
Bulletin N° 7

UNION GÉODÉSIQUE ET GÉOPHYSIQUE INTERNATIONALE

SECTION DE MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES

Comptes Rendus de l'Assemblée de Prague

SEPTEMBRE 1927

Imprimés par les soins de

Ch. MAURAIN

Secrétaire de la Section et Directeur du Bureau Central

PARIS (V^e)

LES PRESSES UNIVERSITAIRES DE FRANCE

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SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

Transactions of Prague Meeting

SEPTEMBER 1927

Edited by

Ch. MAURAIN
Secretary and Director of Central Bureau

JUNE 1929

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Comptes Rendus
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Le rôle du Secrétaire actuel de la Section dans l'établissement de ce Bulletin n° 7 n'a guère été que d'en assurer l'impression. M. Louis A. Bauer, qui a rempli le rôle de Secrétaire de la Section pendant le Congrès de Prague, à la fin duquel il fut élu Président, avait tenu à préparer lui-même l'impression des Comptes-Rendus des séances de la Section, et avait emporté à Washington les documents nécessaires. La maladie l'a malheureusement empêché pendant longtemps de mettre ce projet à exécution. M. J. A. Fleming, Assistant Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and General Secretary of the American Geophysical Union, a bien voulu se charger de ce travail, et il a fait parvenir au Secrétaire actuel de la Section un manuscrit complet, dont celui-ci a dirigé l'impression.

CH. MAURAIN.

Secrétaire et Directeur du Bureau Central
191, Rue Saint-Jacques, Paris, V^e.

PREFACE

The present *Bulletin No.* 7 is the seventh of a series of publications by the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union. (The first six bulletins were edited and published by Louis A. Bauer as Secretary and Director of the Central Bureau during 1919 to 1927.)

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 18-29, 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 It is in a measure superseded by pages 173-181 of Bulletin No. 3 ; its price is 25 cents.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, comprising 182 + viii pages and containing the "Transactions" in full of the Rome Meeting, was issued October 1923. For convenience of reference there was added Part I containing the statures and organization 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.

Bulletin No. 5, comprising 180 + viii pages and containing the "Transanctions" in full of the Madrid Meeting, was issued November 1925. The price of this bulletin is $ 3.50.

Bulletin No. 6, of 40 pages, was issued in November 1926, and was devoted to "Preliminary Reports on Subjects of Investigation" from Reporters for the subjects of investigation recommended at the Madrid Meeting ; its price is 50 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 Secretary.

CH. MAURAIN,

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PART I

PROCEEDINGS AND MINUTES
PRAGUE MEETING

ADRESS OF THE PRESIDENT OF THE SECTION (1)

The extremely valuable work which has gone on under international auspices at De Bilt since 1906, in characterizing days magnetically and selecting quiet and disturbed days, is known to all, and the fact that Holland has now joined our Union is thus a matter for general congratulation.

At Madrid certain gentlemen, Professors Tanakadate, Störmer, Palazzo, Mercanton, Maurain and Mathias, and Dr. Crichton Mitchell, were asked to consider certain questions, and we have been favoured with reports representing much labour, for which our best thanks are due. Other documents bearing on our labours are the Report of the Committee on Solar and Terrestrial Relationships appointed by the International Research Council, and the Minutes of the meeting of the Magnetic Commission of the International Meteorological Committee held at Zurich in September 1926. Some of the resolutions contained in these documents concern us closely.

It is a ground for satisfaction that several of the objects advocated at Madrid have been accomplished. In particular, I would congratulate Dr. La Cour on the establishment of a magnetic observatory at Godhavn in Western Greenland, and on the provision for it of an instrument measuring vertical force directly. Another instrument accomplishing the same object in a different way has been constructed by Dr. Dye of the National Physical Laboratory. The accuracy claimed for these electrical methods of measurement is very high. Horizontal force attains a value of 40000 γ and vertical force of

(1) Presented at the first meeting of the section, September 3, 1927.

70000 γ at undisturbed regions of the earth's surface. Thus an accuracy of 1 γ in magnetic measurements implies an accuracy of the order of 1 in 50000, or even of 1 in 100000, in electrical measurements. The exact degree of agreement between the electrical standards in different countries is thus a question which may concern us very intimately.

The scheme carried out at De Bilt since 1906 has entailed the assignment of magnetic characters at all observatories to days which everywhere contain the same 24 hours. At many, if not most, observatories, however, the choice is based on general inspection of the curves, independent of actual measurements. There has long been a feeling that some criterion depending on exact measurements is desirable. Without anticipating Dr. Mitchell's report, I would call attention to the fact that if any criterion is employed involving such quantities as the diurnal range or the interdiurnal variability, it will become almost a necessity to employ international days for all magnetic purposes, and not merely for our selected quiet and disturbed days.

This would be no obstacle to representing the diurnal inequalities, if desired, in ordinary zonal time.

It is desirable, in this connection, to bear in mind the difference between Terrestrial Magnetism and Atmospheric Electricity. Magnetic disturbance is at times active over limited areas in high latitudes, while insignificant over the greater part of the earth ; but speaking generally, magnetic disturbance which is active in middle and lower latitudes is active everywhere, and in ordinary latitudes there is little if any sensible difference between the records from stations at ground level 50 kilometers apart. But it is otherwise with Atmospheric Electricity. One station, suffering from a thunderstorm or heavy rainfall, may have a succession of high positive and negative potential gradients, while another station 50 km. away may have the moderate positive potential gradients customary in fine weather. There is thus no *a priori* probability that arrangements which work well in the case of Terrestrial Magnetism will work at all in the case of Atmospheric Electricity. The two subjects require separate consideration. One of the great difficulties in the case of Atmospheric Electricity is the small number of days at some stations which are free from negative potential and large disturbances. When a month contains only 2 or 3 fine weather days, as sometimes happens, for example, at Eskdalemuir, the non-cyclic element in the corresponding diurnal variation may be very large.

Additional interest has accrued to the subjects of aurora and magnetic storms through the developments of wireless, especially in connection with the existence of a conducting upper layer. Magneticians, I think, may fairly object to associating the conducting layer as is often done with the names of Heaviside or Kennelly. Its existence was invoked, and apparently with equal justification, before their day by Balfour Stewart, whose theory of the magnetic diurnal variation has been advocated by Sir A. Schuster and Prof. S. Chapman. Also the measurement of the heigts of Aurora by Prof. Störmer are long antecedent to any measurements of heights by wireless. It is possible of course, as suggested by Dr. Eccles, that just as Dante's Purgatory had several strata, so Nature's atmosphere may have not one but several conducting layers. In that event we should not grudge the association of one of them with the names of Heaviside and Kennelly. However this may be, it is obvious that much might be learned from simultaneous observations on the height of the Aurora and the height of the conducting layer for wireless.

Ch. Chree.

COMPTES RENDUS DES SÉANCES DE LA SECTION DE MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES

Prague, Septembre 1927

Discours du Président

Tout le monde connaît l'œuvre précieuse accomplie à De Bilt depuis 1906 sous les auspices internationaux pour la caractérisation magnétique des jours et le choix des jours calmes et troublés ; aussi nous nous félicitons cordialement de l'adhésion des Pays-Bas à notre Union.

Au Congrès de Madrid, on a demandé à quelques membres de la Section, les professeurs Tanakadate, Palazzo, Mercanton, Mathias et Maurain et le D^r Crichton Mitchell, d'examiner certaines questions, et ils ont bien voulu établir des rapports représentant un long travail ; nous les en remercions bien vivement. D'autres documents intéressant notre Section sont le Rapport du Comité constitué par le Conseil International de Recherches pour l'étude des relations entre les phénomènes solaires et terrestres, et les Procès-Verbaux de la réunion de la Commission de Magnétisme du Comité Météorologique international tenue à Zürich en septembre 1926. Quelques-unes des résolutions contenues dans ces documents nous concernent étroitement.

Nous pouvons exprimer notre satisfaction de la réalisation de plusieurs des vœux proposés à Madrid. En particulier, je voudrais féliciter le Dr La Cour d'avoir fait établir un observatoire magnétique à Godhavn dans l'Ouest du Groënland, et de l'avoir muni d'un instrument mesurant directement la composante verticale du champ magnétique. Le Dr Dye du National Physical Laboratory a construit un appareil différent qui permet la même mesure.

La précision atteinte dans ces méthodes électriques est très grande. La composante horizontale atteint une valeur de 40000 γ et la composante verticale une valeur de 70.000 γ dans les régions calmes du Globe. Ainsi, une précision de 1 γ dans les mesures correspond à une précision relative de $\frac{1}{50\,000}$ ou même $\frac{1}{100\,000}$. Il est donc très intéressant de connaître exactement le degré de concordance entre les étalons électriques des différents pays.

Le système suivi à De Bilt depuis 1906 comporte l'assignation des caractères magnétiques en tous les observatoires pour les journées composées des mêmes 24 heures. Cependant à bien des observatoires, si ce n'est presque à tous, les caractères numériques sont choisis d'après un examen général des courbes, sans intervention des résultats même des mesures. Depuis longtemps on a senti l'intérêt qu'il y aurait à employer une caractérisation dépendant de ces résultats. Sans anticiper sur le rapport du Dr Mitchell, je voudrais appeler l'attention sur le point suivant : Si la caractérisation numérique adoptée comporte des quantités telles que l'amplitude diurne ou la variabilité interdiurne, il deviendra presque nécessaire d'utiliser des jours internationaux pour toutes les questions magnétiques, et non pas seulement les jours choisis comme calmes ou troublés.

Ceci ne créerait pas un obstacle à représenter la variation diurne selon le temps zonal ordinaire, si on le désirait.

A ce sujet, on doit porter l'attention sur les différences entre le Magnétisme terrestre et l'Electricité atmosphérique. Les perturbations magnétiques sont parfois fortes dans des régions limitées des hautes latitudes alors qu'elles sont insignifiantes sur la plus grande partie de la Terre ; mais, en général, les perturbations magnétiques qui sont accentuées dans les latitudes moyennes et basses sont accentuées partout, et, dans les latitudes ordinaires, il n'y a guère de différence sensible — s'il y a vraiment une différence — entre les graphiques enregistrés en des stations situées à 50 kilomètres l'une de l'autre. Mais les choses ne se passent pas ainsi dans le domaine de l'Électricité atmosphérique. Une station où se produisent des orages ou de fortes pluies peut avoir une suite de gradients de potentiel élevés positifs ou négatifs, pendant qu'une autre station à une distance de 50 kilomètres aura les gradients positifs modérés correspondant généralement au beau temps.

Les deux sujets doivent donc être considérés de manières différentes. En Electricité atmosphérique, de grandes difficultés se présentent en quelques stations du fait de la rareté des jours ne présentant ni potentiels négatifs ni fortes perturbations. Quand il n'y a en un mois que deux ou trois beaux jours — comme cela arrive par exemple parfois à Eskdalemuir — l'élément non cyclique de la variation diurne correspondante peut être très grand.

Le développement de la T. S. F. a conduit plus de personnes à s'intéresser aux aurores polaires et aux orages magnétiques, spécialement en ce qui concerne les relations avec les couches de haute conductibilité. Les personnes qui s'occupent de magnétisme terrestre peuvent avec raison présenter des objections à l'association fréquente des noms de Heaviside ou de Kennelly à l'existence de ces couches conductrices. Antérieurement, l'existence de ces couches avait été proclamée par Balfour Stewart, dont la théorie de la variation magnétique diurne a été appuyée par Sir A. Schuster et le Professeur S. Chapman. De plus, le professeur Störmer avait mesuré la hauteur des aurores bien avant les mesures de hauteur par la T. S. F. Il est possible, naturellement, comme l'a suggéré le Dr Eccles, que, de même que le purgatoire de Dante avait plusieurs couches, l'atmosphère possède plusieurs couches conductrices. S'il en est ainsi nous n'avons pas à regretter l'association avec une de ces couches des noms d'Heaviside et de Kennelly. Quoi qu'il en soit, il va sans dire qu'on peut apprendre bien des choses par des études simultanées de la hauteur des aurores et de celle des couches conductrices intervenant en T. S. F.

CH. CHREE.

REPORT OF SECRETARY, AND DIRECTOR OF CENTRAL BUREAU, 1924-1927 (1)

GENTLEMEN :

Since the Madrid meeting, three years ago, it is gratifying to be able to report that continued progress has been made in the mission of the Section and in putting into effet its various resolutions, as briefly recorded in the following paragraphs.

