, in Surrey. The geographical position is Lat. 51°11′03″N.; Long. 0°23′12″W. The height above sea level is 800 ft. The distance from the nearest railway line is 2¾ miles, and in view of possible electrification it is satisfactory to note that the configuration of the district will almost certainly ensure that no line will be constructed nearer than this.

The buildings at the new Observatory will be similar to those in

Greenwich Park and will consist of a wooden pavilion for the absolute instruments, and a house with an inner chamber with a thermostat control for the magnetographs. In addition, there will be a residential house for an observer and another building which consists of a caretaker's residence, offices and dynamo and accumulator rooms. The photographic dark room will be attached to the magnetograph building. The minimum distance between the house containing the instruments and the dynamo room is 370 ft. The dynamo will be shielded with soft iron.

The absolute instruments consist of a unifilar magnetometer by Messrs. Casella and Co., and declinometer magnet by Messrs. Elliott with a special theodolite by Messrs. Watts, and a Dip Inductor with accessories, by the Cambridge and Paul Instrument Co. In addition to these instruments of standard type there will be a coil magnetometer of the Schuster-Smith pattern made by the National Physical Laboratory. This will be similar but smaller than the one at the National Physical Laboratory, described in "Phil. Trans.," A, 223, pp. 175-200, 1922, and will be standardised by comparison with this instrument whose constants have been determined with the greatest accuracy.

The magnetograph house will contain Declination, North Force and Vertical Force Magnetographs with recording mechanism. These instruments are being constructed by the Cambridge and Paul Instrument Co.

In order to ensure continuity of record it was considered advisable to obtain simultaneous absolute observations at Abinger and Greenwich until the electrification of the railway renders observations at the latter impossible. Absolute observations at Abinger were begun on 1924 March 24, the magnetic pavilion having been completed. It is expected that observations will be possible at Greenwich until the end of 1925.

The new Observatory is 25 miles distant from Greenwich and will be an out-station of the Royal Observatory rather than a distinct Observatory. Two observers will be resident there, but the direction will be from Greenwich, and the Superintendent of the Magnetic and Meteorological Department will visit Abinger regularly.

Greenwich Observatory, March 25, 1924. F. W. DYSON.

OBSERVATORY WORK BY THE UNITED STATES.[1]

The magnetic observatories at Cheltenham, Maryland; Vieques, Porto Rico; Tucson, Arizona; Sitka, Alaska; and near Honolulu, Hawaii, have continued in operation with no serious interruption except at Vieques, where the driving clock of the recording apparatus gave much trouble. The instrumental equipment has remained unchanged. The Vieques Observatory is now equipped with a radio receiving set for receiving time signals.

[1]Communicated by the Director of the United States Coast and Geodetic Survey, Col. E. Lester Jones.

Unfortunately the grounds occupied by the Vieques Observatory must be vacated by June 30, 1925. Plans are being made for the erection of observatory buildings on the island of Porto Rico, and it is hoped to have them ready by that date so that the interruption in the series of observations will be small.

Systematic observations of the *aurora* are now being made at the Sitka Observatory; also a study of the effect of magnetic storms on cable transmission. At the Cheltenham Observatory investigations are in progress looking to the control of the temperature coefficient of horizontal-intensity variometers and the development of a vertical-intensity variometer with bifilar suspension.

In cooperation with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, special observations were made at the five observatories in connection with the solar eclipses of September, 1922, and September, 1923. The results have been published in "Terrestrial Magnetism and Atmospheric Electricity," 1923 and 1924.

The observatory results have been published to the end of 1920, and those for 1921 and 1922 are in the hands of the printer or ready to be sent.[1] The cost of publication of these results has been reduced more than 60 per cent by the photographic reproduction of the tables of hourly values, the reduction in the size of the the printed page and the reduction in the size of the reproductions of magnetic disturbances. New methods and devices for computing have been adopted which speed up the work, relieve the computer of much eyestrain and reduce the chances of error. Some of these will be made the subject of a special paper.

Thus far attention has been directed to the complete and prompt publication of results. It is hoped in the near future to secure an increase of personnel so that it will be possible to take up the discussion of the accumulated 20 years of homogeneous data from five widely distributed observatories.

Special Publication No. 89, Horizontal Intensity Variometers, is a mathematical discussion of the theory of both bifilar and unifilar variometers, with practical applications to their actual operation and should prove of great assistance to those in charge of magnetic observatories.

PUBLICATIONS ISSUED DURING THE LAST TWO YEARS.

Special Publication No. 87, Results of Magnetic Observations made by the U. S. Coast and Geodetic Survey in 1921;

Special Publication No. 94, Results of Magnetic Observations made by the U. S. Coast and Geodetic Survey in 1922;

Special Publication No. 102, Serial No. 268, Results of Magnetic Observations made by the U. S. Coast and Geodetic Survey in 1923;

Special Publication No. 90, Magnetic Declination in the United States for January 1, 1920, with isogonic chart. (A similar chart will be published for 1925);

Serial No. 272, Magnetic Surveys;

Serial No. 237, Magnetic Declination in Arkansas;

[1]These have since been published.—*Sec.*

Serial No. 262, Magnetic Declination in Florida;
Special Publication No. 89, Horizontal-Intensity Variometers;
Special Publication No. 96, Compensation of the Magnetic Compass;
Serial No. 200, Honolulu Observatory Results for 1919 and 1920;
Serial No. 214, Cheltenham Observatory Results for 1919 and 1920;
Serial No. 168, Porto Rico Observatory Results, 1917-1918;
Serial No. 235, Sitka, Alaska Observatory Results for 1919-1920;
Serial No. 239, Porto Rico Observatory Results for 1919-1920;
Serial No. 248, Tucson, Arizona Observatory Results for 1919-1920;
Serial No. 275, Cheltenham Observatory Results for 1921 and 1922;
Serial No. 276, Honolulu Observatory Results for 1921 and 1922;
Serial No. 282, Sitka, Alaska Observatory Results, 1921 and 1922;
Investigation of Local Magnetic Disturbances at Port Snettisham, Alaska, by Commander N. H. Heck, U. S. C. & G. S., Chief, Division of Terrestrial Magnetism;
Where the Compass Fails to Guide, by Commader N. H. Heck, U. S. C. & G. S., Chief, Division of Terrestrial Magnetism;
Vertical-Intensity Variometers, by George Hartnell, Magnetic Observer, Coast and Geodetic Survey;
Results of Observations made at the time of the Solar Eclipse of September 10, 1923, by the U. S. Coast and Geodetic Survey; by D. L. Hazard, Assistant Chief, Division of Terrestrial Magnetism;
Computation of Tabular Values, by Frank Neumann, Mathematician, U. S. C. & G. S.

N. H. HECK,
Commander, U. S. C. & G. S., and Chief of Division of Terrestrial Magnetism.

United States Coast and Geodetic Survey, Washington, D. C., 1924.

THE COMPUTATION OF MAGNETIC OBSERVATORY RESULTS.

The United States Coast and Geodetic Survey operates five magnetic observatories. They are so widely distributed that it is important that the results from all of them should be published in full, and this has been the policy of the Bureau from the beginning.

The observatory publications contain values of declination, horizontal intensity and vertical intensity for every hour of the year; maximum, minimum, range and mean values for each day; monthly means for each hour of the day, derived (1) from all days, (2) from ten selected quiet days, (3) from five international quiet days; base-line values based on absolute observations made once a week; scale values determined once a month; monthly diurnal variation tables for the various elements and components derived from the ten-day and five-day hourly means; and reproduction of magnetograms showing the principal magnetic disturbances.

The derivation of these results involves an enormous amount of routine computation, simple enough, but monotonous and tiring to eye and brain. The results of a year from a single observatory require about 33,000 additions of two numbers, 1,000 additions of 5 to 31 numbers, 24,000 multiplications and 1,500 divisions. When these are multiplied by five the amounts seem appalling. Nevertheless the work has been so systematized that three computers are able to keep it up to date, but this has been made possible only by the fullest use of adding and tabulating machines, multiplication and addition tables and other time-saving devices. Printed forms are provided for observations as well as for computations.

At each observatory the absolute observations, base-line values and scale values are computed and the hourly ordinates are read and tabulated, together with maximum and minumum values for each day. The declination ordinates are tabulated directly in minutes, but those for horizontal intensity and vertical intensity are given in millimeters. The forms on which the ordinates are tabulated are so arranged that the values for any day are all on the same line. The records and computations are sent to the Washington office once a month. As a rule only the base-line and scale value computations require revision in the office and they receive first attention. The adopted scale values are usually different for different months and in the case of vertical intensity it may be necessary to change the scale value oftener than once a month even when there have been no changes of adjustment. The base-line computations are revised using the adopted scale values and the base-line values are then adjusted.

The next step is the conversion of the hourly horizontal intensity and vertical intensity ordinates from millimeters to gammas, the adopted unit of intensity. This is done with the aid of a Crelle multiplication table and the converted values are tabulated on forms of the same kind, using a ten-key adding and tabulating machine. The work is done by columns, the sum of each column being entered at the bottom.

The hourly values of declination are computed by simply adding the adopted base-line values of the hourly ordinates. In the case of horizontal and vertical intensity the base-line values must be added to the converted ordinates and in addition a temperature correction must be applied. It is here that there has been the greatest improvement in methods, resulting in saving of time, eye strain and brain fag.

First in importance is the use of a ten-key adding and cross-tabulating machine, which can be operated by the touch system with one hand, so that the experienced operator can strike the right key without looking at the key-board. The machine has a carriage long enough to take in the regular tabulation form and is fitted with stops corresponding to the spacing of the columns on the form. The operator sets the carriage for the first column of a line and need not look at the machine again until the end of the line is reached. The sum of the 24 hourly values is tabulated at the end of the line, the paper is turned to the next line automatically and the operator simply has to push the carriage back to the beginning of the line.

The operator can thus keep his eye fixed on the tabulation of ordinates and has one hand free to keep his place on the sheet. The forms are so large, however, that they are inconvenient to work with where two are in use (intensity and temperature) if they are laid flat. This fact led to the construction of a copy holder consisting of two rollers and an aluminum plate mounted on a wooden frame. Two parallel slots extend lengthwise of the plate the same distance apart as the axes of the rollers. A sheet of intensity ordinates is fastened around the lower roller and a temperature sheet around the upper roller and the rollers are turned so that the lines for the same day are seen through the two slots. Two sliding pointers act as guides in the use of the copy holder.

The work is further simplified by the use of an addition table. The table is prepared in a number of sections which cover the desired range and which overlap sufficiently to meet working conditions. The table consists of twenty rows of numbers, each of three figures or less, the numbers being arranged in consecutive order horizontally and differing by ten vertically. Each section is mounted on an aluminum plate which may be placed between the slots of the copy holder. A frame just large enough to enclose ten colums of the addition table is ruled on a piece of celluloid. This is attached to a light bar on the copy holder so that the frame may be placed over any desired portion of the table. Any ten columns enclosed by the frame contain 200 consecutive numbers beginning with the one in the upper left hand corner. The sum of that number and any number from 1 to 199 can be picked out in the frame as readily as a product is taken from Crelle's multiplication tables. For convenience the sixth column is indicated by vertical double lines on the frame; also 50, 100, and 150 are indicated by horizontal double lines.

To use the table, the base-line value for the day, expressed in gammas, is corrected for the temperature of the first hour of the day. The proper section of the addition table is then placed in position on the copy holder and the celluloid frame is set so that the three right hand figures of the corrected base-line value appear in the upper left hand corner. This setting is used until there is a change of temperature, when a new setting must be made, but usually differing by only one unit. In most cases the converted ordinates do not run over 200. If that should occur a sufficient number of hundreds may be added to the corrected base-line value and subtracted from the ordinates to bring them within the limits of the table.

The accuracy of the computations is assured either by direct revision of each step or by the application of suitable checks such as carrying a check sum. The use of the addition table materially reduces the chance of error at an important stage, the final tabulation.

The tables of hourly values are sent to the printer just as they come from the tabulating machine, except for the addition of headings and foot notes, and are reproduced photographically for the publication in reduced size. This eliminates all chance of error in typesetting and saves the time and drudgery of proof-reading.

This, together with a reduction in the size of the printed page from quarto to octavo and a reduction in the size of the reproduction of magnetic storms, has resulted in a reduction of more than 60 per cent in the cost of publication.

It has also been found more advantageous to use an adding machine in preparing the tables showing the diurnal variation of X, Y, I and F than the graphical method explained in recent observatory publications. The tabular quantities are computed from equations of the form:

$$\begin{aligned} \triangle X &= a \ \triangle H + b \ \triangle D \\ \triangle Y &= c \ \triangle H + d \ \triangle D \\ \triangle \mathrm{I} &= e \ \triangle Z + f \ \triangle H \\ \triangle F &= g \ \triangle Z + h \ \triangle H \end{aligned}$$

The computation of each tabular value involves two multiplications and an addition. With the aid of auxiliary tables giving the products of the constant factors and all values of $\triangle D$, $\triangle H$ and $\triangle Z$ from zero to the greatest value needed, there is no difficulty in doing the work mentally, but the use of an adding machine materially reduces the mental effort and chance of error. The proper arrangement of the auxiliary multiplication tables is an important factor in facilitating the work. It is a gain to compute $\triangle X$ and $\triangle Y$ together and $\triangle I$ and $\triangle F$ together and the tables are prepared accordingly. For $\triangle X$ and $\triangle Y$ three tables are prepared in one of which the values of $a \ \triangle H$ appear just over the corresponding values of $c \ \triangle H$, while in the other two the values of $b \ \triangle D$ appear just over the corresponding values of $d \ \triangle D$; one of these two tables is to be used when $\triangle H$ and $\triangle D$ have like signs and the other when they have unlike signs. It should be noted that for use with the adding machine, subtractions are avoided by adding 1,000 to the numbers which would otherwise be negative in the tables. In such cases 1,000 must be subtracted from the adding machine sum. In practice, for given values of $\triangle H$ and $\triangle D$, the values of $a \ \triangle H$ and $c \ \triangle H$ are taken from the table and set up in the machine on the same line; then the values of $b \ \triangle D$ and $d \ \triangle D$ are taken from the proper table and set up on the next line. The values $\triangle X$ and $\triangle Y$ appear in the printed sum. For example:

1,670,029;	$a \ \triangle H$ and $c \ \triangle H$
9,880,066;	$b \ \triangle D$ and $d \ \triangle D$
11,550,095;	$\triangle X$ and $\triangle Y$

In the case $\triangle X = +15.5$ and $\triangle Y = +9.5$. The four places to the right are used for the computation of $\triangle Y$, the next four for $\triangle X$. Again:

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1,380,024
  260,851
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1,640,875
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Here the fact that $\triangle H$ is negative is indicated by a designation key on the machine; the values are $\triangle X = -16.4$ and $\triangle Y = +12.5$.

These results are copied from the adding machine slips on to the prepared forms, which are designed to hold the diurnal variation tables for one element or component for one year. This copying is done on a typewriter with a special keyboard, on which the figures are arranged in the same way as on the adding machine, with the plus and minus signs adjacent, so that it may be operated with one hand by the touch system. A carbon copy of the tabulations is made for the printer. Eventually it may be possible to arrange the tables so that they too may be reproduced photographically.

The copy holder and addition table were devised by Frank Neumann, mathematician in the Division of Terrestrial Magnetism, and the modified typewriter keyboard was also suggested by him. The use of these devices is described more fully in Terrestrial Magnetisn and Atmospheric Electricity for September, 1924.

At present the reproductions of magnetic storms are made from vellum tracings. It is hoped that the sharpness of the lines on the magnetograms may be increased to the point where satisfactory reproductions may be made directly by photography.

The methods outlined above have all contributed to greater economy in the computation and publication of observatory results, directly in the reduction of the time and expense and indirectly in the increased efficiency of the computers as a result of operations less tiring to eye and brain. While the initial cost of the instruments is considerable, they soon pay for themselves in the resultant saving.

D. L. HAZARD,
Assistant Chief, Division of Terrestrial Magnetism.

United States Coast and Geodetic Survey,
Washington, D. C., 1924.

OBSERVATORY WORK OF THE CARNEGIE INSTITUTION OF WASHINGTON IN TERRESTRIAL MAGNETISM AND ELECTRICITY.

The Department of Terrestrial Magnetism of the Carnegie Institution of Washington, since the report made in May 1922 at the Rome Meeting,[1] has continued to operate its two magnetic and electric observatories, namely, Watheroo, Western Australia, and Huancayo, Peru. At the former there is now being carried out the full program of observational and investigational work in terrestrial magnetism, atmospheric electricity, and earth-currents, and at the latter the full program in terrestrial magnetism and atmospheric electricity. It is hoped that earth-current installations may be made at the Huancayo Observatory and records begun there some time during 1925. The Department has also continued its cooperation with the New Zealand Government in the maintenance of the Apia Observatory, Western Samoa, and has cooperated with the MacMillan North Greenland Expedition in the maintenance of a temporary magnetic and electric observatory at Refuge Harbor, near Etah, Greenland, as described later.

[1]Bull. No. 3, pp. 69-71.

The *Watheroo Magnetic Observatory* in Western Australia is located 12 miles west of Watheroo, about 125 miles north of Perth, at an elevation of about 800 feet, latitude 30°19′.1 south, and longitude 115°52′.6 east of Greenwich. The magnetic work there has been continuous since January 1, 1919, and the atmospheric-electric work since the latter part of 1922, except as regards the atmospheric potential-gradient, continuous recording of which was started at the end of December 1923. The approximate values of the magnetic elements in 1923 were: Declination, 4°20′.9 west; inclination, 64°02′.8 south; horizontal intensity, 0.24779 c.g.s.; vertical intensity, 0.50910 c.g.s. The present Observer-in-Charge is Mr. H. F. Johnston.

The Huancayo Magnetic Observatory, in Peru, is located about 9 miles west of Huancayo, about 120 miles east of Lima, at an elevation of about 11,000 feet, in latitude 12°02′.7 south and longitude 75°20′.4 west of Greenwich. The magnetic work at this observatory was begun March 1, 1922, and the work in terrestrial electricity in October 1923 for negative and positive conductivity, and in February 1924 for atmospheric potential-gradient. The approximate values of the magnetic elements in 1923 were: Declination 8°04′.6 east; inclination, 0°45′.6 north; horizontal intensity, 0.29786 c.g.s.; and vertical intensity, 0.00395 c.g.s. The present Observer-in-Charge is Mr. W. C. Parkinson.

The *observatory instruments* continued to be as indicated in the report to the Rome Meeting, the magnetic elements registered being declination, horizontal intensity, and vertical intensity, and the atmospheric-electric elements registered being positive and negative conductivity and potential gradient. The apparatus for registering the electric conductivity of the atmosphere is of standard design of the Department for observatory work; that for the registration of the potential gradient, for the present, pending the completion of the special observatory standard type of electrometer and registration apparatus of the Department, as a recording bifilar string electrometer, as constructed by Günther and Tegetmeyer. The earth-current registrations at Watheróo are obtained on one system of 2-mile overhead lines and one system of 1-mile underground cable, each of which has lines running true south and north, and true west and east from the observatory, the registrations showing the difference of potential between electrodes at the common and terminal points.

Time at both observatories is determined by means of radio time-signals which are regularly received at Watheroo from Adelaide (South Australia), and at Huancayo from Balboa (Canal Zone) and Arlington (United States).

Meteorological observations, as for a first-class meteorological station, are regularly made at each observatory for particular use in investigations of possible correlations between phenomena of terrestrial magnetism, terrestrial electricity, and meteorology. Recording anemographs were installed in 1924 at both observatories.

Sites and buildings at each of the observatories are fully described in the published "Transactions of the Rome Meeting." Arrangements have been made for greater accessibility to the observatories from railway stations, 12 miles distant at Watheroo and 9 miles distant at Huancayo, by improvement of roads and purchase of automobiles.

At the *Apia Observatory*, Mr. Andrew Thomson, of the Staff of the Department of Terrestrial Magnetism, continued in charge of the cooperative observations concerned with atmospheric electricity and allied meteorological phenomena; beginning with January 1, 1923, upon request of the Scientific Honorary Board of Advice of New Zealand, he served as Acting Director of the Observatory, with the aid of Mr. C. J. Westland as Chief Assistant. The mean values for the year 1923 determined from the magnetograms at the Apia Observatory are: Declination, 10°16′.3 east; inclination, 30°06′.6 south; horizontal intensity, 0.35248 c.g.s.; and vertical intensity, 0.20440 c.g.s. Since October 1, 1923, in addition to the registrations of atmospheric potential-gradient at the station of the Observatory grounds, continuous records of that element were also obtained at a specially designed laboratory, designated "reef house," built under the supervision of the Engineer-in-Charge of the Public Works Department of Western Samoa, at the expense of the Department, above the waters of the lagoon inside the reef, about 1/3 mile off shore. The Department also supplied an automatic tide-gauge after the design of the United States Coast and Geodetic Survey to control reduction-factor determinations for the equipment at this special station. Occasional diurnal-variation observations of conductivity are also made. In addition to the magnetic and electric work, an enlarged meteorological program was established and the Observatory now serves as the central station of a service embracing the Fiji, Tonga, Marshall, and New Hebrides islands. The program of upper air work was resumed in June 1923.

The Honorary Board of Advice for Samoa in its 1923 report commented favorably on the continued scientific activities of the Apia Observatory, realized largely, as it stated, through the stimulus afforded by the cooperation of the Carnegie Institution of Washington with the New Zealand Government. Upon the recommendation of the Board of Advice the Secretary of the New Zealand Department of External Affairs asked Mr. Thomson, with the consent of the Institution, to accept the directorship of the Observatory beginning September 1, 1924.

The investigations and control of magnetic standards in the *Standardizing Magnetic Observatory at Washington* were continued. Besides the comparisons of instruments, before and after field work, reductions and compilations of results of comparisons at observatories were made. Comparisons were obtained at the Cheltenham Magnetic Observatory during March 18 to 21, 1924, for the purpose of controlling the constancy of the standards adopted by the Coast and Geodetic Survey as based on the provincial International Magnetic Standards adopted by the Department; these comparisons, as noted elsewhere, were made in accordance with the Resolution No. 4 passed at the Rome Meeting.

Operation of the experimental *atmospheric-electric observatory at Washington* was continued, daily photographic records of the atmospheric potential-gradient and negative electric conductivity of the atmosphere being obtained. This work is primarily intended for experimental studies and for use in the development of atmospheric-electric equipment for observatory and land stations.