Publications. — A general report of the Madrid meeting, 1924, consisting of 10 pages and containing the general proceedings, list of officers of the Union and of Sections, and reso-

(1) Presented at first meeting of the Section, September 3, 1927.

lutions, was issued as "Bulletin No. 4" of the Section in December 1924. The complet "Transactions of Madrid Meeting, October 1924", comprised 180 + viii pages and appeared as "Bulletin No. 5" in November 1925 ; it contains the proceedings in detail, reports of special and of national committees, general information concerning organization, etc. "Bulletin No. 6" of 40 pages appeared in November 1926 ; it contained the "Preliminary Reports on Subjects of Investigation" decided upon at the Madrid meeting, the chief purpose being to furnish information to the National Committees for suggestions of Agenda items for the Prague meeting. It had been the intention to issue, in advance of this meeting, another Bulletin, No. 7, containing additional information from reporters and national committees, but this proved impracticable on account of delay in the receipt of reports requested last December.

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 Störmer* ;
g) Phenomena of Lightning, *E. Mathias*.

As already stated preliminary reports on these subjects have appeared in "Bulletin No. 6" and later information may be submitted for our consideration at the present meeting.

Adhering Countries. — Since the Madrid meeting, Argentina, Finland, Egypt, Holland, New Zealand, and Yugoslavia have joined all the sections of the International Geodetic and Geophysical Union. Table I shows, that according to the latest information, there are now 32 adhering countries.

TABLE I. — *Countries Adhering to the International Geodetic and Geophysical Union, 1927.*

Country	No. of Units of Contribution	No. of Votes	Country	No. of Units of Contribution	No. of Votes
Argentina	3	3	Morocco	2	2
Australia	2	2	New Zealand	1	1
Belgium	2	2	Norway	1	1
Brazil	8	5	Peru	1	1
Canada	2	2	Poland	8	5
Chile	1	1	Portugal	2	2
Czechoslovakia	3	3	Siam	2	2
Denmark	1	1	South Africa	1	1
Finland	1	1	Spain	8	5
France	8	5	Sweden	2	2
Egypt	3	3	Switzerland	1	1
Greece	1	1	Tunis	1	1
Holland	1	1	United Kingdom	8	5
Italy	8	5	United States	8	5
Japan	8	5	Uruguay	1	1
Mexico	3	3	Yugoslavia	3	3
			Totals	105	81

Magnetic Surveys and Observatories. — It will be seen from the Reports of National Committees that since the Madrid meeting awakened interest has been continued, additional surveys (or re-surveys) being in progress, new magnetic charts having been issued by various countries, and additional observatories having been established in accord with the Madrid resolutions. It is a matter of gratification also that marvelous progress on a comprehensive basis is being made in Russian countries. For a brief statement regarding comparisons of instruments and construction of new instruments, reference must be made to the writer's report on pages 1 and 2 of Bulletin No. 6.

Terrestrial Electricity. — The National Reports also show further progress in observations of atmospheric electricity and of earth-currents. In this connection it is also appropriate to mention the remarkable interest being shown by students of radiotelegraphy in correlations between radio disturbances, solar activity, magnetic activity and electric activity. Already at the Brussels meeting of 1919 our Section had made a proposal that a joint committee to be composed of members of the Section and of the International Union of Scientific Radio Telegraphy be appointed for the investigation of these subjects. We shall doubtless have further information from others on this topic.

Personalia. — We regret to be obliged to record the deaths since the Madrid meeting of 10 eminent investigators in terrestrial magnetism and electricity (see Appendix B). Changes of survey and observatory personnel will be found mentioned in the reports of National Committees.

Finances. — The matter of finances has been a source of considerable concern, especially during the period of greatly-depreciated or uncertain value of the French franc. It thus became necessary at one time for the Administrative Bureau to defer the making of grants and initiation of investigational work and to postpone contemplated publications. The monetary value of any particular grant at the time of its actual expenditure could not be foretold, and there was grave danger of incurring deficits if world-wide operations were undertaken. When the franc became somewhat stabilized, the depreciated funds made it necessary to proceed cautiously with the authorization of any grat expenditures before this meeting and to refer further allotments from accrued balances of funds to the Executive Committee. Appendix A shows the financial status of our Section.

Resolutions by the International Research Council Committee. — The Committee appointed by the International Research Council for the Study of Solar and Terrestrial Relationships held a meeting at Brussels on July 5 and 6, 1925 and passed various resolutions pertaining to terrestrial magnetism and electricity. It was possible to publish on page 54 of Bulletin No. 5, as it was passing through the press, two of the resolutions of special interest. Since then the Committee has published its "First Report" containing a full account of the proceedings and various resolutions. The Chairman of the Committee, Dr. S. Chapman, has informed me that he is prepared to make at this meeting a brief statement of progress.

Resolutions by the Commission for Terrestrial Magnetism and Atmospheric Electricity of the International Meteorological Committee. — This Commission at its Zürich meeting in September 1926 passed certain resolutions which will be of interest to us in connection with various items of our Agenda. The one which the Secretary was particularly requested to bring to the attention of our Section concerns the future relationships between the Section and the Commission and reads as follows :

« La Commission considère que la question des relations entre elle et la Section de Magnétisme et Électricité terrestres de l'Union Internationale Géodésique et Géophysique doit être renvoyée à une commission composée de membres des deux organisations. »

"The Commission considers that the question of the relations between it and the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union should be referred to a Committee composed of members of the two organizations. »

Louis A. BAUER.

RAPPORT DU SECRÉTAIRE DIRECTEUR DU BUREAU CENTRAL, 1924-1927 (1)

MESSIEURS :

Il y a lieu de se réjouir de pouvoir dire que les travaux de la Section ont progressé sans cesse depuis le Congrès de Madrid, il y a trois ans, et de pouvoir indiquer les suites qui ont été données aux vœux, ainsi qu'il est indiqué dans les paragraphes suivants.

Publications. — Un rapport général sur le Congrès de Madrid, 1924, de 10 pages, qui contient les procès-verbaux, le bureau de l'Union et des Sections, et les vœux adoptés, fut publié comme « Bulletin No. 4 » de la Section en décembre 1924. Les « Transactions of Madrid Meeting, October 1924 » comprenant 180 + viii pages, constituèrent le « Bulletin No. 5 » paru en novembre 1925. Celui-ci contient les comptes rendus in extenso, les rapports des comités spéciaux et nationaux et des renseignements généraux sur l'organisation, etc. Le « Bulletin No. 6 », de 40 pages, paru en novembre 1926,contenait les « Rapports préliminaires sur les sujets de recherches » décidés au Congrès de Madrid, le but principal étant de fournir aux comités nationaux des renseignements pour faciliter la suggestion d'articles qui devaient figurer à l'ordre du jour du Congrès de Prague. On avait aussi l'intention d'éditer, avant ce Congrès, encore un Bulletin No. 7, qui devait contenir des renseignements supplémentaires des rapporteurs et des comités nationaux.

(1) Présenté à la première séance de la Section, 3 Septembre 1927.

Mais cela se montra impraticable, à cause de la réception tardive des rapports demandés pour le mois de décembre.

Sujets de recherches. — En octobre 1925, le Comité Exécutif a décidé, par correspondance, de nommer des rapporteurs pour divers sujets de recherches comme il suit :

a) Comparaisons des instruments magnétiques, *Louis A. Bauer* ;
b) Caractérisation magnétique et électrique des jours, *A. Crichton Mitchell* ;
c) Terminologie, *Ch. Maurain* ;
d) Commencements brusques des orages magnétiques, *A. Tanakadate* ;
e) Les propriétés et l'état magnétiques des roches, *L. Palazzo* ;
f) Phénomènes fondamentaux des aurores polaires, *Carl Störmer* ;
g) Phénomènes de la foudre, *E. Mathias*.

Des rapports préliminaires sur ces sujets ont paru dans le « Bulletin No. 6 » et des renseignements supplémentaires peuvent être soumis à notre considération au cours du présent Congrès.

Pays Adhérents. — Depuis le Congrès de Madrid, les pays suivants ont adhéré à toutes les sections de l'Union : Argentine, Finlande, Égypte, Pays-Bas, Nouvelle-Zélande, et Yougoslavie. D'après les derniers renseignements, les pays adhérents sont maintenant au nombre de 32.

Réseaux et observatoires magnétiques. — Les rapports des comités nationaux montrent bien que, depuis le Congrès de Madrid, l'intérêt éveillé continue ; de nouveaux réseaux (ou des révisions) sont en cours, de nouvelles cartes magnétiques ont été dressées par divers pays, et de nouveaux observatoires ont été établis conformément aux vœux de Madrid. Il y a lieu de se réjouir des remarquables progrès qui se réalisent dans les pays russes. Un bref résumé des comparaisons des instruments et de la construction de nouveaux appareils se trouve dans le rapport de l'auteur aux pages 1 et 2 du Bulletin 6.

Electricité Terrestre. — Les rapports nationaux indiquent aussi de nouveaux progrès en ce qui concerne les observations de l'électricité atmosphérique et des courants telluriques. Sous ce rapport, il convient de signaler l'intérêt remarquable que manifestent les personnes qui étudient la radiotélégraphie au sujet des corrélations entre les perturbations de la T. S. F. et les activités solaire, magnétique et électrique. Au Congrès de Bruxelles en 1919, notre Section avait déjà proposé qu'une commission commune composée de membres de la Section et de l'Union Internationale de Radiotélégraphie Scientifique fût nommée pour étudier ces sujets. Cette question sera, sans doute, l'objet d'un examen plus approfondi.

Personnel. — Nous regrettons d'avoir à enregistrer la perte de dix savants distingués dans le domaine du magnétisme et de l'électricité terrestres, décédés depuis le Congrès de Madrid (voir l'appendice B). Les changements des observateurs et du personnel des observatoires se trouvent mentionnés dans les rapports des Comités Nationaux.

Budget. — La question du budget a été une source d'inquiétude, spécialement pendant la période des grandes fluctuations et des baisses du franc français. A ce moment le Bureau Administratif se vit dans la nécessité de suspendre temporairement l'allocation des crédits et la mise en train de nouvelles recherches et de renoncer à certaines publications projetées. On ne pouvait faire de pronostics sur la réelle valeur qu'aurait une subvention au moment de son déboursement et l'on s'exposait à un déficit, si l'on s'embarquait dans des entreprises mondiales. Après la stabilisation partielle du franc, il a été nécessaire, à cause de la dépréciation de la valeur des fonds, d'user de grandes précautions en ce qui concerne l'affectation de forts crédits avant ce Congrès et de soumettre la question des allocations ultérieures à la délibération du Comité Exécutif. L'état du budget de notre Section est exposé dans l'Appendice A.

Vœux du Comité constitué par le Conseil International de Recherches. — Le Comité nommé par le Conseil International de Recherches pour l'étude des Rapports solaires et terrestres s'est réuni les 5 et 6 juillet 1925, et divers vœux relatifs au magnétisme et à l'électricité terrestres ont été adoptés. Il fut possible de publier à la page 54 du *Bulletin* No. 5, qui était justement sous presse, deux de ces vœux qui possèdent un intérêt spécial. Depuis ce temps, le Comité a publié son « Premier Rapport » qui contient les procès-verbaux et divers vœux. Le président du Comité, le D^r^ S. Chapman, m'a informé qu'il prépare en vue de ce Congrès un court exposé des progrès réalisés.

Vœux de la Commission de Magnétisme Terrestre et d'Electricité Atmosphérique du Comité Météorologique International. — A son Congrès de Zurich en septembre 1926, cette commission a adopté certains vœux qui nous intéressent par rapport à différents articles de notre odre du jour. Le vœu qu'on a prié particulièrement le Secrétaire de porter à la connaissance de notre Section, concerne les relations futures entre la Section et la Commission ; en voici le texte :

« La Commission considère que la question des relations entre elle et la Section de Magnétisme et Électricité Terrestres de l'Union Internationale Géodésique et Géophysique doit être renvoyée à une commission composée de membres des deux organisations. »

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, for the period October 8, 1924 to July 30, 1927, 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 bank balance of $317.50 on August 2, 1927, which agrees with the total available from the International Geodetic and Geophysical Union of $3128.94 after deducting the net total expenditures through check 110 of $2811.44 (total expenditures $2835.06 less $23.62 for sales of bulletins).

McCLAIN B. SMITH,
Chief Clerk and Cashier, Department of Terrestrial Magnetism.

Washington, D. C., August 4, 1927.

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 Secretary, and Director, Central Bureau were examined and every item was found to be correct and in order.

N. H. HECK,
Auditor (1),
Chief of Division of Terrestrial Magnetism and Seismology, U. S. Coast and Geodetic Survey.

Washington, D. C., August 6, 1927.

APPENDIX B

LIST OF DECEASED INVESTIGATORS IN TERRESTRIAL MAGNETISM AND ELECTRICITY SINCE MADRID MEETING, 1924

Daniel Berthelot, member of the Institute, eminent professor of physics in the University of Paris and president of the Section of Terrestrial Magnetism and Electricity of the National Committee of France, died on March 9, 1927, at the age of 62 ;

(1) Appointed by the President of the Section, June 24, 1927.