A temporary magnetic observatory at *Refuge Harbor, Greenland*, was built according to the design of the Department at the winter quarters of the MacMillan North Greenland Expedition of 1923-1924. A radiogram received on November 9, 1923, from Observer R. H. Goddard of the Department's staff, in charge of the cooperative scientific work of the Expedition, stated that the magnetograph and potential-gradient electrograph registrations were begun at the Refuge Harbor Observatory (latitude 78°31′ north, longitude 72°27′ west of Greenwich) on October 19, 1923. The new observatory, constructed according to the Department's improved design, proved superior to the type used at Bowdoin Harbor, Baffin Land, in 1921-1922. The approximate values of the elements in Refuge Harbor in 1923 were: Declination, 101° west; inclination, 85°.8 north; horizontal intensity, 0.042 c.g.s. Messages received during the winter indicated that the observatory was functioning well. The last radio communication of July 19, 1924, gave information that the *Bowdoin* had left winter quarters and would shortly be headed homeward; thus the series of magnetic and electric observations at Refuge Harbor covers about eight months, namely, from October 1923 to June 1924.

Observations were also made on *Amundsen's Arctic-Drift Expedition* using a temporary snow house as an observatory. The program included diurnal-variation observations in declination and in potential gradient. A radiogram giving details of the observational work, received on January 10 by Captain Amundsen at Christiania from Captain Wisting, in command of the *Maud*, stated at that time thirteen complete daily series of electric potential-gradient observations had been obtained since October 1923 by Dr. Sverdrup. The message stated also that the records with the self-recording electrometer during the winter, when referred to Greenwich time, show results closely similar to those obtained on the *Carnegie*, the mean daily value of the atmospheric potential-gradient being about 120 volts per meter and the diurnal range about 50 volts per meter.

Final reductions of observatory records and publications. Excellent progress was made in the final reductions of the magnetic records obtained at the Watheroo Observatory. The final tabulations for the four years 1919 to 1922 are nearly completed and are being made ready for publication in a volume of the series entitled "Researches of the Department of Terrestrial Magnetism."

LOUIS A. BAUER, *Director;*
J. A. FLEMING, *Assistant Director.*

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
September 10, 1924.

LATEST DATA CONCERNING MAGNETIC OBSERVATORIES, 1924.

COMPILED BY J. A. FLEMING

Observatory	Lat.	Long.	Latest Publication[1]	Latest Magnetic Elements					Person in Charge of Magnetic Work
				Year	Decl'n (D)	Incl'n (I)	Hor. Int. (H)	Ver. Int. (Z)	
	° ′	° ′			° ′	° ′	c. g. s.	c. g. s.	
Matochkin Shar	73 15 N	56 24 E	......	1924	20 35. E	80 03. N	.0952	.5427	....
Sodankylä....	67 22 N	26 39 E	1922	1922	1 22.6 E	75 40.5 N	.12561	.49187	H. Hyyryläinen
Lerwick......	60 09N	1 11W	....	.....	....	....	....	....	A. H. R. Goldie
Pavlovsk.....	59 41 N	30 29 E	....	1924	3 16.1 E	71 07.9 N	.15818	.46970	N. N. Trubiatchinskii
Sitka........	57 03 N	135 20W	1924	1922	30 29.1 E	74 22.4 N	.15560	.55631	F. P. Ulrich
Ekaterinburg .	56 50 N	60 38 E	1925	1924	11 00.8 E	71 58.4 N	.16578	.50942	P. Müller
Rude Skov...	55 51 N	12 27 E	1922	1921	7 45.2W	69 01.2 N	.17105	.44607	J. Egedal
Kasan.......	55 50 N	48 51 E	1916	1924[2]	8 53.5 E	70 07.6 N	.17310	.47517	W. Uljanin
Eskdalemuir..	55 19 N	3 12W	1923	1920	16 49.7W	69 39.5 N	.16706	.45062	A. H. R. Goldie
Meanook.....	54 37 N	113 20W	1925	1924	27 17.7 E	77 53.7 N	.12866[3]	.59984[3]	R. F. Stupart
Stonyhurst...	53 51 N	2 28W	1925	1924	15 05.3W	68 41.7 N	.17276	.44281	A. L. Cortie, S.J.
Wilhelmsh'ven	53 32 N	8 09 E	1913	1911	11 28.2W	67 30.7 N	.18110	.43747	E. Stück (1919)
Potsdam.....	52 23 N	13 04 E	1925	1923[2]	6 56.9W	66 36.5 N	.18565	.42920	Ad. Schmidt
Seddin.......	52 17 N	13 01 E	1925	1922	7 09.4W	66 32.8 N	.18614	.42905	O. Venske
Irkutsk (Zuja)	52 28 N	104 02 E	....	1920	1 02.3 E	71 06.6 N	.19277	.56337	A. I. Pödder
Swider.......	52 07 N	21 15 E	....	.....	....	....	....	....	St. Kalinowski
De Bilt......	52 06 N	5 11 E	1924	1924	10 38.3W	66 52.7 N	.18372	.43024	G. van Dijk
Valencia.....	51 56 N	10 15W	1923	1920	19 17.9W	68 05.3 N	.17840	.44353	L. H. G. Dines
Bochum......	51 29 N	7 14 E	1923	1921	10 10.4W	....	......	....	W. Löhr
Kew.........	51 28 N	0 19W	1923	1920	14 31.0W	66 57.9 N	.18410	.43297	Charles Chree
Greenwich....	51 28 N	0 00	1924	1923	13 35.1W	66 51.9 N	.18431	.43137	F. W. Dyson
Uccle........	50 48 N	4 21 E	1920	1916	12 28.4W	66 02.8 N	.18971	.42703	A. Hermant
Hermsdorf....	50 46 N	16 14 E	....	1913	6 58.2W	....	......	....	Schmalenbach
Prague.......	50 05 N	14 25 E	1921	1921	6 24.2W	....	......	....	....
Val Joyeux...	48 49 N	2 01 E	1924	1922	12 31.5W	64 39.6 N	.19661	.41517	L. Eblé

[1] Year of publication of latest volume known to have been issued.
[2] Latest values of the magnetic elements communicated by letter.
[3] No values in March 1924.

Observatory	Lat.	Long.	Latest Publication[1]	Latest Magnetic Elements					Person in Charge of Magnetic Work
				Year	Decl'n (D)	Incl'n (I)	Hor. Int. (H)	Ver. Int. (Z)	
	° ′	° ′			° ′	° ′	c. g. s.	c. g. s.	
Munich......	48 09 N	11 37 E	1923	1913	9 06.2W	63 04.6 N	.20623	.40609	F. Burmeister
			1923	1921	7 53.6W	....	......	....	F. Burmeister
O'Gyalla.....	47 53 N	18 12 E	1922	1918	5 21.9W	....	.20917	....	I. Kömendy (1919)
Nantes (Petit-Port).	47 15 N	1 33W	....	....	....	....	......	....	E. Tabesse
Odessa.......	46 26 N	30 46 E	....	1910	3 35.9W	62 26.9 N	.21707	.41606	M. Aganin
Pola.........	44 52 N	13 51 E	1923	1922	6 28.0W	60 12.8 N	.22090	.38591	Teodoro Haas
Agincourt....	43 47 N	79 16W	1925	1924	7 05.8W	74 44.4 N	.15752	.57733	R. F. Stupart
Tiflis.........	41 43 N	44 48 E	....	1913	3 09.1 E	56 51.1 N	.25217	.37612	R. F. Assaffrey
Capodimonte (Naples)....	40 52 N	14 15 E	1919	1914	....	....	.24166	....	A. Bemporad
Ebro(Tortosa)	40 49 N	0 31 E	1925	1924	11 20.2W	57 30.5 N	.23359	.36678	Luis Rodés, S.J.
Coimbra.....	40 12 N	8 25W	1921	1920	15 21.5W	58 22.8 N	.23087	.37496	A. F. de Carvalho
Cheltenham...	38 44 N	76 50W	1922	1922	6 27.7W	70 57.6 N	.19020	.55115	George Hartnell
Athens.......	37 59 N	23 42 E	1910	1908	4 53.0W	52 11.7 N	.26197	.33613	D. Eginitis
San Miguel...	37 46 N	25 39W	1921	1920	19 24.9W	60 26.0 N	.23123	.40759	F. A. Chaves
San Fernando.	36 28 N	6 12W	1925	1924	13 23.5W	53 46.8[4] N	.25016	....	León Herrero
Kakioka.....	36 14 N	140 11 E	1923	1916	5 17.6W	49 31.7 N	.29743	.34859	Sin-iti Kunitomi
Tsingtau.....	36 04 N	120 19 E	1922	1920	4 12.9W	52 07.0 N	.30817	.39610	Kao Kiun
Tucson.......	32 15 N	110 50W	1924	1922	13 47.5 E	59 29.0 N	.26839	.45533	A. K. Ludy
Lukiapang....	31 19 N	121 02 E	1923	1920	3 21.4W	45 30.7 N	.33175	.33773	J. de Moidrey, S. J.
Dehra Dun...	30 19 N	78 03 E	1924	1922	1 43.2 E	45 02.6 N	.32927	.33091	R. H. Thomas
Helwan......	29 52 N	31 20 E	1924	1919	1 30.6W	41 09.6 N	.29947	.26175	P. A. Curry
Hongkong....	22 18 N	114 10 E	1925	1924	0 23.8W	30 42.8 N	.37294	.22155	T. F. Claxton
Honolulu.....	21 19 N	158 04W	1922	1922	9 57.1 E	39 24.5 N	.28794	.23658	H. E. McComb
Teoloyucan...	19 45 N	99 11W	1923	1922	9 09.9E	....	....	....	R. O. Sandoval
Toungoo.....	18 56 N	96 27 E	1924	1922	0 29.7W	23 07.2 N	.39156	.16717	E. C. J. Bond
Alibag.......	18 38 N	72 52 E	1922	1922	0 12.6 E	25 05.0 N	.36967	.17303	S. K. Banerji
Vieques (Porto Rico)	18 09 N	65 27W	1925	1922	4 00.9W	51 33.1 N	.27695	.34880	Ralph R. Bodle
Antipolo.....	14 36 N	121 10 E	1923	1920	0 35.9 E	16 11.7 N	.38100	.11065	M. Saderra Masó

[4] Derived from absolute observations and somewhat unreliable.

Observatory	Lat.	Long.	Latest Publication[1]	Latest Magnetic Elements					Person in Charge of Magnetic Work
				Year	Decl'n (D)	Incl'n (I)	Hor. Int. (H)	Ver. Int. (Z)	
	° ′	° ′			° ′	° ′	c. g. s.	c. g. s.	
Kodaikanal[5]	10 14 N	77 28 E	1924	1922	1 58.7W	4 40.1 N	.37878	.03093	E. C. J. Bond
Batavia-Buitenzorg	6 11 S	106 49 E	1924	1924	0 52.9 E	32 04.3 S	.36821	.23072	S. W. Visser
St. Paul de Loanda	8 48 S	13 13 E	....	1919	14 49.0W	....	......	....	....
Huancayo	12 03 S	75 20W	....	1924[6]	8 01.7 E	0 54.6 N	.29755	.00395	W. C. Parkinson
Apia	13 48 S	171 46W	1924	1924[2]	10 19.2 E	30 07.5 S	.35249	.20453	C. J. Westland
Tananarive	18 55 S	47 32 E	....	1914	8 25.2W	53 37.9 S	.22484	.30532	E. Colin, S. J.
Mauritius	20 06 S	57 33 E	1924	1923	10 49.2W	52 33.7 S	.22982	.30018	A. Walter
La Quiaca	22 08 S	65 43W	....	...	....	....	......	.....	A. G. Johansen
Vassouras	22 24 S	43 39W	....	1923[2]	11 42.8W	15 53.7 S	.24407	.06950	G. Soares
Watheroo	30 19 S	115 53 E	....	1924	4 18.3W	64 05.2 S	.24750	.50941	H. F. Johnston
Pilar	31 40 S	63 53W	1924	1920	7 48.6 E	25 41.2 S	.25297	.12168	Enrique Wolff
Toolangi	37 32 S	145 28 E	....	1920	8 00.8 E	67 55.1 S	.22874	.56384	J. M. Baldwin
Christchurch	43 32 S	172 37 E	1925	1923	17 11.7 E	68 12.0 S	.22209	.55526	H. F. Skey
Orcadas	60 43 S	44 47W	1913	1912	4 46.5 E	54 26.0 S	.25343	.35442	....