Ernest Biese, for many years director of the Meteorological Observatory of Helsingfors, leader of the Finland Polar Expedition of 1882-83 at Sodankylä, died on July 10, 1926, at the age of 70 ;

Francisco Alfonso Chaves, the energetic director of the Meteorological-Magnetic Service of the Azores, contributor to the bulletins of the Section of Terrestrial Magnetism and Electricity, died on July 23, 1926, at the age of 69 ;

A. L. Cortie, S. J., for many years the director of the Stonyhurst College Observatory, indefatigable investigator of relationships between solar and magnetic activity, died on May 13, 1925, at the age of 66 ;

Albert Gockel, well-known for his investigations in atmospheric electricity, the penetrating radiation and radioactivity, professor of physics at the University of Freiburg, Switzerland, died on March 4, 1927, at the age of 65 ;

Olivier Heaviside, distinguished electrician, who indicated the existence of a conducting layer in the atmosphere for wireless telegraphy ;

Col. Mellish, Ex-President of the Royal Meteorological Society of England ;

Francis E. Nipher, made first detailed magnetic survey of Missouri, author of various papers on terrestrial magnetism, professor emeritus of physics at Washington University, St. Louis, Missouri, died on October 6, 1926, at the age of 78 ;

Sir Franklin Parry, formerly chief of the Hydrographical Section of the British Admiralty ;

George M. Watson, member of the British Advisory Committee on Atmospheric Pollution, died April 9, 1925, at the age of 28 ;

Walter Budig, author of investigations on atmospheric electricity and radioactivity while connected with the Prussian Meteorological Institute, died on August 31, 1926, at the age of 48 ;

Franz Exner, fruitful pioneer investigator in atmospheric electricity and designer of simple portable instruments for securing absolute values of the potential gradient, professor emeritus of physics at the University of Vienna, died on November 15, 1926, at the age of 78 ;

A. A. Friedman, able director of the Central Geophysical Observatory at Leningrad, died on September 16, 1925, at the age of 37.

STATUS OF FUNDS
SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY
INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION

Credits

		Francs	Francs
1924, Apr. 1	Balance due	35,003.00	
	Regular Allocation for 1924	20,480.00	
	Special Allocation for 1924	20,000.00	
1925, Apr. 1	Regular Allocation for 1925	20,480.00	
	Special Allocation for 1925	20,000.00	
1926, Apr. 1	Regular Allocation for 1926	20,480.00	
	Special allocation for 1926	20,000.00	
	Total Credits	156,443.00	

Advances made by General Secretary

1924, Oct. 15	To Secretary of Section for General Expenses	10,000.00	
1925, Jul. 3	To Secretary of Section for General Expenses	20,000.00	
1926, Apr. 1	To Secretary of Section for General Expenses	25,000.00	
1926, Jun. 24	To Secretary of Section for General Expenses	25,000.00	
1926, Jun. 14	To Dr. A. C. Mitchell for Characterization of Days	650.00	
1926, Nov. 8	To Dr. A. C. Mitchell for Characterization of Days	1,049.40	
1927, Jun. 21	To Dr. A. C. Mitchell for Special Instruments	5,308.00	
1927, Jul. 17	To Dr. A. C. Mitchell for Special Instruments	1,242.50	
	Total Advances	88,249.90	
	Balance Available		68,193.10

Estimated Liabilities

1925, Dec. 31	Grant made to Prof. E. Mathias (Special Investigation)	2,500.00	
1927, Aug.–Sep.	Employment of Assistant Secretary and Miscellaneous Expenses, about	800.10	
	Total Estimated Liabilities.	3,300.10	
	Estimated Balance Available		64,893.00

LOUIS A. BAUER,

Secretary, and Director of Central Bureau.

Washington, D. C., August 3, 1927.

APPENDIX C

With the aid of letters received to date from the General Secretary of our Union, the following preliminary estimate of the status of our funds may be made :

	Francs
Total funds allocated during the three years 1924–1926 inclusive of the balance (35,003 francs) on April 1, 1924	156,443 00
Total funds advanced to the Secretary for publication and miscellaneous expenses, and to Dr. Mitchell for special work and instruments	88,249.90
Estimated liabilities (Grant to Professor Mathias, Miscellaneous Expenses, etc.)	3,300.00
Estimated balance available at Prague	64,893,00

LOUIS A. BAUER, *Secretary*.

Washington, D. C., August 3, 1927.

ANNEXE C

A l'aide des lettres actuellement reçues du Secrétaire Général de notre Union, on peut faire l'estimation préliminaire suivante de l'état de nos fonds :

	Francs
Fonds totaux assignés pendant les trois ans 1924–1926, y compris le reliquat de compte (35.003 fr.) le 1er avril 1924	156.443,00
Fonds totaux avancés au Secrétaire pour la publication et les frais divers, et au Docteur Mitchell pour des recherches spéciales et des instruments.	88.249,90
Engagements estimés (allocation au Professeur Mathias, frais divers, etc.)	3.300,00
Reliquat estimé disponible à Prague	64.893,00

Le Secrétaire, LOUIS A. BAUER.

Washington, D. C., le 3 *août* 1927.

APPENDIX D

BUDGET FOR THE SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY, 1928-1930.

That the equivalent of 40,480 French francs, reckoned on the new gold franc basis, be annually allocated 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 ;
e) Grants to committees for special investigations including experiments on the magnetization of rocks.

Approved by the Section, Tuesday, September 6, 1927.

C. CHREE, *President.*
LOUIS A. BAUER, *Secretary.*

INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION

SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

Agenda for Prague Meeting, September 3-10, 1927

1.—Opening of Meeting, and Address of President.
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 President and of Vice-President.
6.—Appointement of Committees, or of Reporters.
7.—Resolutions.

The subjects (No 4) proposed for discussion are items in the various reports and the following questions :

A.—Instruments and Constants

1. Need of continued control of instrumental constants through international program of comparisons between adopted standard magnetic instruments and the selected standard instruments of the various countries, and of consideration of plans to accomplish this.

2. Need of readily portable apparatus for accurately recording continuously during short periods, for example, two days to a week, the magnetic and the atmospheric-electric elements at field stations in order to facilitate investigation of variations with geographic position in diurnal changes.

3. Consideration of feasibility for practical application and development of apparatus for utilizing magnetic and electric methods in the investigation of underground geological formations.

B.—Magnetic and Electric Surveys

1. That the magnetic surveys of the different countries be referred to the same date, so as to have thus, *ipso facto*, a general magnetic chart of the regions having magnetic surveys.

2. Need of continued prosecution of magnetic and electric surveys in all regions of the Earth and particularly in the polar regions for determination of secular changes for practical and theoretical purposes, and of agreement as to epochs to which published data of various surveys are to be reduced.

C.—Observatory Work

1. Zonal time or Greenwich time : *a*. To define zonal time for the purposes of Madrid resolution No. 6 as time differing from Greenwich by whole hours. *b*. To consider whether some definite time limit should be specified for the introduction of a change. *c*. To reconsider the question whether the Madrid resolution should apply to atmospheric electricity.

2. Non-cyclic correction : To formaly recommend that a non-cyclic correction should be applied in all cases as preliminary to the calculation of Fourier coefficients.

3. Consideration of the best form of publication of magnetic data.

4. Consideration of methods by which expense of observatory compilations and reductions may be lessened to permit prompter publication of results, of the minimum requirements in observatory publications, and of the various methods of reduction and compilation.

5. The normal value of a magnetic element on January 1 is the mean of the values of that magnetic element during the twelve months comprising the six months which precede this January 1 and the six months wich follow it.

6. The annual secular variation of a magnetic element during a given year is the difference between the values on the January 1 which terminates that year and the January 1 which begins it.

7. That the Prague Meeting determine the manner in which the means of the electric field of the atmosphere are to be taken (monthly, annual). *a*. Should all the values be used ? *b* Should only the positive values be used, merely indicating the frequency of the negative values ?

8. Future of Indian magnetic observatories.

D.—General Proposals

1. To discuss the best method of observing atmospheric ionization.

2. A scheme for the publication of a summary of auroral observations by all countries in which aurora is ordinarily seen.

3. Desirability of securing additional statistics of lightning flashes.

4. Need of measurements concerned with atmospheric pollution (dust content and nucleation), of observational program for correlation studies with atmospheric-electric and meteorological elements, and of methods for corrections to atmospheric-electric results for possible effects arising therefrom.

5. Need of additional earth-current installations, of duplicate lines at any station to eliminate local effects, and of earth-current-density data with the aid of resistivity surveys.

6. Need of an international program for study of correlations between radio reception and magnetic, atmospheric-electric, and auroral activities and solar activity.

UNION GÉODÉSIQUE ET GÉOPHYSIQUE INTERNATIONALE

SECTION DE MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES

Ordre du Jour, Congrès de Prague, 3-10 *Septembre,* 1927

1. — Ouverture de la Séance et discours du Président.
2. — Rapport du Secrétaire et du Directeur du Bureau Central.
3. — Rapports divers des Comités nationaux et autres ; recherches spéciales, etc.)
4. — Sujets soumis à la discussion et à l'étude des comités.
5. — Élection du Président et du Vice-Président.
6. — Nomination des commissions, ou des rapporteurs.
7. — Vœux.

Les sujets (No. 4) à discuter sont compris dans les différents rapports et les questions suivantes :

A. — Appareils et Constantes

1. Nécessité d'un contrôle continu des constantes instrumentales d'après un programme international des comparaisons entre les appareils magnétiques adoptés comme étalons et les appareils étalons choisis par les divers pays, et de la considération d'un plan destiné à en assurer la réalisation.

2. Nécessité de disposer d'un appareil portatif pour l'enregistrement d'une manière continue et précise pendant de courtes périodes, par exemple, deux jours à une semaine, des éléments du magnétisme et de l'électricité atmosphérique dans les stations de campagne en vue de faciliter l'étude du changement de la variation diurne avec la situation géographique.

3. Considération de la praticabilité de l'application et du développement d'appareils destinés à utiliser des méthodes magnétiques et électriques pour l'étude des formations géologiques souterraines.

B. — Réseaux Magnétiques et Électriques

1. Que les réseaux magnétiques des différents États soient rapportés aux mêmes dates, de manière à avoir ainsi, *ipso facto*, une carte magnétique d'ensemble des régions possédant des réseaux magnétiques.

2. Importance de continuer des levés magnétiques et électriques dans toutes les régions du Globe et particulièrement dans les régions polaires afin de déterminer la variation séculaire des éléments pour des buts pratiques et théoriques, et de fixer des époques auxquelles doivent être rapportées les données publiées des divers levés.

C. — Travaux des Observatoires

1. Temps zonal ou temps de Greenwich : *a*. Pour donner suite au vœu No. 6 de Madrid, il convient de définir le temps zonal comme le temps qui diffère du temps de Greenwich par des heures entières. *b*. Doit-on fixer une période définie quelconque pour l'introduction d'un changement. *c*. Examen nouveau de la question : Le vœu de Madrid doit-il s'appliquer à l'électricité atmosphérique ?

2. Correction non-cyclique : Recommandation formelle qu'une correction non-cyclique soit appliquée dans tous les cas avant de procéder au calcul des coefficients de Fourier.

3. Considération de la meilleure forme sous laquelle on doit publier des données magnétiques.

4. Considération des méthodes ayant pour but la diminution

des frais de compilation et de réduction des observations faites dans les observatoires afin de permettre une publication plus prompte des résultats ; du minimum qu'il faut introduire dans les publications des observatoires ; et des diverses méthodes de réduction et de compilation.

5. La valeur normale d'un élément magnétique au 1er janvier est la moyenne des valeurs de cet élément magnétique pendant les douze mois comprenant les six mois qui précèdent ce 1er janvier et les six mois qui le suivent.

6. La variation séculaire annuelle d'un élément magnétique pendant une certaine année est la différence entre les valeurs au 1er janvier qui termine cette année et au 1er janvier qui la commence.

7. Que le congrès de Prague fixe la manière dont doivent être prises les moyennes du champ électrique de l'atmosphère (moyennes mensuelles, annuelles). *a*. Doit-on tenir compte de toutes les valeurs ? *b*. Doit-on tenir compte des valeurs positives seules, en signalant seulement la fréquence des valeurs négatives ?

8. L'avenir des observatoires magnétiques indiens.

D. — Propositions Générales

1. Discussion de la meilleure manière d'observer l'ionisation atmosphérique.

2. Projet de publication d'un résumé des observations d'aurores polaires par tous les pays où l'on voit d'ordinaire des aurores.

3. Importance d'obtenir des données additionnelles sur les éclairs.

4. Nécessité des mesures de la pollution de l'atmosphère (teneur en poussière, nucléation) ; d'un programme d'observation pour faciliter les études sur la corrélation de celle-ci avec les éléments de l'électricité atmosphérique et de la météorologie, et des méthodes pour éliminer des résultats des observations de l'électricité atmosphérique tout effet possible provenant de cette source.