[5]Discontinued beginning October 1923.
[6] Mean values of absolute observations.

DISTRIBUTION OF MAGNETIC OBSERVATORIES, 1924.

It will be seen that the geographic distribution of magnetic observatories is still far from satisfactory; about 40 per cent of the observatories are in Europe and only about 9 per cent in the Southern Hemisphere.

About 85 per cent of the observatories regularly reporting to the De Bilt Observatory the "magnetic character" numbers are in countries adhering to, or affiliated with, the International Geodetic and Geophysical Union. Over 60 per cent of the observatories are under the administration of other than strictly meteorological auspices.

(Word has been received since the preparation of the above from Dr. D. la Cour that the Danish Government has provided means to establish in the summer of 1925 a completely equipped magnetic observatory near Godhavn, Greenland.)

J. A. FLEMING.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington.

COMMUNICATIONS ON TERRESTRIAL ELECTRICITY[1]

ÉTUDE DU CHAMP ÉLECTRIQUE TERRESTRE AU VAL-JOYEUX, PRÈS PARIS.

Une installation a été établie pour l'enregistrement du champ électrique à l'observatoire du Val-Joyeux, qui dépend de l'Institut de Physique du Globe de l'Université de Paris. La différence de potentiel qui est mesurée est celle existant entre un sol herbeux plat et une prise de potentiel au radium située à 2 m. au dessus du sol au milieu d'un long fil métallique parallèle au sol. L'enregistrement est fait par points avec un électromètre de Benndorf. L'installation comprend deux appareils semblables, mais de sensibilités différentes, de manière qu'on puisse connaître le potentiel même lorsqu'il est élevé, et que cependant on ait avec détail les variations des faibles potentiels.

Les résultats de la première année de mesures ont été publiés dans les Comptes Rendus de l'Académie des Sciences du 16 juin 1924, t. 178, p. 2112. La moyenne générale du gradient de potentiel en volts par mètre est 89.5.

Des mesures régulières de la conductibilité électrique de l'atmosphère sont faites aussi au Val-Joyeux.

CH. MAURAIN,
Directeur de l'Institut de Physique du Globe de Paris.

LUFTELEKTRISCHE BEOBACHTUNGEN IN DER SCHWEIZ.

Auf Veranlassung von Herrn Direktor Gautier beehre ich mich mitzuteilen, dass im verflossenen Jahre in der Schweiz folgende luftelektrische Arbeiten ausgeführt wurden:

- Registrierungen des Potentialgefälles in Freiburg;
- Messungen desselben in Altdorf (Kanton Uri);
- Untersuchungen über Entstehung der Gewitterelektrizität, ausgeführt im Laboratorium in Freiburg;
- Untersuchungen über die Abhängigkeit der Intensität radiotelegraphischer Signale von meteorologischer Faktoren, Freiburg.

Für das kommende Jahr sind Messungen des luftelektrischen Vertikalstromes geplant.

A. GOCKEL.

Freiburg, Schweiz,
den 22. März, 1924.

[1]For reports of Committees on Observational Work in Terrestrial Electricity, see pp. 39-45.

NOTE ON CONTROL OF ATMOSPHERIC POTENTIAL-GRADIENT OBSERVATIONS AT OBSERVATORIES.

The practice of finding a factor for reducing atmospheric potentials recorded at an observatory to the corresponding gradient "in the open," or "over an infinite plane," assumes a close approach to simultaneity of variations at the observatory and field stations and, also for both stations, the prevalence of normal values at the time of the observations. Various observers have shown that the progress of the potential gradient may be considerably different at stations not more than several hundred meters apart. Sometimes this difference is manifested by the occurrence of a stationary or rising gradient at one station simultaneous with a falling gradient at the other. At other times, however, there may be almost perfect simultaneity of variations at two stations, at one of which the absolute value of the gradient may be perfectly normal while at the other it may be very considerably above or below the normal value corresponding to the time of the observations.

It is obvious that under such a variety of possible combinations of phenomena, the reduction-factors as deduced from all the observations as they are made from time to time will have rather widely scattering values.

In view of the foregoing it appears that if reduction-factor observations are of only a few minutes duration they must be made as nearly every day as the weather will permit. Even then it is doubtful if any significance may be attached to anything less than the monthly mean values of the computed factors.

From the experience of the Department of Terrestrial Magnetism with potential-gradient control observations it appears to be more desirable to make rather extended control observations (extending over say 2 or 3 hours) once per month, rather than daily or weekly tests covering only a few minutes of actual observation. The longer periods are much less likely to produce abnormal results caused by temporary local disturbances, and will therefore supply a better index of the occurrence of any significant variations in the control factor.

No series of control observations is used for computation of reduction-factor unless the simultaneous variations are practically the same at the observatory and field stations. (Whether or not this condition is satisfied is determined by plotting the simultaneous values on coordinate paper.) Comparison of results from a number of successive series shows for a given station a decided tendency toward a fixed value of the factor, and it is probably safe to assume that at least for a given time of year the departures from the mean are due to disturbing conditions that are not common to both stations and which tend, during their continuance, to increase or decrease the factor with respect to its proper normal value.

In the foregoing the existence of an actual variation of the reduction-factor is neither assumed nor excluded. Properly conducted control observations must furnish the decisive data on this point.

S. J. MAUCHLY,
Chief of Section of Terrestrial Electricity.

*Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
September, 5, 1924.*

NOTE REGARDING THE REAL AND THE APPARENT ATMOSPHERIC POTENTIAL-GRADIENT.

In field observations of potential gradient taken by means of a collector attached to a stretched wire, the poetential difference between a point A in the atmosphere, and the electrical ground at B (Fig. 1) is measured. On the assumption that the ground at C directly beneath the collector A is at the same potential as at B, the readings are reduced to volts per meter. Let the line BE (Fig. 1) represent a zero equipotential surface, and let the point A have a potential V_1. When the space $BEFG$ is filled with conducting material the potential gradient, P_1, as measured, will be given by the expresion $P_1 = V_1/d_1$, where d_1 represents the distance AC, expressed in meters. If now the space $BEFG$ were filled with sufficiently good insulating material and if the potential as measured were V_2, the distance AD being represented by d_2, then the actual potential gradient would be given by the expression, $P_2 = V_2/d_2$. If we assumed that the distance between the collector and the zero equipotential surface were d_1, we would get a quantity P_3, given by the expression $P_3 = V_2/d_1$ as the potential gradient. The ratio between the apparent potential gradient in this case and the true potential gradient is $P_3/P_2 = d_2/d_1$.

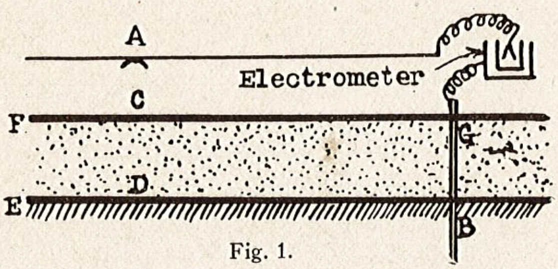

Fig. 1.

During certain times of the year the surface of the soil, at places such as Watheroo, may become so dry that it is a very poor conductor. It is, however, very unlikely that the apparent potential gradient during such times is appreciably different from the true potential gradient. However, I believe that it would be very much worth while to test this point experimentally.

One set of observations to test this point was made this year at the Watheroo Observatory, in Western Australia, during the regular set for the determination of reduction-factor. The reduction-factor obtained accordingly, however, was not appreciably different from those made during the other observations. There was however not time to obtain sufficient data to settle this question definitely. Various methods of measurement might be adopted, but the following is suggested.

Select two stations, A and B, for simultaneous observations of potential gradient, the stations being so selected that there will be as little station-difference as possible and little outside disturbance. Station A in particular must be located where the soil even at the surface is moist. Here measure the potential difference between a collector attached to a stretched insulated wire in the usual way. At station B measure the potential difference between two collectors, one directly above the other. From a sufficient number of simultaneous observations obtain the station-difference. Now cover the soil beneath the collector at station A, first with dry charcoal and then with perfectly dry sand to a reasonable depth and over a reasonable area and again obtain the station-difference. A comparison of the station-differences will thus furnish a measure of the ratio between the real and the apparent potential gradient.

G. R. WAIT.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
September 4, 1924.

ATMOSPHERIC-ELECTRIC WORK IN CANADA.

So far we have been content to appoint a committee to determine what steps can be taken to investigate atmospheric electricity in Canada, and I am receiving reports from the members of the committee which have to be summarized and circulated in due course.

A. S. EVE.

McGill University,
Montreal, Dec. 20, 1923.

ON THE POSSIBILITY OF A COMMON ORIGIN OF ELECTRICAL DISCHARGES IN THE ATMOSPHERE.

The modern theories of the origin of polar lights are very contradictory. It seems to me that we have not yet made a sufficient number of experiments, nor have we found all the operating causes necessary for a complete explanation of these phenomena. I would therefore draw attention to the possibility of a common origin of polar lights, and other electrical manifestations in the atmosphere, such as thunder storms and St. Elmo's fire, as explained in a paper, which I have recently published[1], entitled "Sur l'origine commune de toutes les décharges électriques dans l'atmosphère."

G. MELANDER.

Valtion Meteorologinen Keskuslaitos,
Helsinski.

[1] *Annales Acad. Sci. Fennicae, Helsinski*, Ser. A, t. XXIII, No. 6, 1924.

OBSERVATIONS DES COURANTS TELLURIQUES FAITES PAR L'ADMINISTRATION DES TÉLÉGRAPHES DE SUÈDE.

En Suède un réseau d'observations a été organisé qui se compose de vingt-six lignes télégraphiques. Les employés des télégraphes notent chaque occasion où ils observent des courants telluriques qui sont assez intenses pour déranger les communications télégraphiques. D'après un projet de la commission de courant tellurique de l'année 1919, la Direction Générale des Télégraphes a décidé ce qui suit:

1. Des observations systématiques des courants telluriques doivent être exécutées dans toutes les stations télégraphiques du royaume, lorsqu'il se produit des perturbations dans la communication, et notées sur des formulaires (Nos. 468 et 469) légalisés par la Direction. Ces formulaires peuvent être reçus par le Bureau de matières de la Direction de la manière ordinaire. Les observations du trimestre précédent doivent être envoyées au Bureau de correspondance télégraphique de la Direction le 15 avril, le 15 juillet, le 15 octobre et le 15 janvier au plus tard. Si aucune observation n'est faite, il faudra en aviser le même Bureau à la date citée ci-dessus.