5. Nécessité d'installations additionnelles pour l'étude des courants telluriques, de lignes établies en double à toutes les stations pour éliminer des effets locaux, et de données sur la densité des courants telluriques observés dans les mesures de la résistivité.

6. Nécessité d'un plan international pour l'étude des corrélations entre la réception des ondes de T. S. F. et les activités du magnétisme, de l'électricité atmosphérique et des aurores polaires, et l'activité solaire.

MINUTES OF THE EXECUTIVE COMMITTEE

Session of September 6, 1927

The Executive Committee held a session just before the morning meeting of the Section to consider a budget for the Section for the period 1928-1930. The budget recommended by the Executive Committee was adopted and recorded in the minutes of the morning session of the Section on September 6, 1927.

In the discussion of the budget, the following proposition presented by Prof. Palazzo was favorably considered.

« Certaines recherches récentes sur l'aimantation des roches éruptives semblent prouver que l'inclinaison magnétique du globe se serait inversée au cours des âges. Les conséquences scientifiques d'un tel fait, s'il s'avérait définitivement, seraient si importantes qu'il convient de le vérifier par des études systématiques. Celles-ci comportent d'une part le prélèvement d'échantillons bien repérés de tous les terrains éruptifs possibles à la surface de la terre et d'autre part l'étude au laboratoire de l'aimantation permanente de ces échantillons mis en état convenable.

« Nous proposons qu'un crédit de 10.000 francs soit ouvert au professeur Mercanton, à Lausanne, auteur des recherches précitées, aux fins d'organiser à la fois la collecte des échantillons dans les divers pays et leur examen dans son laboratoire à Lausanne. M. Mercanton s'est déclaré prêt à assumer cette tâche si la Section de Magnétisme de l'Union veut bien la lui confier en lui assurant les moyens de réalisation. »

Members of the Executive Committee present were: Dr. CHREE, Dr. BAUER, Prof. MAURAIN, Prof. PALAZZO, and Prof. TANAKADATE.

Charles CHREE, *President*;
Louis A. BAUER, *Secretary*.

Session of September 8, 1927

During a meeting from 2^h30^m to 3^h. P. M. on September 8, 1927, in accordance with the actions taken by the Section September 5, 1929, the Executive Committee appointed the committees as indicated in Resolutions I and XXIX.

The membership for a joint committee of the Section and of the Magnetic Commission of the International Meteorological Committee to consider the relationship of the two bodies was considered in accordance with the Section's instructions of September 3, 1927. Action was taken later by the Section in the matter as per Resolution III.

Members of the Executive Committee present were: Dr. CHREE, Dr. BAUER, Prof. MAURAIN, Prof. PALAZZO, and Prof. TANAKADATE.

Charles CHREE, *President*;
Louis A. BAUER, *Secretary*.

MINUTES OF PRAGUE MEETING, SEPTEMBER 3-10, 1927

Session of September 3, 1927

The meeting was opened at 15^h by the President, Dr. Chree.

Copies of a short address by the President were circulated while a French translation was read to the meeting by Dr. Moscheles (interpreter). The Secretary's report followed, together with a short statement of account with the auditor's report which was accepted and approved. The President congratulated Dr. Bauer on the present state of the Section's finances and on his competent management of the funds.

The President then referred to a matter already raised by Dr. Bauer in his report. He said that at the last meeting of the International Meteorological Committee it had been suggested that a joint committee composed of members of the two organizations, i.e., the Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics and the Magnetic Commission of the International Meteorological Committee, should consider the question of future relations. The President thought that it would be convenient if the meeting would leave the preparation of a joint list of members to the Executive Committee in collaboration with Professor van Everdingen, who was Secretary of the Magnetic Commission. The list would be submitted to a subsequent meeting for approval. The meeting agreed to this proposal.

The President called attention to the fact that in the past some of the resolutions which had been approved by the Section were subsequently adopted by the International Magnetic Commission. He thought that in the same way resolutions which had been adopted by the International Magnetic Commission at Zürich might be regarded as included in the Agenda list of the present meeting of the Section. This was approved.

The Secretary then stated that he had received reports from the National Committees of two-thirds of the countries adhering to the Union. As there was not time to read all the reports received, the President suggested that only résumés should be read, and he himself gave a summary of his report for Great Britain. Following this, delegates gave summaries of their reports, and in the absence of delegates the Secretary made brief mention of outstanding points in the other reports. Reports were received from the following countries : Australia, Brazil, Canada, Denmark, Egypt, Finland, France (2), Italy, Japan, Mexico, New Zealand, Norway, Poland, Siam, South Africa, Sweden, Switzerland, United Kingdom, and United States (2).

There were 26 persons present, 22 of whom were delegates and four invited guests, 12 countries being represented.

The meeting adjourned at 17^h20^m.

(Signed) Charles CHREE, *President* ;
Louis A. BAUER, *Secretary*.

Session of September 5, 1927

The meeting was opened at 10^h by the President, Dr. Chree.

The minutes of the first meeting were read and confirmed.

The President said that it was desirable for the Section to elect as Vice-President for the term of the meeting a gentleman representing the country in which the meeting was being held, and he proposed that for the meeting in Prague, Professor Salamon should be Vice-President of the Section. Mr. Thomson seconded the proposal, which was then carried unanimously.

The Secretary reported that neither he nor the President had been able to attend the general meeting at which finance had been discussed, but he understood that sections were asked to nominate representatives on a committee to consider the future budget. Professor Tanakadate was proposed as representative on this committee and unanimously elected.

The next business of the meeting was the consideration of reports on special investigations.

Printed copies of Professor Mathias' second preliminary report on lightning were circulated (the first report having been published in Bulletin No. 6), and he gave the meeting a summary of his conclusions.

Professor Maurain's report on terminology (printed in Bulletin No. 6) gave rise to some discussion in which Dr. Bauer, Sir Frank Dyson, Professor Mercanton, Professor Chapman, Dr. Deslandres, and Professor Palazzo took part. Professor Mercanton was of the opinion that if Professor Maurain had no objection the question of terminology could usefully be recommitted to a subscommittee, and Dr. Deslandres seconded this proposal which was approved in the form of Resolution XXIX.

Professor Palazzo's report on the magnetism of rocks had also been printed in Bulletin No. 6. Certain corrections and additions were necessary, and two corrected copies of the report were handed to the Secretary by Professor Palazzo. Professor Maurain said that Professor Chevallier had also done a considerable amount of work on the same subject, which he would bring forward at a later meeting.

Dr. Bauer then presented his report on the comparison of instruments (printed in Bulletin No. 6), pointing out that the instruments in use at Washington had been compared with the standards in use in Europe. He also presented a report on the distribution-coefficients which was taken as read. The discussion of instrumental questions was left to a subsequent meeting.

Professor Störmer's report on crucial phenomena of polar lights had been printed in English in Bulletin No. 6, and he gave the meeting a summary in French. Some discussion then took place on the subject, Dr. Deslandres, Dr. La Cour, Dr. Carlheim-Gyllensköld, and Professor Chapman taking part. Dr. Carlheim-Gyllensköld thought that a special subcommittee should be appointed to consider the matter.

Professor Chapman reported to the Section the formation of a committee by the International Research Council to consider terrestrial and solar relationships. The subject was one which interested three unions, the Terrestrial Magnetism Section of the International Union of Geodesy and Geophysics, the Union of Astronomy, and the Union of Radiotelegraphy. The committee met in 1925, and the report which they drew up had been circulated. The committee had been reappointed until the next meeting of the International Research Council and was requested to prepare regulations for a permanent committee to consider the questions affecting the three unions after consultation with those interested in the subjects concerned. Professor Chapman thought that the Executive Committee of the Section might wish to make proposals regarding the nomination of the personnel of the committee or as to its work and cooperation with the three unions interested.

Dr. Carlheim-Gyllensköld said that there were two different subjects to discuss, (1) Professor Störmer's proposition for exact observations of the aurora and (2) the relations of the terrestrial phenomena of magnetic storms and aurora with the sun, and he thought that both subjects should be considered by a subcommittee. He mentioned Dr. Deslandres' extensive work on the subject. It was understood that the subject would come up for further discussion at a later meeting.

Dr. Mitchell then read the second part of his report on magnetic characterization of days, the first part having been printed in Bulletin No. 6. He expressed his thanks to Professor Maurain for the extensive tabulation of ranges and products of ranges which he had supplied for Val Joyeux, and acknowledged also help received from Dr. van Dijk's paper on the subject.

Considerable discussion took place on Dr. Mitchell's report, Professor van Everdingen, Dr. Bauer, Professor Chapman, Mr. Thomson, Dr. van Dijk, and Dr. Chree taking part. Professor van Everdingen suggested that a subcommittee should be appointed to consider the question of the trial of Dr. Mitchell's methods at observatories, the nomination of members to the subcommittee being left to the Executive Committee who would take into consideration the remarks which had already been made at the meeting. Resolution I was adopted.

The President expressed the thanks of the Section to the various members who had presented such valuable reports.

There were 27 persons present, 24 of whom were delegates and three invited guests, 14 countries being represented.

The meeting adjourned at 12^h45^m.

(Signed) Charles CHREE, *President* ;
Louis A. BAUER, *Secretary*.

Morning session of September 6, 1927

The meeting was opened at 10^h by the President, Dr. Chree.

The Executive Committee, which had met immediately before the meeting, made the following proposals with regard to finances :

(1) That the balance remaining to the credit of the Section on March 31, 1927, namely, 74,743.60 French francs, continue available until expended.

(2) That the equivalent of 40,480 French francs, reckoned on the new gold franc basis, be annually allocated (total for three years 121,440 French francs) for the following objects :

a) Publications and miscellaneous expenses.
b) International comparisons of instruments.
c) Magnetic and electric characterization of days.
d) Construction of instruments for special purposes.
e) Grants to committees for special investigations including experiments on the magnetization of rocks.

These were approved by the Section, who entrusted Professor Tanakadate to represent their interest on the main committee.

Professor Tanakadate read an additional note which he had prepared on sudden commencements of magnetic storms (see Bulletin No. 6), and Dr. Crichton Mitchell explained the difficulties he had experienced with the instruments he had designed.

The subject of comparison of instruments (A^1 of Agenda) was then brought forward. Dr. La Cour described variometers in use at Godhavn and Rude Skov. He thought that it was possible to obtain very exact measurements without constructing special instruments. Professor Maurain stated that at Val Joyeux there was an instrument such as Dr. Mitchell had constructed..

Dr. La Cour spoke further of an apparatus capable of determining both horizontal and vertical force. A description had been given in the December 1926 number of *Terrestrial Magnetism and Atmospheric Electricity*. Coil instruments had special advantages for the intercomparison of observatory standards because the coil could be of a rigid construction and so safely transportable from place to place. An advantage of Dr. La Cour's instrument was the small temperature correction. Dr. La Cour thought it most important that comparisons with such instruments should be made.

On behalf of the Astronomer Royal, Professor Chapman described a Schuster-Smith coil magnetometer at Abinger which took only about two minutes to make an observation and attained a very high degree of accuracy.

Dr. Chree, Dr. Bauer, Professor Tanakadate, and Commander Heck also took part in the discussion. Resolution XI was adopted.

It was understood that comparisons of magnetic instruments by other methods would have to continue, but that it was desirable that no work of the kind should be carried on which was not absolutely essential.

The need for a readily portable instrument for purposes of field work (A^2 of Agenda) was then discussed by Dr. Bauer, Commander Heck, D. La Cour, Professor Tanakadate, and Dr. Chree, and Resolution XII was approved.

Professor Chapman described a portable declination magnetometer designed by Dr. F. E. Smith, which gave accurate records of changes in declination.

Professor Tanakadate described a number of methods for securing a complete magnetic record on disturbed days. Agreement was not reached as to which method was preferable, but Resolution XIII was adopted.

The question of dates for magnetic surveys (B^1 of Agenda) was then considered, Professor Maurain, Professor Tanakadate, Dr. Bauer, Sir Frank Dyson, and Dr. Carlheim-Gyllensköld taking part in the discussion. The latter said that, although at Madrid he had proposed a definite date for surveys, he did not now think this practicable as conditions differed so widely in different countries and as funds were not always available for a survey at the fixed date. Resolution X was therefore approved.

In connection with the necessity for continued magnetic surveys, Resolution XXIV was adopted.

There were 27 persons present, 24 of whom were delegates and three invited guests, 14 countries being represented.

The meeting adjourned at 12^h55^m.

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

Afternoon session of September 6, 1927

The meeting was opened at 14^h30^m by the President, Dr. Chree.

Professor Mercanton described the investigations he had carried out in connection with the magnetization of rocks. Professor Maurain gave a résumé of the work of Professor Chevallier on this subject. The President thanked Professor Mercanton for his remarks and expressed the hope of the Section that further research could be carried out in that direction.

The minutes of the meeting held on September 5 were read and confirmed.

After a few remarks by Professor Arctowski, Resolution XXV was adopted.

The proposed definition in C^5 of the Agenda gave rise to much discussion. Dr. La Cour objected to the term "normal value" as already in general use in a different sense. Dr. Carlheim-Gyllensköld, Dr. Chree, Dr. Bauer, and Dr. Crichton Mitchell took part in a discussion as to the use of 12 months for obtaining the value on January 1. Professor Mathias then put forward an amended definition which was adopted as Resolution VIII by five votes to four, the remaining members not voting.

The definition of the annual secular-variation proposed in C^6 of the Agenda also provoked much discussion. No conclusion was reached, and Professor Mathias agreed to bring forward an amended definition in time for the next meeting.

There were 26 persons present, 23 of whom were delegates and three invited guests, 16 countries being represented.

The meeting adjourned at 14^h30^m.

(Signed) Charles CHREE, *President* ;
Louis A. BAUER, *Secretary*.

Morning session of September 8, 1927

The meeting was opened at 10^h10^m by the President, Dr. Chree.

Professor Mathias submitted a revised definition of annual secular-variation (C^6 of the Agenda), which was approved as Resolution IX.

Professor Störmer proposed a scheme for the preparation of an auroral atlas and the execution of eye-observations according to a definite plan. Dr. Carlheim-Gyllensköld, Dr. La Cour, and Dr. Melander stated what auroral observations were already being made in their respective countries. Commander Heck, Dr. Crichton Mitchell, Professor Chapman, Professor Maurain, and Dr. Bauer took part in further discussion in the course of which questions of personnel of the committee and the expenses involved in the scheme were raised. A further proposal by Professor Strömer respecting the institution of pairs of stations for determining the height of aurora by photographic methods was also discussed. Following the discussion Resolution XIV was adopted (see also minutes of afternoon session of September 9).

There were 21 persons present, 19 of whom were delegates and two invited guests, 12 countries being represented.

The meeting adjourned at 12^h55^m.

(Signed) Charles CHREE, *President*;
Louis A. BAUER, *Secretary*.

Afternoon session of September 8, 1927

The meeting was opened at 15^h10^m by the President, Dr. Chree.

The minutes of the morning and afternoon meetings of September 6 were read and, after correction, confirmed.

The Secretary reported that at a meeting of the Executive Committee held immediately before the present meeting the subcommittees as indicated in Resolutions I and XXIX had been appointed. Members were invited to send any suggestions regarding terminology to Professor Maurain.

With regard to D^6 of the Agenda, Professor Chapman thought it desirable too proceed without any reference to the committee appointed by the International Research Council to report on solar and terrestrial relationships (see minutes for meeting of September 5, morning session). Commander Heck, Professor Maurain, Professor Chapman, Dr. Chree, Dr. Bauer, Dr. Crichton Mitchell, and Dr. Krogness discussed the work which was already being done, and Resolution XVI was approved.

The President stated that the subject of obtaining additional statistics of lightning flashes (D^3 of the agenda) had been suggested by the British Meteorological Office but, owing to the illness of the British delegate, Mr. Whipple, who had the subject in hand, no proposal had been formulated. Dr. Bauer read a letter from Professor McAdie, and the Reverend P. Lejay described work which he had carried out at Pic du Midi. General Resolution XXI was adopted.

Dr. Bauer said that D^5 of the Agenda had been proposed by the American Geophysical Union. He mentioned that there were at present only four stations making such observations and suggested a number of other places suitable for measurements of earth-currents. Dr. Krogness, Commander Heck, and Dr. Chree made further remarks, and Resolution XV was passed.

Consideration was then given to the investigation of underground geological forms by magnetic and electric methods (A^3 of the Agenda). Señor Gil, Dr. Evans, and Dr. Carlheim-Gyllensköld described work which was being done in their respective countries, and Señor del Bosch stated that at the last Geological Congress, which was held in Spain in 1926, the importance of modern geophysical methods in prospecting had been very clearly shown. The framing of a definite resolution on the subject was left to a later meeting.

The President said that he had received a letter from Professor Salamon thanking the Section for the honor they had conferred upon him in electing him Vice-President.

There were 22 persons present, 19 of whom were delegates and three invited guests, 12 countries being represented.

The meeting adjourned at 18^h.

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

Morning session of September 9, 1927

The meeting was opened at 10^h by the President, Dr. Chree.

The first item considered was the election of officers. On the retirement of Dr. Chree from the Presidency of the Section, Dr. Bauer was elected to that office. Dr. Carlheim-Gyllensköld was elected to succeed Professor Palazzo as Vice-President, and the vacancy caused by the acceptance by Dr. Bauer of the office of President wad filled by the election of Professor Maurain as Secretary.

Resolution XVII following on the discussion of the previous meeting (A^3 of the Agenda) was approved.

Items C^3 and C^4 of the Agenda were discussed together. Commander Heck described an improved method of dealing with and publishing results. Dr. Carlheim-Gyllensköld thought that all values should be published which were useful for the purposes of special investigators, while Dr. Uljanin was of the opinion that it would be sufficient if data existed in MS, less detailed results being published. Professor Chapman, Dr. Crichton Mitchell, Sir Frank Dyson, Professor Tanakadate, and Dr. Chree also took part in the discussion, and Dr. Bauer mentioned a letter he had received on the subject from the Reverend J. de Moidrey. No resolution was passed.

The question in C^1 of the Agenda as to the use of zonal or Greenwich time had been brought before the International Commission for Terrestrial Magnetism and Atmospheric Electricity at Zürich and, after discussion in which Dr. Carlheim-Gyllensköld, Commander Heck, Dr. Chree, and Dr. Bauer took part, the resolution taken at Zürich was adopted by the Section as Resolution IV.

After discussion of $C^1(a)$ of the Agenda, Resolution VI was approved.

After discussion of $C^1(c)$ of the Agenda, the resolution (No. 6) taken at Madrid was re-affirmed after the omission of the words "terrestrial magnetism" in the new form of Resolution V.

With to the question of non-cyclic correction raised in C^2, the Section agreed to accept the resolution passed at Zürich without any additions as Resolution VII. Difference of opinion existed as to the application of a correction in the calculation of Fourier coefficients.

After discussion of resolution coupling the observatories of Siberia with those of India, proposed from the Chair, and seconded by Sir Frank Dyson, Resolutions XXVI and XXVII were approved.

There were 25 persons present, 23 of whom were delegates and two invited guests, 15 countries being represented.

The meeting adjourned at 13^h.

(Signed) Charles CHREE, *President* ;
Louis A. BAUER, *Secretary*.

Afternoon session of September 9, 1927

The meeting was opened at 15^h by the President, Dr. Chree.

The Secretary reported that the Executive Committee had nominated the following gentlemens to serve on the joint committee of the Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics and the Magnetic Commission of the International Meteorological Committee (see minutes of meeting on September 3) : Dr. Chree (Chairman), Dr. Bauer, Dr. Carlheim-Gyllensköld, Dr. La Cour, Professor van Everdingen, Professor Maurain, and Professor Palazzo. This was approved.

The Secretary also reported that the Executive Committee had expressed the desire that Dr. Chree and Professor Palazzo should continue as members of the Executive Committee.

Discussing C^7 of the Agenda, Professor Maurain thought that it would be very useful that some stations should for a number of years use both methods of indicating the frequency of negative values, i.e., (1) by employing all values and (2) by employing only positive values. At the end of that time it might be possible to prepare a report on the subject for submission to the next meeting of the Union. Mr. Thomson pointed out the difficulty they had in Samoa with the high values recorded.

After further discussion between Dr. Chree, Professor Maurain, and Professor Tanakadate, Resolution XVIII was approved.

In the absence of Sir Frank Dyson, Professor Chapman proposed Resolution XXII which was passed unanimously.

With regard to D[4] of the Agenda, Mr. Thomson had a proposal to make which, after discussion by Dr. Chree and Dr. Bauer, was approved as Resolution XIX.

The President referred to the work which had been instituted in Apia, Samoa, by the Germans and now caried on under New Zealand, and moved consideration of Resolution XXVIII which was adopted.

Referring to the minutes of the morning session on September 8 and Resolution XIV, Dr. Chree said that no Chairman had been decided upon for the committee in question. Professor Störmer was duly appointed to that office and the resolution so amended.

Discussing the best method of observing atmospheric ions, Mr. Thomson referred to the work already being done at Apia, Samoa, and pointed out the importance of comparison between the Ebert and Swann ion counters. After some discussion Resolution XX was adopted.

Dr. Deslandres then described to the meeting a self-recording apparatus (1) he had used for the study of solar activity, in which the sensitized paper did not require developing, the eight-day curve being always before the observer. A special contrivance drew attention to the curve in cases of large magnetic disturbance.

There were 18 persons present, 17 of whom were delegates and one invited guest, 13 countries being represented.

The meeting adjourned at 17^h15^m.

(Signed) Charles CHREE, *President* ;
Louis A. BAUER, *Secretary*.

Final session September 10, 1927

The meeting was opened at 10^h by the President, Dr. Chree.

The minutes for the morning and afternoon meetings held on September 8 and 9 were read and duly approved.

The resolutions passed up to the time of meeting were then read and adopted unanimously with the exception of Nos. VIII and IX which were adopted by a majority.

The Section gave formal approval to the final arrangement

(1) This apparatus is fully described in an article by B. Lyot in *L'Astronomie*, Bull. Soc. Astr. France, 42e année, août 1928 (402-405).

and presentation of the resolutions being entrusted to the President and Secretary.

No formal resolution having been passed by the Section as to the formation of the joint committee mentioned in the minutes of the first meeting and those for the afternoon of September 9, Resolution III was approved.

Dr. Crichton Mitchell thought that some action ought ot be taken with regard to Professor Tanakadate's report on sudden commencements, and Resolution II was agreed upon.

As the Section wished to put on record its appreciation of the Action of the Danish Government in establishing an observatory at Godhavn, Greenland, Resolution XXIII was adopted.

The Section concluted its meeting by passing Resolution XXX.

Professor van Everdingen expressed the thanks of the Section to the three retiring officers.

A vote of thanks was given to Dr. Moscheles for her valuable assistance as interpreter and to Dr. Simpson in connection with the much-appreciated services of Miss Chambers as Assistant Secretary.

There were 21 persons present, 19 of whom were delegates and two invited guests, 13 countries being represented.

The meeting adjourned at 11^h55^m.

(Signed) Charles CHREE, *President* ;
Louis A. BAUER, *Secretary*.

MEMBERS OF THE EXECUTIVE COMMITTEE

The Executive Committee for 1924 to 1927 consisted 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).

The Executice Committee from 1927 following the Prague Meeting is composed of the new officers of the Section, namely, Louis A. BAUER (president), V. CARLHEIM-GYLLENSKÖLD (vice-president), Ch. MAURAIN (secretary and director of the Central Bureau), C. CHREE, J. JAUMOTTE, Luigi PALAZZO, and A. TANAKADATE.

RESOLUTIONS OF INTERNATIONAL SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

(Adopted at Prague Meeting, September 10, 1927)

I.—That a small sub-committee should be appointed to propose definite choice of several of the criteria contained in Dr. Mitchell's paper, with a view to asking certain specified observatories, to apply these criteria for a period of two or three years. The committee appointed consists of

Dr. Chree (Chairman),
Dr. Bauer,
Prof. Chapman,
Dr. van Dijk,
Prof. van Everdingen,
Prof. Maurain,
Dr. Crichton Mitchell,
Prof. Tanakadate,

II.—That the Executive Committee take the steps necessary to complete the investigation into the times of commencements of magnetic storms.

III.—The Section approves of the constitution of a joint committee of its own members and those of the Magnetic Commission of the International Meteorological Committee to consider the future relationship of the two bodies, to consist of

Dr. Chree (Chairman),
Dr. Bauer,
Dr. Carlheim-Gyllensköld,
Dr. La Cour,
Prof. van Everdingen,
Prof. Maurain,
Prof. Palazzo.

IV.—That the following resolution made at Zürich by the International Commission for Terrestrial Magnetism and Atmospheric Electricity of the International Committee be accepted :

"It was decided to recommend the universal adoption of Greenwhich time for all ordinary magnetic data, especially international magnetic data, while recognising that zonal or even local time might usefully be employed for local purposes."

V.—That Resolution No. 6 passed at Madrid be confirmed after omission of the words *terrestrial magnetism* from the English version, the new resolution being as follows :

"That curve measurements pertaining to atmospheric electricity be made according to Greenwich time or zonal time based thereon."