2. A l'égard de la nature et de l'étendue des observations, les stations télégraphiques sont divisées en trois groupes, *A*, *B* et *C*.

Le groupe *A* comprend des stations télégraphiques où des observations sont faites avec des instruments enregistreurs.[1]

Le groupe *B* comprend les stations télépraphiques suivantes: Boden, Falun, Gävle, Göteborg, Halmstad, Haparanda, Hudiksvall, Hälsingborg, Kalmar, Karlstad, Kristanstad, Luleå, Malmö, Norrköping, Nässjö, Oskarshamn, Skellefteå, Sollefteå, Stockholm, Sundsvall, Söderhamn, Umeå, Visby, Örebro, Örnsköldsvik et Östersund.

Le groupe *C* comprend toutes les stations télégraphiques du royaume.

3. A toutes les stations télégraphiques les observations générales des perturbations de la communication télégraphique causées par des courants telluriques doivent être notées. Les notes à prenre sont:

a. les numéros des lignes dans lesquelles les perturbations se produisent;

b. les instants où commencent et finissent les perturbations;

c. la marche générale et la grandeur approximative des perturbations.

Les perturbations sont notées comme très fortes, si la transmission télégraphique est tout à fait empêchée; comme fortes, si

[1]Dans la station télégraphique de Lund (56° N.) on a temporairement installé un instrument enregistreur. En outre l'Administration télégraphique a une station spéciale à Älvsjö (59° N.) près de Stockholm avec un instrument enregistreur.

elle est partiellement empêchée; et comme faibles, si elle est rendue seulement un peu difficile.

4. Aux stations appartenant au groupe *B* des mesures directes doivent être faites sur les lignes suivantes: Boden—Östersund (No. 117), Falun—Gävle (No. 155), Gävle—Stockholm (No. 72), Göteborg—Karlstad (No. 165), Halmstad—Göteborg (No. 42), Haparanda—Boden (No. 142), Hudiksvall—Sundsvall (No. 1), Hälsinborg—Halmstad (No. 137), Kalmar—Visby (No. 18), Karlstad—Örebro (No. 171), Kristianstad—Hälsingborg (No. 422), Luleå—Gällivare (No. 95), Malmö—Nässjö (No. 161), Norrköping—Stockholm (No. 157), Nässjö—Göteborg (No. 66), Oskarshamn—Nässjö (No. 25), Skellefteå—Umeå (No. 1), Sollefteå—Ramsele (No. 30), Stockholm—Örebro (No. 67), Sundsvall—Ange (No. 60), Söderhamn—Gävle (No. 60), Umeå—Lycksele (No. 123), Visby—Stockholm (No. 100), Västervik—Norrköping (No. 27), Växjö—Karlskrona (No. 154), Örebro—Nässjö (No. 99), Örnsköldsvik—Sundsvall (No. 1), Östersund—Ånge (No. 158).

Les mesures doivent être faites sur chacune de ces lignes dans la station télégraphique qui est nommée la première dans la liste et à la manière qui est décrite ci-dessous.

5. Les mesures doivent être faites au moyen d'un milliampèremètre qui relie la ligne et le fil de terre de la station. En même temps la station à l'autre bout de la ligne doit être installée de manière que la ligne soit reliée directement à la terre sans autres résistances. Au cas où d'autres appareils ou des résistances (sauf le milliampèremètre) seraient intercalés dans le circuit, cela doit être noté. Il faut aussi noter, si l'ampèremètre a un shunt ou non.

Les observations comprennent la détermination de la direction et la grandeur du courant. Le courant est désigné comme positif (+), s'il va de la station à la ligne et comme négatif (−), s'il va de la ligne à la station. L'intensité du courant exprimée en milliampère doit être observée pendant les perturbations cinq minutes au commencement de chaque heure et de chaque demi-heure. La déviation que prend l'aiguille de l'instrument doit être notée chaque minute, c'est à dire aux minutes 0, 1, 2, 3, 4 et 30, 31, 32, 33, 34 (le formulaire No. 468).

6. S'il y a des instruments et du personnel suffisants, il est désirable que des observations soient faites en même temps sur deux lignes. L'angle entre les deux directions doit être de 90°, si possible.

7. C'est bien si l'on fait des mesures des courants telluriques aussi dans d'autres stations et pendant d'autres heures ainsi qu'il est dit auparavant. En suite il est désirable de noter les conditions atmosphériques pendant le temps qu'on observe des courants telluriques, spécialement des aurores boréales et du tonnerre.

Au mois de novembre 1921 des mesures des courants telluriques au moyen d'un instrument enregistreur (non photographique) furent commencées dans le Bureau d'essais de l'Administration des Télégraphes à Stockholm. Deux lignes télégraphiques, l'une à Vaxholm (dist. = 20 kilomètres), l'autre à Södertälje, (dist. = 28 kilomètres) étaient utilisées. A l'aide d'une horloge d'un type spécial les deux lignes pouvaient être mises alternativement en contact avec l'instrument, quinze minutes chaque fois. Bientôt on a trouvé préférable d'avoir chaque ligne en contact avec l'instrument pendant huit à quinze jours de suite. Des courants du réseau de tramway perturbaient beaucoup les mesures. C'est pourquoi on a déplacé la station enregistreur. Depuis le mois d'août 1923 elle est placée à Älvsjö, sept kilomètres au sud de Stockholm. Les lignes ont ici 1.7 et 1.3 kilomètres de longeur. Ce sont des lignes aériennes. Leurs résistances électriques et l'instrument enregistreur y compris, sont de 800 et de 700 ohms environ. Les directions des lignes sont 26°E et 68°W de la direction du sud. Les plaques de terre, faites de cuivre, ont une surface de 60 x 45 cm. et sont placées à 55 centimètres sous la surface du sol. L'échelle de l'instrument étant divisée en dixièmes de milliampère, on peut lire un centième d'un milliampère. Une division de l'échelle (0.1 milliampère) est 3.3 mm. L'étendue de l'échelle est de ± 1.5 milliampère. La bande de papier est mue par un movement d'horologerie à raison de douze centimètres par heure.

Des mesures des courants telluriques à l'aide d'un instrument enregistreur ont été commencées en août 1924 dans la station télégraphique de Lund. L'instrument est pareil à celui de Älvsjö, mais les lignes d'observation sont plus longues (10–15 kilomètres).

En septembre 1924 des mesures des courants telluriques furent faites dans la station télégraphique de Luleå (66°N.). A l'avenir des observations au moyen des instruments enregistreurs seront faites à deux stations téléphoniques près du cercle polaire, l'une à Jokkmokk (sur une ligne E–W) et l'autre à Matarengi (sur une ligne N–S).

Stockholm, Valhallavagen, 158,
5/7, 1924.

DAVID STENQUIST,
Ingénieur des Télégraphes.

EARTH-CURRENT STORM OBSERVATIONS ON TELEGRAPH LINES.

In December 1923 General J. J. Carty, Vice-President in charge of Development and Research of the American Telephone and Telegraph Company, invited the Department of Terrestrial Magnetism of the Carnegie Institution of Washington to examine the records of earth-current storms which have been observed during a number of years on that Company's circuits. In response to this invitation, a mass of usable data was seen and several series were selected for more detailed examination later. From these examinations it seems that much of value to a study of earth-current storms is contained in these records, especially in those obtained since January 1917, when a new and more elaborate system of observation was put into effect.

Although the duration of a set of observations is usually considerably restricted by the regular duties of the operators, this disadvantage may be largely offset by the advantage coming from the extensive area embraced. The following description of the chief features of the scheme may be of interest, and if it elicits suggestions for improvement these doubtless will be gladly entertained by the engineers supervising the work.

The plan calls for observations on 105 lines ranging in length from 80 to 800 kilometers (50 to 500 miles), involving 79 operating stations and covering an area of 3.6 million (3.6×10^6) square kilometers (1.4 million square miles), which lies between the 30th and 47th parallels of north latitude and between the 68th and 105th meridians of longitude west from Greenwich.

The observing station for each line is definitely indicated, and the order of preference of lines assigned to each station is designated. A voltmeter having a resistance of 100,000 ohms is used in most of the measurements, and readings on each line are required at regular intervals of 30 seconds. In addition to measurements on lines having both ends connected to earth, readings are also required, in the case of shorter lines, on closely parallel lines of which the far end is not connected to earth. No appreciable reading is obtained on the latter except when considerable insulation leak exists or possibly when unusual atmospheric-electric conditions occur. In such cases it is inadvisable to use the observations on the line proper for determining the earth-current potential-gradient, especially when the course of the line is somewhat circuitous. Prearrangements are made for making proper connections in case communication between the end stations is impossible, and any end station is instructed to call to the attention of the measuring station evidence of the existence of a storm.

Special forms are provided for recording the observations. These forms call for details regarding the lines and the connections, for observations of weather conditions, and other possibly correlated phenomena. Measurements of the insulation resistance are required, and when values of less than one megohm per mile are found the report is not kept. The considerable bulk of records which has accumulated since the above plan has been in operation includes observations at the times of the more pronounced storms that have occurred during that period.

O. H. Gish, *Associate Physicist.*

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
July 22, 1924.

ON QUESTIONS OF THE AGENDA[1]

CONCERNING ELECTRICAL CHARGES ON CLOUDS.

The Agenda for the Madrid Meeting seem to me very well thought out and should help bring about team work by independent as well as official observatories. The recent remarkable progress in astronomy, as I look at it, is due to the fact that many independent observatories work together on certain lines, without loss of individual initiative and the special problem is tackled where the equipment is best by the men best fitted to solve it. We are reaping now the fruits of the establishment thirty years ago of great observatories with adequate instrumental equipment and large endowments. If we had twenty high-class aerographical observatories, with proper endowment, we would be making many discoveries regarding the workings of the great thermal engine—the atmosphere.

Under IIA (Atmospheric Electricty) how about cloud charges; not only on visible clouds but the invisible vapor-dust masses? And Lightning? Is it advisable to add item 7—Desirability of studying the frequency and intensity of cloud charges? I only suggest this.

ALEXANDER MCADIE, *Director.*

Harvard University,
Blue Hill Observatory,
Readville, Massachusetts,
May 29, 1924.

MEASUREMENTS OF MAGNETOGRAMS.

In the matter of *Curve Measurements* (IB1 of the Agenda for the Madrid Meeting), this Bureau, beginning with 1915, has been tabulating and publishing (b) mean values for successive periods of an hour, (c) centering at the half hour, (a) zonal time, for all days for each month and for its five magnetic observatories for the reasons set forth on pages 133 and 134 of Bulletin No. 3 (Transactions of the Rome Meeting). The same practice had previously been followed by several other observatories and it has now been adopted by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for its two observatories. This group of ten or more widely distributed observatories constitutes a decided majority of those publishing their results *in full for all days* and it is hoped that others may feel justified in adopting the same practice, particularly in cases where a change is to be made from local mean time to Greenwich or Zonal time.

R. L. FARIS, *Assistant Director.*

United States Coast and Geodetic Survey,
Washington, D. C., September 4, 1924.

[1]See pp. 14-17.

COMMENTS ON THE AGENDA.

1A3 "*Distribution constants.*"—See statement in this Bulletin, page 117.

IB4.—It is only in the case of *H* that there is a material difference between monthly means derived from all days and those from selected quiet days. For some purposes the former are to be preferred, and for other purposes the latter. Probably the best plan would be to compute both sets of monthly means, where the hourly values are tabulated for all days, and compute two sets of annual means also.

IB9.—It is doubtful whether the gain in accuracy of time determination for "sudden commencements" of magnetic disturbances would justify even the operation of existing magnetographs at greater speed, as was done at some observatories for certain specified hours in 1902 and 1903. The number of such disturbances is small and the selection of the exact point of beginning is in many cases as uncertain as the determination of the time of the selected point.

IC3.—Up to the present time this Bureau has attempted only to correct the declination field results for diurnal variation. With the aid of the records of an observatory not too far away this can be done with sufficient accuracy for most purposes. Where greater accuracy is required more sets of observations, at different times of the day, should be made, and repeated on another day in case the results indicate magnetic disturbance.

Where magnetic observatories are far apart, as in the United States, field stations must be reoccupied from time to time to secure information regarding the secular change. About 175 such stations are provided for the continental part of the United States and the practice is to occupy about one-fifth of them every year, so that all of them will be reoccupied once in five years. This number is probably greater than would be required if unchanged conditions could be assured, but unfortunately it not infrequently happens that a station ceases to be of value for secular change puposes because of industrial or other developments. A plan similar to the one adopted in India, having three stations in each locality to insure continuity, is being given serious consideration.

IC4.—For the convenience of those having occasion to compile world magnetic charts from the results of surveys executed by individual countries, the advantage of uniformity in the epochs selected is evident.

IC5.—Whole minutes of declination and dip and the fourth decimal place C.G.S. units represents the accuracy obtainable in ordinary field work and it is doubtful whether anything is gained by indicating greater accuracy in the published results, except perhaps to retain the observed accuracy where corrections are to be applied. For secular change purposes it is desirable to retain the next significant figure.

IIC1.—The observation of auroras has been adopted as a regular part of the program of the Sitka magnetic observatory.[1] Unfortunately the percentage of clear nights at that place is relatively small, so that only a limited amount of data may be expected.

D. L. HAZARD,
Assistant Chief of Division of Terrestrial Magnetism.

*United States Coast and Geodetic Survey,
Washington, D. C.*

COMPARISONS OF MAGNETIC STANDARDS AND MAGNETIC VARIATIONS.

IA1.—*Comparisons of magnetic standards. Would it not be* possible for some central institutions to acquire say 6 standard instruments which could be loaned periodically to various institutions for comparison? If such comparisons were made every ten years there would be no possibility of serious error creeping into the observatory records.

IB1a, b.—*Zonal time* would appear to be the most advantageous as it permits direct comparison between the records from various stations with the least inconvenience, the minutes and seconds being the same throughout the world. *Mean values*, unless some invariable or instrumental method of determining the mean is adopted, must inevitably give rise to errors of appreciation. Any instrumental method of determining the mean value must increase the work of measurement. The final daily, monthly or annual means are but little influenced by taking mean values in place of the 24 instantaneous measures.

IB2.—*a. Diurnal inequalities* should in my opinion be determined from all days; *b.* non cyclic corrections should not be applied but the 24th hour should in all cases be given; *c.* Fourier coefficients only appear to be necessary for mean diurnal inequalities as determined from a sufficiently long series.

Diurnal inequalities may be divided into two categories: (1) those which give the mean values for the station; (2) those which show results of types of phenomena. The former can only be determined from a long series of observations and hence may—and in fact should—include all types without distinction.

I am strongly of opinion that *hourly values* for each day should be published. What, it appears to me, we have to bear in mind is the physical interpretation which can be placed on the results. Now, the mean diurnal inequality for 30 days—each day showing different characteristics—can have no physical meaning whatever taken alone. If, however, the diurnal inequality for the month of January, say, derived from 20, 30 or more years observations—according to station—is given it may be taken to represent the mean

[1]See this Bulletin, p. 44.

value for that particular epoch and hence can be given an interpretation in terms of the Earth's revolution round the Sun. On the other hand, individual days do represent, each one, a characteristic type, the cause of which is still under investigation and, for purpose of such investigation, can be selected and combined according to their departure from the mean values determined from a long series. Combining them into monthly diurnal inequalities and publishing them without giving the results for the individual days which have formed the monthly inequalities can only mask the physical cause underlying these changes and delay the solution of the problems we are all anxious to see solved.

The same remarks apply *mutatis mutandis* to *diurnal inequalities for selected days*. This work belongs strictly to investigation of phenomena. What the standard observatories should publish are the records, unadulterated and untouched, in such a form as will render them most easily accessible to research workers, whether forming part of the observatory staff or not.

At the Mauritius Observatory, in preparing the volumes for 1911 to 1915, it has been found very economical to prepare the tables of inequalities by reducing each hourly value by the least value for each day and inserting it at the foot of each column, together with the mean of the inequalities. This method has reduced printing to a minimum and gives at the same time the inequality, the absolute value for any hour and the mean value for the day.

I shall be happy to give every assistance with regard to item IB9 and hope to be able to help in Terrestrial Electricity at an early date. Whatever type of instrument is secured for the latter work the whole instrument must be under a damp proof cover, as dampness is my great enemy here, and no one who has not worked here can understand the appalling effect of this hot, damp, saline atmosphere on our instrumental equipment.

A. WALTER, *Director*.

Royal Alfred Observatory,
Mauritius, August 26, 1924.

COMMENTS ON QUESTIONS OF THE AGENDA[1].

I.—TERRESTRIAL MAGNETISM.

A.—INSTRUMENTS AND CONSTANTS.

1. *Program for national and international comparisons of magnetic standards*.—It seems desirable that arrangement be made, as soon as possible, for the designation of some one organization suitably equipped to act as the intermediary for effecting reliable intercomparisons of standard instruments at the national observatories which have been designated by the different countries in accordance with Resolution 4 of the Rome Meeting.

As the result of the extensive experience of observers of the

[1]Submitted by the Director, the Assistant Director, and the Section Chiefs of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

Carnegie Institution of Washington, it is recommended that magnetic observatories, or magnetic services, be urged to provide the necessary means for effecting an *interchange of stations during comparisons* of instruments in order to eliminate any possible station-difference between the piers on which the respective instruments are mounted.

2. *Instrument to measure the vertical intensity directly.*—It seems highly expedient to design and construct an instrument for measuring at observatories in high magnetic latitudes the vertical intensity directly in absolute measure.

3. *Distribution-constants.*—Reference is made to a paper by H. W. Fisk and C. R. Duvall, which will appear in the March 1925 number of *Terrestrial Magnetism and Atmospheric Electricity*, on "A differential method for deriving magnetometer deflection-constants." Experience indicates that the small differences in values from different determinations are in general due to accidental errors of observation or adjustment of the instrument. Where a series is continued for a long time these differences tend to average out. It is best then to adopt a well determined value derived from a long series of observations for each coefficient which may be employed, and then by application of the differential method, which entails very little labor, to note what the change in the correction of the instrument to adopted standard would have been had the constants been derived from any new series of sufficiently extensive observations. It is important that full information be given regarding any changes made in distribution-coefficients and as to possible causes for the changes. Because of the more sensitive response of P and Q to small errors in the deflection angles, we have found it more satisfactory to use P' for instruments so designed that Q is theoretically small. [See page 121.]

B.—Observatory Work.

1. *Curve measurements.*—To facilitate the comparison of values obtained at observatories throughout the world, it seems to us important that the method of making curve measurements should be standardized by (*a*) using zonal standard mean time (nearest fifteenth meridian mean time), this procedure making readily possible referring observatory tabulations to Greenwich mean time when desired; (*b*) scaling mean hourly values which furnish more trustworthy comparison data; and (*c*) having these mean values center preferably at the half hour in order to keep each day's record separate, and at the same time to simplify reductions. When the time of Greenwich midnight at an observatory is not too inconvenient, it is suggested that the daily records be changed at about the zonal hour of Greenwich mean midnight, thus facilitating both reproduction of records for publication and readier comparison of reproductions from different observatories for studies of magnetic storms.

2. *Diurnal inequalities.*—*a.* Diurnal-variation data would appear more strictly comparable if reduced from a larger number of selected days per month, say ten, than from the five quiet days recommended by the Commission for Terrestrial Magnetism and Atmospheric Electricity of the International Meteorological Committee. In addition, however, it would appear desirable, whenever possible, to derive the diurnal inequalities from all days for the month.

b. Correction for the so-called *non-cyclic changes* requires most careful consideration and, if possible, uniform practice. In view of the uncertain nature of the laws followed by such changes during the day, it may even be desirable, at present, not to apply non-cyclic corrections.

c. There is some question as to whether it is worth while for observatories to devote much time to the computation of the Fourier coefficients until international practice and conventions have been established and adopted with reference to questions *a* and *b*. In any case, it is important that publications contain explicit statements as to whether hourly values represent instantaneous or smoothed values, or 60-minute means, and whether the diurnal inequalities have been derived with or without the non-cyclic correction and how the correction was determined.

3. *Publications.*—*a* and *b*. It is felt that, if possible, some agreement should be reached as to suitably distributed observatories at which the complete program in terrestrial magnetism and electricity might advantageously be undertaken. For such observatories it appears desirable that the publications give complete hourly data somewhat after the style followed in the observatory publications of the United States Coast and Geodetic Survey. The publications should include hourly values of the three magnetic elements together with daily means and hourly means for all days and for selected days, the daily extremes with times of occurrence, diurnal-variation tables, complete data as to scale-value and base-line determinations, and full information as regards any corrections which have been applied to the results as published. The direct reproduction of the main tabulation from manuscript permits great economy, not only in publication expense, but in the expense and time required for proof reading.

c. While there is generally no doubt as to the precise meaning of various conventions, or symbols, at present used by different organizations, it is desirable, in the interest of uniformity, that a *standardized terminology* be recommended for general adoption.

4. *Derivation of monthly and annual means.*—It appears most likely that the greater the number of selected days from which a mean value is derived the more reliable and comparable it will be for international comparisons. (See also remarks under IB2*a*.)

5. *Characterization of days and magnetic activity.*—Various investigations have indicated the possibility of devising a simple numerical measure, of the linear type, which apparently suffices

not only for the selection of special days during the month for international purposes, but also for investigations as to relationships between solar activity and terrestrial magnetic activity. The suggestion made at the Utrecht meeting in 1923 of the Commission for Terrestrial Magnetism and Atmospheric Electricity of the International Meteorological Committee to amplify the method used by the Commission for the selection of five "quiet days" during each month by setting certain limitations for the three classifications adopted as regards the departures from normal diurnal-variation curves doubtless is a step which will yield the most that may be expected of such a classification, and one which will be least subject to differences in personal judgment. However, the limits for departures from the normal diurnal-variation curves must be different for each observatory, and to make such a method universal it will be necessary to determine approximate relations representative of the equivalent normal diurnal-variations for different localities, that is, for different magnetic latitudes. Doubtless the Committee (No. 3) of the Section will have some definite proposals to submit regarding measures of magnetic characterization of days, which will afford further information for discussion of this important matter.

7. *Minimum distribution of observatories.*—In the investigation of the causes of magnetic disturbances, a systematic study of polar lights would seem to offer fruitful sources of information. To this end it would be desirable that magnetic and electric observatories be established in regions where auroral displays are frequent. Regions where observatories might be feasibly operated for a period of years are: The Labrador, Northwest Canada, Alaska, Norway, New Zealand, Tasmania, and Orcadas. Considerations of the need for these observatories emphasize the lack of magnetic data in high latitudes, both north and south. Some expression regarding the urgent need of such data, particularly in the Antarctic, might encourage the undertaking of polar exploratory work.