VI. — Zonal time should be time differing from Greenwhich time by whole hours.

VII.—It was decided that whether a correction was or was not applied for non-cyclic change in the calculation of diurnal inequalities—a practice as to the desirability of which there is much diversity of opinion—it was desirable that all magnetic observatories should publish information as to the non-cyclic change, sufficient to enable a correction to be applied, or the original figures to be recovered if a correction had already been applied. In the case of observatories which took mean hourly values centering at the half-hour, the arithmetic mean of the mean values for the two hours immediately preceding and following midnight, might be accepted as the midnight value, and employed in the estimation of the non-cyclic change.

VIII.—The value of a magnetic element on January 1 will be the mean of the values of that element during the 24 months comprising the 12 months which precede and the 12 months which follow January 1.

IX.—That the annual secular variation of a magnetic element during a given year will be the difference between the values on the January lst which terminates that year and the January lst which begins it. This method of considering the facts is by no means obligatory.

X.—There are advantages if the magnetic surveys of different countries refer to common epochs. The Section draws the attention of the authorities interested in the several countries to this fact.

XI.—1. It is desirable that as soon as practicable an intercomparison should be made of the coil magnetometers of different countries (1).

2. Directors of observatories willing to take part in such comparisons should be asked to inform the Secretary of the Section.

XII.—In view of the need for readily portable apparatus for accurately recording continuously during short periods the

(1) The difference between the C. G. S. units and the international electric units is to be taken account of.

magnetic elements at field stations in order to facilitate determination of diurnal variation and the study of magnetic storms in high latitudes, it is recommended that consideration be given to the development of such apparatus.

XIII.—It is recommended that adequate provision should be made for securing a complete magnetograph record on highly disturbed days.

XIV.—1. As the photographic method is the only one which gives reliable determinations of auroral heights and situations, it is very desirable that each country where polar lights can be seen should have at least one pair of photographic stations for the purpose of measuring the height and situation of aurora. The available pair of stations ought to be situated either approximately along a line parallel to the polar lights zone or along a line from the magnetic axis across the zone.

2. That a Committee be formed by the Section to prepare a photographic atlas of auroral forms with descriptions for the purpose of visual observations.

3. That a Committee representing the countries in wich polar lights are frequently visible should be appointed :

(*a*) to reveive the auroral atlas prepared and approved by the Committed charged with the duty of preparing it.

(*b*) to prepare a scheme for visual observations of aurora.

4. That this Committee should maintain correspondence with other countries which may be interested.

5. That the Committee consist of the following persons :

Canada,	Sir F. STUPART,
Denmark,	Dr. La COUR,
Finland,	Dr. MELANDER,
Great Britain,	Prof. CHAPMAN,
Norway,	Prof. STÖRMER (Chairman),
Sweden,	Dr. CARLHEIM-GYLLENSKÖLD,
United States,	Commander HECK.

6. That the Committee named in (4) constitute the Committee named in (2).

XV.—The necessity for additional information as to earth-currents is recognized and the execution of earth-resistivity surveys at as many stations as possible is recommended.

XVI.—That while the Section is of opinion that the time has not yet arrived at which any international programme can be usefully framed, it considers it desirable that the study of the subjects included in Agenda D 6 should be encouraged in every possible manner.

XVII.—That it is desirable to appoint a committee to act in cooperation with a similar committee of the Geological Congress at Madrid to consider the best means of promoting research and instruction in the methods of applying the principles of Geophysics to the investigation of the Earth's crust and the minerals it contains, the Committee consisting of the following persons :

Sr. GIL (Chairman),
Prof. ARCTOWSKI,
Dr. BĚHOUNEK,
Dr. EVANS,
Mr. FLEMING,
Dr. ONO.

XVIII.—*Potential Gradient of Atmospheric Electricity.*—Results from all was well as quiet days are desirable from stations which are able to supply them. It is desired that all stations should give the annual duration of negative electricity.

XIX.—The Section recommende that a complete study be made of the effects of atmospheric pollution and atmospheric nuclei of all kinds on atmospheric-electric elements.

XX.—It is desired that a thorough investigation be made of the Ebert, Swann, and other forms of ion counters. It is suggested that the investigation might be made at Kew Observatory and at another observatory further from a large city.

XXI.—It is desirable that our knowledge of the optical phenomena of lightning and the physical phenomena at the spot and at a distance be extended in the near future.

XXII.—The Section is glad to hear that the cruises of the "Carnegie" are to be resumed. The work by the "Carnegie" in the past has been a most valuable contribution to terrestrial magnetism and electricity. It was proposed that a copy of the resolution be forwarded to the Carnegie Institution of Washington.

XXIII. — 1. The Section expresses its great satisfaction that the Danish Government has established a magnetic observatory at Godhavn (Greenland), the desirability of which was expressed in a resolution passed at Madrid.

2. It is to be hoped that full advantage will be taken of the special opportunities offered by the situation of this observatory for the study magnetism and the aurora.

XXIV.—The Section considers that it is very important that a magnetic survey of the land area of Sweden and Denmark should be undertaken as soon as possible, in connection with the surveys of Finland, where magnetic mapping has already been successfully completed, and of Norway, where funds for starting the magnetic survey have been already secured. This would fill a regrettable blank in the magnetic map of North Europe.

XXV.—It is most desirable to have the systematic magnetic survey of Poland continued in order to extend the general magnetic survey of Central Europe.

XXVI.—The Section of Terrestrial Magnetism and Electricity expresses its sense of the great value of the magnetic survey of India recently completed, but regrets the present suspension of work at several of the Indian magnetic observatories. It trusts that these observatories at least will be restored to their full activity at an early date.

XXVII.—The Section welcomes the return of the observatories in Siberia to their pre-war activity. The magnetic observatories in Asia are regrettably few, and an increase in their number is much to be desired.

XXVIII.—That whereas the Apia (Samoa) Observatory is uniquely situated near the centre of the largest oceanic area in the world, and data in atmospheric electricity have been obtained for twenty-four years, the Section of Terrestrial Magnetism and Atmospheric Electricity expresses its high appreciation of New Zealand's present support of Apia Observatory and trusts that the investigations there in magnetism and atmospheric electricity will be continued.

XXIX.—That the report on terminology be referred, for further consideration, to a small sub-committee. The sub-committee consist of

Prof. MAURAIN (Chairman),
Dr. BAUER,
Prof. CABRERA,
Dr. van DIJK,
Prof. TANADAKE.

XXX.—The Section desires to express its warm appreciation of the kindness received from the Government of Czechoslovakia and for the excellent facilities afforted for the meetings.

VŒUX DE LA SECTION DE MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES

(*Adoptés à l'Assemblée de Prague, le* 10 *septembre* 1927)

I. — Qu'on nomme une sous-commission pour proposer un choix définitif de plusieurs des formes de caractérisation numérique que contient le rapport du Docteur Crichton Mitchell, en vue de demander à certains observatoires spécifiés d'employer ces formes pendant deux ou trois années. La sous-commission se compose de :

Dr. CHREE, Président,
Dr. BAUER,
Prof. CHAPMAN,
Dr. van DIJK,
Prof. van EVERDINGEN,
Prof. MAURAIN,
Dr. Chrichton MITCHELL,
Prof. TANAKADATE.

II. — Que le Comité exécutif fasse le nécessaire pour compléter les études sur les débuts des orages magnétiques.

III. — La Section approuve la formation d'un Comité composé de membres de la Section même et de membres de la Commission de Magnétisme du Comité Météorologique International, pour étudier les relations futures des deux Commissions. Le Comité se compose de :

Dr. CHREE, Président,
Dr. BAUER,
Dr. CARLHEIM-GYLLENSKÖLD,
Dr. LA COUR,
Prof. van EVERDINGEN,
Prof. MAURAIN,
Prof. PALAZZO.

IV. — Que le vœu suivant émis à Zürich par la Commission Internationale de Magnétisme Terrestre et Electricité Atmosphérique du Comité Météorologique International soit accepté.

« Il a été décidé de recommander l'adoption universelle du temps de Greenwich pour toutes les données magnétiques ordinaires, surtout pour les données magnétiques internationales, tout en reconnaissant que le temps zonal ou même local peut être employé avec succès pour des buts locaux. »

V. — Que le vœu No. 6 accepté à Madrid soit confirmé, en omettant les mots « terrestrial magnetism » de la traduction anglaise. La nouvelle résolution est comme suit :

« Que le dépouillement des courbes relatives à l'électricité terrestre soit fait d'après le temps moyen de Greenwich, ou d'après le temps zonal basé sur le précédent. »

VI. — Le temps zonal doit différer du temps de Greenwich par heures entières.

VII. — Il a été décidé que, qu'une correction non cyclique soit employée ou non dans le calcul des inégalités diurnes — le fait de savoir si une telle correction est désirable est encore en discussion — il est désirable que tous les observatoires magnétiques publient des informations sur la variation non-cyclique, suffisantes pour permettre d'appliquer une correction, ou de retrouver les données originales si une correction a été déjà appliquée. Dans le cas d'observatoires notant les valeurs moyennes horaires rapportées à la demi-heure, la moyenne arithmétique des valeurs moyennes pour les deux heures avant et après minuit peut être acceptée comme valeur à minuit et employée pour évaluer la variation non-cyclique.

VIII. — Qu'on appelle valeur au 1er janvier d'un élément magnétique, la moyenne des valeurs de cet élément pendant les vingt-quatre mois comprenant les douze mois qui précèdent ce 1er janvier et les douze mois qui le suivent.

IX. — Qu'on appelle variation séculaire annuelle d'un élément magnétique pendant une certaine année la différence entre les valeurs au 1er janvier qui termine cette année et au 1er janvier qui la commence. Cette manière de considérer les choses n'est nullement obligatoire.

X. — Qu'il serait avantageux que les levés magnétiques des différents pays se rapportent aux mêmes époques. La Section attire sur ce point l'attention des autorités intéressées des différents pays.

XI. — 1. Qu'il est important de faire, aussitôt que possible, une intercomparaison des magnétomètres à bobines des différents pays. La différence entre les unités C. G. S. et les unités électriques internationales sera prise en considération.

2. Que les Directeurs des observatoires qui voudraient prendre part à de telles comparaisons veuillent bien en avertir le Secrétaire de la Section.

XII. — En raison de la nécessité de disposer d'appareils portatifs pour l'enregistrement d'une manière précise et continue pendant de courtes périodes des éléments magnétiques dans des stations de campagne en vue de faciliter la détermination de la variation diurne et l'étude des orages magnétiques aux hautes latitudes, il est recommandé de s'intéresser au développement de tels appareils.

XIII.— Il est recommandé de faire le nécessaire pour obtenir des courbes magnétiques complètes pour les jours de forte perturbation.

XIV. — 1. Comme la méthode photographique est la seule qui donne des déterminations sûres de la hauteur et de la situation de l'aurore boréale, il est désirable que chaque pays où les aurores peuvent être observées possède au moins une paire de stations pour la mesure photogrammétrique de celles-ci. Les paires de stations doivent être situées approximativement, soit le long d'une ligne parallèle à la zone des aurores, soit le long d'une ligne à peu près normale à cette zone.

2. Qu'un Comité soit formé par la Section pour préparer un atlas photographique des formes de l'aurore polaire, avec descriptions pour les observations visuelles.

3. Qu'un Comité représentant les pays dans lesquels l'aurore polaire est fréquemment visible, soit élu :

(*a*) Pour recevoir l'atlas des aurores polaires préparé et accepté par le Comité chargé de sa préparation.

(*b*) Pour préparer un plan pour l'observation visuelle de l'aurore.

4. Que le Comité se tienne en correspondance avec les autres pays qui pourraient être intéressés.

5. Que le Comité soit composé des membres suivants :

Canada,	Sir F. STUPART,
Danemark,	Dr. LA COUR,
États-Unis,	Commander HECK,
Finlande,	Dr. MELANDER,
Grande Bretagne,	Prof. CHAPMAN.
Norvège,	Prof. STÖRMER, Président,
Suède,	Dr. CARLHEIM-GYLLENSKÖLD.

6. Que le Comité nommé ci-dessus se confonde avec le Comité visé au paragraphe 2.

XV. — La nécessité d'informations additionnelles sur les courants telluriques est reconnue et l'exécution de mesures de la résistivité de la terre à autant de stations que possible est recommandée.

XVI. — Bien que la Section juge que le temps n'est pas encore venu de formuler avec succès un programme international, elle considère cependant comme désirable que l'étude des sujets rentrant dans le domaine de D.6 de l'ordre du jour soit encouragée de toute manière possible.

XVII. — Qu'il est désirable d'élire un Comité qui en coopération avec le Comité analogue du Congrès Géologique de Madrid étudierait les meilleurs moyens pour développer la recherche et l'application des méthodes de Géophysique en vue de l'étude de l'écorce terrestre et des minéraux qu'elle renferme, le Comité étant constitué comme suit :

Sen. GIL, Président,
Dr. BEHOUNEK,
Prof. ARCTOWSKI,
Dr. EVANS
Mr. FLEMING,
Dr. ONO.