9. *Times of occurrence of "sudden commencements."*—With the equipment generally in use, the time-scale at normal speed is about 20 mm per hour, and there seems little doubt that with such a scale, if proper precautions be taken, times may be estimated to within 30 seconds, which seems sufficient, account being taken of the inertia of the magnet system which must be overcome in registering the commencement of the magnetic impulse. It is important that all observatories have accurate time control, and the installation of wireless receiving devices suitable for reception of standard long-wave time signals is recommended. The intensive study of "bays," particularly in reference to their times of occurrence, their magnitudes, and their directions as referred to normal curves, is recommended as possibly aiding investigations of the character of electric currents causing such disturbances.[1]

[1]For further information on this matter, reference may be made to the article by Louis A. Bauer and W. J. Peters, *Terr. Mag.*, June, 1925.—*Sec.*

C.—MAGNETIC SURVEYS.

1. *Additional data in polar regions.*—Although the regions north of parallel 60° north and south of parallel 50° south include but small portions of the Earth's entire surface (about 18 per cent), yet the importance of securing magnetic data within these areas continues to increase, especially as regards a complete mathematical analysis of the Earth's magnetic field and for the practical purposes of possible aerial navigation over these regions in the near future. There is at present practically no control for drawing the isogonics and magnetic meridians over the rather large unexplored areas, as for example that between Fort Conger, Point Barrow, and Sagastyr. The simultaneous reoccupation of a number of stations, such as the circumpolar magnetic stations of 1882-1883, would doubtless be much more valuable than isolated expeditions upon which we must now depend for secular-variation and distribution data. Modern progress in means of transportation, subsistence, and communication has minimized the hardships of former expeditions. Other fields of allied investigation offer many tempting possibilities in these regions.

2. *Need of further ocean work.*—While the first general ocean survey has been accomplished the work already done can hardly be more than preliminary as regards the very important question of the magnetic secular-variations over ocean areas. On land there are the advantages of easy location and occupation by field parties and establishment of fixed observatories. For the oceans, occupying three-quarters of the Earth's surface, observations on islands, because of their generally disturbed character, have proved to be an inadequate substitute for actual ocean observations. For a more general account of the need of such work see the report of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington on ocean work on pages 98 and 99.

3. *Methods of correcting field results for diurnal and secular variation.*—There is no entirely satisfactory way of correcting field observations for diurnal variation with the present distribution of observatories, unless an exception be made of Western Europe. In recent field work of the Department of Terrestrial Magnetism and in work projected, provision has been made for deriving diurnal variations for each of the elements at selected field stations. It is hoped, by comparing the curves derived from these observations with those obtained simultaneously at the nearest observatories, that some improvement may be developed in the limited knowledge of the way in which the range, times of extremes, and other characteristics of the curves change from place to place.

4. *Adoption of stated epoch for field data.*—While it is desirable that magnetic-survey data of various organizations be reduced to a common epoch, it is felt to be more important at first that publication of observed values, reduced to those with standard instruments, be made as promptly as possible, giving details regarding dates, geographical positions, local mean times, methods of ob-

servation, and descriptions of stations. It is of course desirable, if possible, that some agreement be reached regarding the adoption of stated epochs for the reduction of all field data by various organizations.

5. *Accuracy worth while in expressing data.*—This depends upon the region of the Earth in which the data are obtained. In locally disturbed regions where it would be difficult or impossible to repeat the observations under precisely the same conditions, a less degree of accuracy generally will suffice, but in cases where an *exact* reoccupation is practicable, an increased degree of accuracy is desirable. For secular-variation stations the accuracy should be the highest obtainable. Field observations, carefully made in ordinary magnetic latitudes and controlled through comparisons with standard instruments, will be within 5 gammas (0.00005 c.g.s unit) in horizontal intensity, and 0.′1 to 0.′2 in declination for complete determinations with a magnetometer, and 0.′1 to 0.′2 in inclination with an earth inductor. The final limits of accuracy will be fixed then, in the case of carefully-made and controlled observations, by uncertainties in reduction to the selected common epoch.

6. *Upper-air observations of magnetic elements.*—This problem is one of great importance in theoretical studies of the Earth's magnetic field and may be of practical importance some time in aerial navigation. It would be necessary first to make a careful study of methods and instruments best suited for investigations of the change of magnetic elements with altitude. There are some indications that magnetic activity, diurnal ranges, etc., are considerably modified at high-altitude stations. It would be desirable to establish two observatories not far apart but at as greatly different altitudes as possible for continuous recording of the magnetic elements, as well as the electric elements. Consideration might also be given to the possibility of measuring the magnetic elements in ocean depths.

II.—TERRESTRIAL ELECTRICITY.

A.—Atmospheric Electricity.

1. *Terminology.*—There appears to be a fair agreement in the use of the terms applied to the quantities dealt with in atmospheric electricity except as regards somewhat indiscriminate use of the terms "air-earth current" and "earth-air current." It would seem desirable to use a uniform terminology, as far as possible, and to adopt certain symbols for the quantities generally measured.

2. *Curve measurements, electric characterization of days, and variations.*—It appears desirable that zonal mean time be used in reporting upon observatory data in atmospheric electricity, thus greatly facilitating the comparison of results of various observatories. Mean values of the electrogram ordinates for a 60-minute interval, centering at the half hour, are preferred and adopted for the observations of the Department of Terrestrial Magnetism (*cf.* IB1).

Until there is an indicated need for a more detailed comparison of the Earth's relative electric activity, three general classes of characterization seem sufficient, bearing in mind that in any system the artificially disturbed days (caused, for instance, by thunderstorms, smoke, etc.) and the accidentally disturbed days (caused, for instance, by breaking down of insulation, spider-webs, etc.) should be unmistakably indicated. It must be borne in mind that variations in atmospheric electricity are influenced more by local conditions than are those of terrestrial magnetism, and therefore the results from any broad classification will not necessarily be comparable over large areas. Unless the meteorological conditions are recorded throughout and these conditions made the bases of sub-classification, it is doubtful whether a classification providing more than three classes can be efficiently employed.

Diurnal inequalities from selected days have a peculiar value in that such means from stations in different parts of the world are more nearly comparable for the study of general phenomena than would be the case with means based on all days, since the latter involve to a high degree such local features as cloudiness, precipitation, and others. Hence diurnal-variation means based on selected days and uniform classification should be available for each station. However, for the study and elucidation of local phenomena, means based on all days, and means based especially on disturbed days only have considerable value.

In view of the known large effect of local meteorological conditions, the application of non-cyclic corrections does not appear justified, without more detailed study.

It is desirable that the Fourier coefficients of the mean diurnal variation be determined, both for the year and for the solstitial and equinoctial quarters (three-month periods centering about March, June, September, and December), thus throwing the emphasis of comparisons on the effect of the Earth's orbital position rather than on the local seasons. Since for many stations the analysis of potential gradient and some other elements shows for the fourth harmonic a greater amplitude than for the third, it is desirable that the analysis be extended to include the fourth term to facilitate inquiry regarding the causes of the diurnal variation.

Publication is desirable of all hourly values where continuous registrations are being obtained.

3. *Atmospheric-electric survey.*—With regard to ocean atmospheric-electric work, while confirmatory observations are desired with respect to the newest developments in the diurnal variation of potential gradient, the greater need is for a wider distribution and greater density of observing stations at sea, not only for potential gradient but also for the other elements, especially the electric conductivity. For any adequate investigation regarding the variations with time of year and with latitude such additional observations are necessary of both the absolute values of the electric elements and the nature of the diurnal variations of the atmos-

pheric-electric elements at sea (the major part of the Earth). For all practical purposes the "simultaneous determination" of the diurnal variation of the potential gradient is provided by the recording observatories now functioning. However, the value of such records will be greatly enhanced by (1) the addition of a number of well-distributed stations, and (2) by the publication of hourly values as indicated under IIA2.

4. *Minimum requirements for control observations at observatories.*—The number of control observations necessary in potential-gradient work at a given observatory must of necessity depend largely upon local conditions. Where there are apparently large daily and seasonal variations in the reduction-factor, more frequent observations must be made. Certainly, potential-gradient control observations should be obtained at least once each month by rather extended observations over not less than two or three hours rather than by daily or weekly tests covering only a few minutes of actual observation. The longer periods are much less likely to produce abnormal results owing to temporary local disturbances and therefore supply a better index of the occurrence of any significant variation in the control factor. In the case of conductivity apparatus, the frequency with which control data should be taken will depend largely upon the type of instrument used and upon factors tending to cause variations in calibrations. The best way of adjusting, or reducing, the observations at the recording station to those at the control station, also merits careful consideration so as to avoid the introduction of spurious effects.

It is important that observatories carrying out atmospheric-electric observations should make also continuous records of barometric pressure, duration and intensity of rainfall, direction and velocity of wind, relative humidity, maximum and minimum temperatures, solar and nocturnal radiation, and observations of cloud forms including height, duration, direction, and velocity—in short, a complete meteorological program for class A stations.

5. *Upper-air observations of electric elements.*—Because of the difficulty of continuous observations for determining variations with time at great altitudes, the best approach at present appears to be in designing light apparatus for small-balloon mounting capable of measuring a given element (or more than one if found feasible) at a number of predetermined altitudes in a short period of time, and then repeat the process at intervals of several hours to give evidence regarding the diurnal variations at the various heights (*cf.* IC6).

Additional data on the variation with height of the potential gradient, negative conductivity, and positive conductivity are much needed.

6. *Mean value of potential gradient of atmospheric electricity and its diurnal variations from two groups of days.*—The chief difficulty in adopting a method of calculating the mean value of the potential gradient and of its mean diurnal variation for the "international

magnetically quiet" and "international magnetically disturbed" days is in the great local disturbances from meteorological effects to which the potential gradient is subject. Nevertheless, if the scheme is carried out at a number of well-distributed stations, and over a considerable period of time, the plan should give information which would be statistically valuable, even though month-by-month comparisons might not appear worth while. It is a question for discussion, however, whether results derived in this way are strictly comparable with results obtained from investigations of the correlations between solar activity and annual values of the atmospheric potential-gradient covering a sunspot cycle, or longer.

B.—Earth-Currents.

1. *Terminology.*—Methods of measuring earth-currents are so little developed and the number of observatories undertaking such work are so few that the chief needs in this field would seem to be new and independent methods of measurement and continuous observations at more well-distributed places. To what extent standardization should at present be attempted is itself a matter for consideration.

The methods thus far used yield at best components of the earth-current potential-gradient; hence the measurements should be expressed in units of electric-potential. Millivolts per kilometer seems a convenient unit, which may be abbreviated *mv/km*. If the measurements are not made on lines extending south-north and west-east respectively, they should be reduced to components in these directions. The south-north component may be abbrevaited N and the west-east as E, N being taken positive when it is such as to produce a current flowing from south to north and E positive when it would produce a current flowing from west to east. The departures of these components from their mean of day may be conveniently expressed as $\triangle N$ and $\triangle E$ and the signs of these determined in the same way as for N and E. The annual variations, when desired, may be represented by dN and dE.

2. *Curve measurements.*—The general methods recommended in terrestrial magnetism for curve measurements and simple characterization of days will doubtless apply in earth-currents (*cf.* IB1 and IB5). In the determination of diurnal variation, an appreciable acyclic correction may be found generally necessary. The existence of local conditions such as thunderstorms may effect the selection of quiet days.

3. *General consideration of existing methods.*—It is well known that a considerable part of the measured quantities are usually extraneous effects as, for example, electrochemical e.m.f.'s between the earth plates and the soil. To what extent variations, especially those of longer periods, may be of similar origin is not known. Methods of evaluating, eliminating, or entirely avoiding these effects are highly desirable. The desirability and feasibility of measuring earth-currents at sea, well removed from land bodies, should be considered.

4. *Utilization of earth-current disturbances recorded by telephone and telegraph companies.*—Doubtless much data of value for special investigations, especially as regards storms, are in the files of telegraph organizations. A survey to determine the periods for which such records have been obtained and the organization holding them, the character of the records, and whether and how copies may be obtained for special investigations, should be made and published. Suggestions for earth-current observations on telegraph lines at times of earth-current storms should be formulated for the use of interested telegraph organizations.

C.—AURORA POLARIS.

1. *Minimum standard requirements.*—For visual recording of auroral displays the following minimum details seem desirable: (*a*) Location of observer and azimuth, or limiting azimuths in case of large display; (*b*) apparent lower and upper limits of altitude referred to horizon; (*c*) type or form; (*d*) color; (*e*) intensity; (*f*) time; beginning, maximum, ending (stating whether local or Greenwich mean time).

Suggested experimental lines of approach for investigations on the aurora at fixed stations and observatories where more extensive equipment may be available are: (*a*) Repetition of Babcock's experiments in modified form for polar lights instead of non-polar aurorae (the green monochromatic light present in the absence of polar lights); (*b*) exact measurement of λ for the 5577-Å line with possibility of determining velocity by Doppler effect; (*c*) systematic observations of intensity of non-polar aurorae under comparable conditions; (*d*) observations on intensity of sky luminescence in polar regions which will determine in how far the general luminescence is an afterglow effect; and (*e*) simultaneous light-intensity observations on different portions of the sky (*cf.* Lord Rayleigh's report on the light of the night sky in the Proceedings of the Royal Society, vol. 106, August 1, 1924, pp. 117-137).

2. *Urgent need for one or two suitably located observatories where auroral displays are frequent.*—The establishment of one or two suitably located magnetic and electric observatories where auroral displays are frequent is recommended. It is highly desirable that at least such work as is being done at the Sitka Magnetic Observatory of the United States Coast and Geodetic Survey be carried out at existing observatories where auroral displays are frequent as, for example, at Meanook (Canada), and also that similar observations be made at stations in the southern hemisphere as, for example, in New Zealand and, if possible, in Tasmania and at one of the island observatories in the higher southern latitudes as, for example, Orcadas (*cf.* IB7).

DEPARTMENT OF TERRESTRIAL MAGNETISM.

Carnegie Institution of Washington,
September 9, 1924.

COMMENTS ON THE MADRID AGENDA.

I.—TERRESTRIAL MAGNETISM.

A1.—*Program for national and international comparisons of magnetic standards.*—Whatever program is decided upon, its successful execution will be facilitated if favorable consideration could be given to the following matter. I quote from the last paragraph of my last report to the Director of the Department of Terrestrial Magnetism, dated November 8, 1922, which was submitted at the conclusion of my campaign of intercomparisons in Europe:

"At various observatories I found a reluctance on the part of the observers to use their instruments at any other station than their standard piers and it seems to me that the following recommendation, if acted upon, would facilitate the very necessary international comparisons of instruments and at the same time tend to add to their efficiency: That magnetic observatories be urged to provide, beside their regular observing stations, and in the near vicinity, secondary piers, protected from the weather, where the observatory standard magnetic instruments could be used, when necessary, so that during intercomparisons, an exchange of stations could be made and any station difference be eliminated."

B9.—The study of "sudden commencements" I regard as the most important part of the whole investigation of magnetic storms. There are, however, many grades of "suddenness." Among those commencements which most observers would designate as sudden there are some, probably the majority, which occupy quite an appreciable time. I consider that the highest degree of accuracy with which any event on a trace traveling at the normal speed (20 mm. per hour) can be timed is within 20 seconds of time. But seeing that most commencements which are rightly classed as sudden in a general sense, occupy, owing presumably to some inertia of the magnet system, well over a minute, it would be at least equally difficult on an enlarged time scale to designate the actual time of the commencement of the magnetic impulse. It is quite probable, however, that some commencements are sufficiently sudden and violent to warrant special apparatus being designed for their registration.

II.—TERRESTRIAL ELECTRICITY.

A2.—In considering a scheme for the electric characterization of days it must be borne in mind that variations in atmospheric electricity are influenced much more by local conditions than are those of terrestrial magnetism. Therefore the results from any broad classification will not necessarily be comparable over large areas.

A4.—If this item is intended to include meteorological controls I should suggest as a minimum:

Continuous records of barometric pressure, duration and intensity of rainfall, direction and velocity of wind, temperature (dry and wet bulb) maximum and minimum temperatures, solar and nocturnal radiation, the computation of dew-point and humidity, observations of cloud forms, heights, directions and velocity. Besides these a meteorological journal should be kept giving information which is not derived from the recording instruments. In short, an atmospheric-electric station should be also a Class A meteorological station.

WILFRED C. PARKINSON,
Magnetician and Observer-in-Charge.

Huancayo Magnetic Observatory,
Huancayo, Peru,
July 1, 1924.

COMMENTS ON THE MADRID AGENDA.

IA2.—Under the present scheme of continuously recording the magnetic elements at observatories by which curves are obtained of declination, horizontal intensity and vertical intensity, it would seem highly expedient to design an *instrument to measure directly the vertical intensity* and thus eliminate the uncertainties due to the fact that now the vertical intensity constants are determined indirectly.

IB1.—In the matter of *curve measurements,* and in order to facilitate the comparison of values obtained at observatories throughout the world, it is, I think, very important that the method of making curve measurements should be standardized, namely using G.M.T. thus giving a universal time, mean values which would give more trustworthy comparison data, and these mean values to center at the half hour in order to keep each day's record separate, and at the same time, simplify reductions. These remarks apply equally to curves for the magnetic elements and atmospheric electric elements and to earth current measurements.

H. F. JOHNSTON, *Observer-in-Charge.*

Watheroo Magnetic Observatory,
Western Australia,
July 18, 1924.

ON MAGNETIC CHARACTERIZATION OF DAYS.

IB5.—I have no opinion as to the best way of recording the character of the curves. All methods that have been proposed are based on an assumption of the nature of the matter that is to be investigated. This does *not* imply that *no* progress will thus be made; but it seems to me that there is reason to preserve a plan for a method that assumes nothing, such as the one that has been in use for eighteen years from which much more can be derived than has been done.

A characterization can be made without any calculation, by the simple scrutiny of the magnetograms, with good judgment and care. This appears to have been the directing idea of Eschenhagen. I prefer it to any method that requires calculation, no matter how simple. It is only necessary to guard against prejudice in estimating characterization; the fact that there are forty observatories, and over, furnishing such estimates greatly eliminates the disadvantages that might exist.

It may be worth while to try a method involving calculation without too much regard for the *a priori* ideas which any such method must necessarily imply, but in which common sense should also play its part.

Moreover, it is to be feared that any method involving calculations will greatly delay the returns to De Bilt; from forty or more collaborators, the number may fall very quickly to a dozen.

Zi-ka-wei Observatory,
China, March 13, 1924.

J. DE MOIDREY, S. J.

MAGNETOGRAM SCALINGS AT TOOLANGI OBSERVATORY.

We are just making arrangements to start the scaling of the Toolangi magnetograms, the Government having provided a temporary assistant which will enable this work to be commenced. We shall start with the most recent curves, and then, as opportunity offers, work off the earlier years. The general procedure will be that stated in my note in the Journal of "Terrestrial Magnetism and Atmospheric Electricity," vol. 25, p. 184, 1920.

Melbourne Observatory,
South Yarra, Victoria,
December 12, 1924.

J. M. BALDWIN,
Government Astronomer.

ARTICLES ON ITEMS OF THE AGENDA.

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Weinberg, Boris. The minimum distribution of magnetic observatories. [M.S.]

———. On the publication of data relating to magnetic surveys. [M.S.]

GENERAL INFORMATION

STATUTES.

(*See Bull. No. 3, Sec. T. M. and E., pages 7-11, and 16-20.*)

LIST OF ADHERING COUNTRIES, 1925.

(*See this Bulletin, No. 5, page 35.*)

OFFICERS OF THE UNION AND OF ITS SECTIONS

(*See this Bulletin, No. 5, page 33.*)

NATIONAL SECTIONS, OR COMMITTEES, FOR TERRESTRIAL MAGNETISM AND ELECTRICITY,[1] 1925.

Country	President or Chairman	Vice-President or Vice-Chairman	Secretary	Approx. No. of Members[2]
Australia				4
Belgium				2
Brazil	(Dr. H. Morize)			
Canada			C. A. French	3
Chile				
Czechoslovakia	(Profs. S. Hanzlik and B. Salamon)			
Denmark	(Dr. D. la Cour)			
Egypt				
France	Prof. D. Berthelot		Prof. E. Mathias	23
Greece	(Prof. D. Eginitis)			
Italy	Prof. L. Palazzo		D. Pacini	19
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Peru				
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[1]When there is no information at hand regarding the formation and composition of national committees, the names of chief correspondents are given in parentheses.

[2]Inclusive of the officers.

NATIONAL COMMITTEES FOR GEODESY AND GEOPHYSICS,[1] 1925.

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Belgium	Col. Seligmann	J. Jaumotte	O. Somville	10
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Chile[4]	...	...	...	...
Czechoslovakia	Dr. V. Laska	...	Dr. J. Pantoflíček	5
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France	A. Lacroix	D. Berthelot, G. Bigourdan, E. Fichot, Rollet de l'Isle, H. Deslandres, A. Rateau	G. Ferrié	166
Greece	Prof. D. Eginitis	Prof. D. Hondros	Prof. D. Lampadarios	3
Holland[5]	Prof. J. J. A. Muller	...	Prof. H. J. Heuvelink	9
Italy	Prof. C. Somigliana	...	Prof. G. Magrini	128
Japan	Dr. K. Nakamura	Prof. A. Imamura	S. Kikusawa	26
Mexico	(Dr. P. C. Sanchez)	...	...	2
Morocco	(Dr. J. Liouville)	...	...	1
Norway	Prof. J. F. Schroeter[6] Prof. Fridtjof Nansen[7]	...	Dr. K. S. Klingenberg[6] Dr. Th. Hesselberg[7]	5 13
Peru	Col. G. Thomás	...	...	1
Poland	...	...	Dr. G. Knoblensky	5
Portugal	Prof. F. M. da Costa Lobo	F. Oom, M. Guerra	Nuñez Ribeiro	5
Siam	(Roy Surv. Dept., Bangkok)	...	...	...
South Africa[8]	...	...	...	...
Spain	...	Col. E. Escribano	Lieut. Col. Martinez Cajen	29
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Switzerland	Prof. R. Gautier	Prof. F. Baeschlin Prof. P. L. Mercanton	Prof. A. de Quervain	14
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United States	Prof. H. F. Reid	Dr. H. S. Washington	J. A. Fleming	70
Uruguay	(Col. Juan Sicco)	...	...	1

[1]When there is no information at hand regarding the formation and composition of national committees, the names of chief correspondents are given in parentheses.

[2]Inclusive of officers.

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