XVII. — *Gradient du potentiel de l'Électricité Atmosphérique.* — Il est désirable que les stations qui peuvent le faire donnent les résultats de toutes les journées aussi bien que des journées calmes. Il est désirable que toutes les stations donnent la durée annuelle pendant laquelle le champ est négatif.

XIX. — La Section émet le vœu qu'une étude complète soit faite de l'influence de la pollution de l'atmosphère et de la nucléation sur les éléments de l'électricité atmosphérique.

XX. — Il est désirable qu'une étude détaillée soit faite des compteurs d'ions d'Ebert, de Swann et autres. On suggère que ces recherches soient faites à l'observatoire de Kew et à un autre observatoire plus éloigné de toute grande ville.

XXI. — Il est désirable que nos connaissances des phénomènes optiques de l'éclair et des phénomènes physiques causés à proximité de l'orage et à distance soient approfondies dans un avenir prochain.

XXII. — La Section est heureuse d'apprendre que les croisières du « Carnegie » vont recommencer. Le travail accompli par le « Carnegie » dans le passé a été une contribution fort précieuse à nos connaissances sur le magnétisme et l'électricité terrestres. Il est proposé d'envoyer une copie de cette résolution à l'Institution Carnegie à Washington.

XXIII. — 1. La Section exprime sa grande satisfaction que le Gouvernement Danois ait établi un observatoire magnétique à Godhavn (Groenland), conformément au désir qui en avait été exprimé dans une résolution prise à Madrid.

2. On espère qu'on tirera le plus grand avantage possible des conditions spéciales offertes par la situation de cet observatoire pour l'étude du magnétisme et de l'aurore.

XXIV. — La Section considère comme très important que le levé magnétique de la terre ferme de la Suède et du Danemark soit fait aussitôt que possible, conjointement avec celui de la Finlande où le levé magnétique vient d'être achevé et de la Norvège où les fonds nécessaires pour commencer la réalisation ont déjà été accordés ; une lacune regrettable dans le levé magnétique de l'Europe du Nord sera ainsi comblée.

XXV. — Il est hautement désirable que le réseau magnétique systématique soit continué en Pologne, de manière à étendre le réseau magnétique général de l'Europe Centrale.

XXVI. — La Section de Magnétisme et Électricité terrestres se rend compte de la grande valeur du levé magnétique des Indes récemment accompli, mais regrette la suspension actuelle des travaux dans plusieurs observatoires magnétiques des Indes. Elle espère que ces observatoires reprendront leur activité le plus tôt possible.

XXVII. — La Section se félicite du retour des observatoires de Sibérie à leur activité d'avant-guerre. Il est regrettable qu'il y ait si peu d'observatoires en Asie, et une augmentation de leur nombre est vivement à désirer.

XXVIII. — Comme l'observatoire d'Apia (Samoa) a une situation unique au centre de la plus vaste région océanique du monde, et comme des données sur l'électricité atmosphérique y ont été obtenues depuis 24 ans, la Section de Magnétisme et Électricité Terrestres désire exprimer sa satisfaction de l'aide donnée par la Nouvelle Zélande à l'Observatoire d'Apia. La Section envisage avec confiance la continuation des études sur le magnétisme et l'électricité atmosphérique dans cette station.

XXIX. — Que le rapport sur la terminologie soit renvoyé, en vue d'une étude ultérieure, à une petite sous-commission. La sous-commission se compose de :

Prof. MAURAIN, Président,
Dr. BAUER,
Prof. CABRERA,
Dr. van DIJK,
Prof. TANAKADATE.

XXX. — La Section désire exprimer son appréciation chaleureuse de l'amabilité du Gouvernement tchécoslovaque et des grandes facilités offertes pour les assemblées.

SECRETARY'S SUMMARY OF PRAGUE MEETING

The third General Assembly of the International Geodetic and Geophysical Union met at Prague, September 3-10, 1927, twenty-seven countries which adhere to the Union being represented by delegates and guests. The total number was about one hundred and sixty-five.

All sessions of the Union and of the Sections were held in the Chamber of Deputies at Prague from September 3 to 10, 1927. At the opening meeting on the morning of September 3, the Vice-President of the Chamber of Deputies of Czechoslovakia briefly welcomed the Union and its guests in the name of the President who, because of illness, could not be present personally. Then followed addresses by the Minister of Public Instruction, M. Milan Hodža ; the Mayor of Prague, M. Karla Baxy ; the Vice-President of the National Research Council of Czechoslovakia, M. B. Bydžorsky, and the Vice-President of the Committee of Geodesy and Geophysics of Czechoslovakia, M. Fr. Nušl. The President of the Union, M. Lallemand, then responded. 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, Volcanology, and Scientific Hydrology.

The first plenary meeting of the Union was held on the afternoon of September 3. President Lallemand reported the adherence to the Union of Argentina and New Zealand. The report of the Secretary General for the period April 1, 1924 to March 31, 1927, was read and adopted. Matters pertaining to the entire Union were briefly discussed and referred as found necessary to special committees for report at the closing plenary session.

Upon opening the final plenary meeting of the whole Union on the afternoon of September 10, the President, M. Lallemand, presiding, reported upon the message of thanks sent His Excellency President Dr. Masaryk of Czechoslovakia. The report of the Auditor, Dr. Walter D. Lambert, certifying to the correctness of the financial report submitted by the Secretary General, was then received and approved. The Budget Committee then submitted recommendations for annual allotments for the years 1927, 1928, and 1929 ; these include for the Section of Terrestrial Magnetism and Electricity 40,480 francs for each year. The Union then heard the reports for the several sections. President Chree summarized briefly the activities of our Section during the Prague Meeting and the leading Resolutions. The officers of the Union and of its various sections at the close of the Prague Meeting are shown in Table 2.

The following general report pertains specifically to the meeting of the Section of Terrestrial Magnetism and Electricity. There were nine meetings of the Section, all being well attended, to which reports were presented from many of the 27 nations represented at the Assembly. The names of delegates to the Section and of guests with their countries and the record of their attendance upon the meetings of the Section are shown in Table 3.

The report on proposed French work in Indo-China and in the Pacific was of special interest. Reports from the United States, including that of the United States Coast and Geodetic Survey and that of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, were well received ; the latter contained much material relating to international work. Several progress reports were submitted on the development of instruments to record the abrupt beginnings of magnetic storms.

Practically all topics proposed in the printed agenda were thoroughly discussed, and as a result 30 resolutions were adopted. These may be briefly summarized as follows :

Appointment of a subcommittee of eight to propose definite choice of the criteria suggested for magnetic characterization of days, this committee being under the chairmanship of Chree, the other members being Bauer, Chapman, van Dijk, van Everdingen, Maurain, Crichton Mitchell, and Tanakadate.

Authorization of the Executive Committee to take necessary steps to complete the investigation into the times of commencement of magnetic storms.

Appointment of a committee of seven under the chairmanship of Chree with Bauer, Carlheim-Gyllensköld, La Cour, van Everdingen, Maurain, and Palazzo as members to act with a committee of the Magnetic Commission of the International Meteorological Committee to consider the future relationship of the two bodies.

Recommendation of adoption of Greenwich time in observatory publication without fixing a date for such adoption.

Decision that data for the application of noncyclic changes in the calculation of diurnal inequalities should given in observatory publications whether such changes were applied or not.

Definition of method for computing values of a magnetic element for a given date and of the annual secular-variation of a magnetic element during a given year; invitation of special attention to the advantages of referring magnetic surveys of different countries to common epochs.

Desirability of intercomparisons of coil magnetometers of different countries.

Need of development of readily portable apparatus for accurately recording continuously during short periods at field stations.

Recommendation of adequate provision to permit complete magnetograph records on highly disturbeb days.

Appointment of an international committee of seven to advance auroral studies under the chairmanship of Störmer of Norway and including Carlheim-Gyllensköld, Chapman, La Cour, Heck, Melander, and Stupart.

Need of additional earth-current data and recommendation for additional earth-resistivity surveys.

Expression of opinion that the study of correlations between radio reception and magnetic, atmospheric-electric, and auroral activities and solar activity should be encouraged in every possible manner, although it does not appear that the time has arrived at which any international program can be usefully framed.

Appointment of a committee of six under the chairmanship of Gil of Spain and including Arctowski, Běhounek, Evans, Fleming, and Ano to consider the best means of promoting research and instruction in the methods of applying the principles of geophysics to investigations of the Earth's crust.

Recommendations in five resolutions regarding atmospheric electricity that data be compiled for Greenwich or zonal time, that results from all as well as quiet days be included in potential-gradient compilations, that there be a complete study of the effects of atmospheric pollution on the atmospheric-electric elements, that there be made a thorough investigation of different forms of ion counters, and that knowledge of the optical phenomena of lightning be extended.

Seven resolutions were concerned with existing and proposed magnetic surveys including appreciation of the forthcoming cruise of the *Carnegie*, of the establishment of the observatory at Godhavn by the Danish Government, and of the return of the observatories in Siberia to pre-war activity, the hope the observatories in India might be resumed at an early date, and that the operations of the Apia Observatory might be continued. Resolutions concerned with magnetic surveys included land areas of Sweden, Denmark, Poland, and India.

A committee on improvement and uniformity of terminology was appointed under the chairmanship of Maurain with Bauer, Cabrera, van Dijk, and Tanakadate as the other members.

Funds.—In addition to the balance of funds still remaining to the credit of the Section at the time of the Prague meeting, a total of 121,440 francs was allocated by the Union to the Section for the period 1927-1930 for the following purposes: (*a*) Publication and miscellaneous expenses of Central Bureau; (*b*) International comparisons of instruments; (*c*) Magnetic and electric characterization of days; (*d*) Construction of instruments for special investigations; (*e*) Grants to committees for special investigations including experiments in the magnetization of rocks. The Finance Committee of the Union, in recommending the above allotment, made the following annotation:

« Dans le courant du mois de mai de chacune des années 1928, 1929 et 1930, l'excédent éventuel d'encaissements résultant de la substitution, par certains pays, du franc-or au franc-papier pour leurs cotisations, sera partagé entre les diverses Sections au prorata des sommes qui leur auront été définitivement attribuées par l'Assemblée générale. »

Bauer was elected President of the Section ; Carlheim-Gyllensköld, Vice-President ; and Maurain, Secretary and Director of the Central Bureau.

The next General Assembly will be held at Stockholm, Sweden, in August 1930.

Appropriate appreciation was recorded by the Section of the kindnesses received from the Government of Czechoslovakia and for the excellent facilities afforded the meetings which had much to do with the marked success of the Assembly.

Louis A. BAUER, *Secretary.*

TABLE 2.— OFFICERS OF INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION, 1927

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 * H. F. Reid ** J. Galbis ** B. Salamon *	E. Rothé *
Meteorology ...	N. Shaw **	P. Eredia * V. Bjerknes *	Ph. Wehrlé *
Terrestrial Magnetism and Electricity...	L. A. Bauer *	V. Carlheim-Gyllensköld	Ch. Maurain *
Oceanography..	O. de Buen **	G. Schmidt * E. Fichot * V. Volterra * L. Joubin ** G. W. Littlehales * H. G. Maurice **	G. Magrini *
Volcanology....	A. Lacroix *	H. S. Washington * L. F. Navarro ** J. Pantoflicek *	A. Malladra * G. Platania *
Scientific Hydrology......	B. H. Wade *	A. Wallén * J. Smetana *	G. Magrini *

* Electred at Prague for the period 1927-1931.
** Electred at Madrid for the period 1924-1930.

TABLE 3.—*Summary of meetings and attendance of delegates and guests for the Section of Terrestrial Magnetism Electricity at Prague, September 3 to 10, 1927.*

Name	Country	Meeting of September								
		3 p.m.	5 a.m.	6 a.m.	6 p.m.	8 a.m.	8 p.m.	9 a.m.	9 p.m.	10 a.m.
Delegates :										
Prof. H. Arctowski........	Poland	—	—	p	p	—	—	p	—	—
Dr. Louis A. Bauer........	United States of America	p	p	p	p	p	p	p	p	p
Señor T. M. del Bosch.....	Spain	—	—	p	p	—	p	p	—	—
Prof. M. Brillouin.........	France	—	—	p	—	—	—	—	—	—
Prof. B. Cabrera..........	Spain	p	p	p	p	—	—	—	—	—
Dr. V. Carlheim-Gyllensköld.	Sweden	p	p	p	p	p	p	p	p	p
Dr. A. Ferraz de Carvalho..	Portugal	—	p	p	p	—	—	—	—	—
Dr. Fr. Cěchura..........	Czechoslovakia	p	p	p	p	p	p	p	p	p
Prof. S. Chapman.........	Great Britain	p	p	p	p	p	p	p	p	p
Dr. C. Chree.............	Great Britain	p	p	p	p	p	p	p	p	p
Dr. D. La Cour...........	Denmark	p	p	p	p	p	p	p	p	p
Dr. J. H. Dellinger........	United States of America	p	—	p	p	—	—	—	—	—
Dr. H. Deslandres.........	France	—	p	—	—	p	—	p	p	—
Dr. G. van Dijk...........	Holland	—	p	p	p	p	—	p	p	p
Sir F. W. Dyson..........	Great Britain	p	p	p	—	p	—	p	—	—
Dr. J. W. Evans.........	Great Britain	—	p	—	—	—	p	p	—	—
Prof. E. van Everdingen...	Holland	—	p	—	—	—	—	—	—	p
Señor Rodrigo Gil.........	Spain	p	p	p	p	p	p	p	p	p
Com'd'r N. H. Heck.......	United States of America	p	p	p	—	p	p	p	—	—
Dr. H. E. Hurst..........	Egypt	—	—	—	p	—	—	—	—	—
Ing'r P. Kazda...........	Czechoslovakia	—	—	—	p	—	—	p	p	p
Dr. O. Krogness..........	Norway	p	p	p	p	p	p	p	p	p
Prof. E. Mathias..........	France	p	p	p	p	p	p	p	p	p
Prof. Ch. Maurain.........	France	p	p	p	p	p	p	p	p	p
Dr. G. Melander..........	Finland	p	p	p	p	p	—	p	—	p
Prof. P. L. Mercanton.....	Switzerland	—	p	—	p	—	—	—	—	—
Dr. A. Crichton Mitchell...	Great Britain	p	p	p	p	p	p	p	—	p
Dr. W. Oishi.............	Japan	p	—	—	—	—	—	—	—	—
Prof. Luigi Palazzo.......	Italy	p	p	p	p	p	p	p	p	p
Dr. V. H. Ryd...........	Denmark	p	—	—	—	—	p	—	p	—
Dr. Carl Störmer..........	Norway	p	p	p	—	p	p	—	—	p
Prof. A. Tanakadate.......	Japan	p	—	p	p	—	p	p	p	p
Mr. Andrew Thomson.....	New Zealand	p	p	—	—	p	p	p	p	p
Guests :										
Dr. F. Běhounek..........	Czechoslovakia	p	p	p	p	—	—	—	—	—
Prof. B. Hostinsky........	Czechoslovakia	p	—	—	—	—	—	—	—	—
Dr. P. Lejay.............	France	—	—	—	—	—	p	—	—	—
Mr. Jas. M. Stagg.........	Great Britain	p	p	p	p	p	p	p	—	p
Dr. D. Stenquist..........	Sweden	p	p	p	p	p	p	—	—	p
Prof. W. Uljanin.........	U. R. S. S.	—	—	—	—	—	—	p	p	—
Total attendance............		26	27	27	26	21	22	25	18	21

REPORTERS FOR SUBJECTS OF INVESTIGATION

By mail vote the Executive Committee decided in October, 1925, to appoint reporters for the subjects of investigations 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. TANAKA-DATE) ; *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).

APPENDIX

RESOLUTIONS PASSED BY THE COMMISSION FOR TERRESTRIAL MAGNETISM AND ATMOSPHERIC ELECTRICITY OF THE INTERNATIONAL METEOROLOGICAL COMMITTEE AT ZURICH, SEPTEMBER 1926 (1).

(I) Dr. Venske called attention to certain advantages for the purpose of magnetic characterization possessed by a day starting at Greenwich noon, and suggested that the attachment of a dash to the character figures 0 and 1, to signify an enhanced amount of disturbance, would introduce increased precision. In view, however, of the fact that the Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics had arranged in Madrid in 1924 for a report, to be submitted in 1927 at Prague, on characterization, it was considered inadvisable to make any change at present.

(II) In view of the desirability that the same days should be employed at all stations for the deduction of diurnal inequalities on disturbed days, and in view of the great liability to loss of trace at stations in high latitudes on occasions of outstanding disturbance, it was agreed that certain days included amongst the five most disturbed days of the month should not be included amongst the days selected for the calculation of diurnal inequalities. Days of character 2.0 should be excluded, and other highly disturbed days on which loss of trace had occurred. Directors of Observatories were to be requested to inform Prof. E. van Everdingen promptly of such loss of trace, so that

(1) Reports of the meetings at Zürich, September, 1926, London, Met. Office (M. O. 296), 1927, pp. 7-9.

he should be in possession of the necessary information at the appropriate time.

(III) It was considered inadvisable to lay down at the present moment the policy to be adopted in the event of a scheme being approved by the Section of Terrestrial Magnetism and Electricty for assigning to individual days character numbers based on curve measurements.

(IV) It was decided to recommend the universal adoption of Greenwich time for all ordinary magnetic data, especially international magnetic data, while recognizing that zonal or even local time might usefully be employed for local purposes.

In view of the great diversity of opinion entertained as to the relative advantages of instantaneous and mean hourly values, and as to the relative advantages of mean hourly values centering at the hour and at the half-hour, it was decided that no decision could be reached.

(V) It was decided that whether a correction was or was not applied for non-cyclic change in the calculation of diurnal inequalities—a practice as to the desirability of which there is much diversity of opinion—it was desirable that all magnetic observatories should publish information as to the non-cyclic change, sufficient to enable a correction to be applied, or the original figures to be recovered if a correction had already been applied. In the case of observatories which took mean hourly values centering at the half-hour, the arithmetic mean of the mean values for the two hours immediately preceding and following midnight, might be accepted as the midnight value, and employed in the estimation of the non-cyclic change.

(VI) The attention of the meeting was called to resolutions passed at Madrid by the Section of Terrestrial Magnetism and Electricity. It was pointed out that two of these, the devising of an instrument for the direct measurement of vertical force, and the institution of a magnetic observatory in Western Greenland, had been realized already by Dr. La Cour, and it was reported by Sir Frederic Stupart that a third object declared by the Section to be desirable, viz. the full equipment of Meanook Observatory, was about to be accomplished.

Attention was also called to the two following recommendations of the Commission on Solar and Terrestrial Relationships appointed by the International Research Council:—

(1). « Le Comité désire attirer l'attention sur le manque d'informations au sujet de la variation annuelle et quotidienne du potentiel dans l'hémisphère sud, et spécialement dans le sud de l'Afrique et de l'Australie. »

(2). « Il est à souhaiter que l'on entreprenne des observations sur l'électricité atmosphérique si possible dans tous les observatoires magnétiques. »

The Commission decided to express its full acquiescence with statement (1), and also with statement (2), provided it were modified by the addition of the following words:—

« bien situés et à une distance suffisante d'autres observatoires qui observent l'électricité atmosphérique. »

The question of the future relationship between the Magnetic Commission and the Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics having been raised by Dr. V. Carlheim-Gyllensköld, the following resolution was passed:—

« La Commission considère que la question des relations entre elle et la Section de Magnétisme et Électricité Terrestres de l'Union Internationale Géodésique et Géophysique doit être renvoyée à une commission composée de membres des deux organismes. »

THE INTERNATIONAL UNION
OF SCIENTIFIC RADIO TELEGRAPHY.
COMMISSION ON RADIO TRANSMISSION PHENOMENA (1)

Suggestions for The International Study of the Correlations between Radio Transmission Phenomena and Solar Activity

It seems to be now certain that there is a well marked connection between the strength of radio signals and solar activity. In the study of this correlation the following solar phenomena may be considered :

1. The general radiation (solar constant) and ultra violet light in particular.
2. Sunspots and their 11-year cycle, faculae and prominences.
3. Local solar magnetic fields.
4. Sudden solar outbursts.
5. Alternation of magnetic polarity of sunspots in successive 11-year cycles.
6. Absorbing material thrown out by the sun.

There are also the following terrestrial phenomena which are believed to be controlled largely by solar activity and which may perhaps be used to a certain extent as a measure of its intensity.

1. Magnetic variations (character of days and diurnal range).
2. Earth currents.
3. Atmospheric electricity (potential gradient and ionization of the atmosphere).
4. Aurora.
5. Amount of ozone in the atmosphere.

(1) Copy received from Dr. Austin with his transmitting letter of June 2, 1927.

The study of most of these subjects has been much more highly developed than that of the measurement of radio signal intensity. The suitable observational material on this subject in any continuous and reliable form certainly covers no more than the last five years and is confined almost entirely to wave lengths above 5000m, therefore it seems highly important to undertake the following measurements taken preferably at least three times daily on signal intensity.

1. at various lengths.
2. in different portions of the earth (observing points in the far north or south may prove of special importance).
3. at various distances.
4. in different directions.
5. for all daylight path.
6. for partial daylight path.
7. for all darkness path.
8. at sunrise and sunset.

In comparing signal strength with the other natural phenomena it would seem advisable to make use of

1. day by day comparisons.
2. short period averages (3-10 days).
3. monthly averages.
4. yearly averages so as to cover eventually the 11-year sunspot cycle..

In all of these, straight averages, moving averages and periodic averages (period of solar rotation and others) would all seem to be probably useful.

While absolute measurements of signal intensity in microvolts per meter are desirable, relative measurements where the sensitivity of the apparatus can be kept constant will also be of value. It will be important to have the observations published or at least distributed promptly through a central office for the information of other workers in this field. The importance of this work should be called to the attention of governments and research organizations.

L. W. AUSTIN, *President of the Commission.*

Washintgon.

PART II

SPECIAL REPORTS [1]

REPORT ON COMPARISONS OF MAGNETIC INSTRUMENTS

Supplementary Notes

Since the writer's " Preliminary Report " published in Bulletin No. 6, the following additional information has been received :

The Department of Terrestrial Magnetism has determined the instrumental constants and has compared at Washington with its standards a magnetometer-inductor of the C. I. W. design for the Hydrographic Office of Sweden.

The investigations by the Department since its establishment in 1904, indicates the necessity of exercising every possible control on the moment of the principal magnet for magnetometers of any design. For the Department's types of instruments, experience has shown that the factors involving distribution coefficients may be considered as constant with all necessary precision for long periods. For standard magnetometer No. 3, the value of the distribution coefficient P′, resulting from all observations made with that instrument since 1907, gives a mean value of 13.38, the extreme range over the 20 years of operation being 0.5 which corresponds to a total range in the values of horizontal intensity, computed on the basis of the mean value of P′, of 0,0004 H, or less than 8γ for Washington.

The universally satisfactory character of the earth inductor

(1) See Bulletin No. 6 for preliminary reports.

as an instrument with negligible correction for all values of inclination has also been shown by experience.

The reports of National Committees contain accounts of comparisons made within recent years and. therefore, need not be given in detail here.

A portable magnetometer of the coil type for special use in intercomparisons is under development and test by various institutions.

Other matters will come up for discussion under item A1 of the Agenda.

LOUIS A. BAUER.

Washington, D. C., July 28, 1927.

REPORT OF THE COMMITTEE ON INVESTIGATION OF SUDDEN COMMENCEMENTS OF MAGNETIC STORMS

According to the decision made at the Madrid meeting of the Section of Terrestrial Magnetism and Electricity, the Reporter requested the Secretary to send a circular to various authorities asking them to communicate their views concerning the method and instruments to be used in investigating sudden commencements of magnetic storms. The replies received were summarized and published in Bulletin No. 6.

An exchange of wiews of the members of the Committee was carried out by correspondence and personal conversations as a result of which an instrument designed by Professor Crichton Mitchell was approved and constructed in Scotland and is being tried out under the direction of the designer.

The Committee recognizes the utility of observing induced currents in fixed coils but has not yet decided upon any definite measure to be adopted in international work. Professor Maurain has a plan which is described in the preliminary report—Bulletin No. 6, page 20—but it has not yet been put into operation.

A new set of instruments, described in the Geophysical Magazine, Vol. I, No. 3, in which the two components of the horizontal intensity can be adjusted to any desired degree of sensitivity by taking advantage of the mutual action of the suspended magnets has been designed by D. Ono and is being tried out at Kakioka.

The Committee recommends the following proposal : Considering that most magnetographs now in use fail to record the highly disturbed portions of the curve on exceptional days and, considering the importance of knowing the range of such disturbances, and further considering that important sudden changes might take place in the portions of the curve lost, it is recommended :

To make provision in magnetographs for procuring records on highly disturbed days, either by (1) adding records in reduced sensitivity, or (2) providing the suspended system with auxiliary mirrors which will come into action when the usual mirror is deflected out of the ordinary range, or (3) providing fixed mirrors on both sides of the recording ray of light so as to reflect it back to the recording paper when the deflection exceeds the ordinary range.

[It is hoped that economy in recording paper may be materially effected by means of (2) or (3) by diminishing its breadth or else that the sensitivity can be increased without fear of missing records of large disturbances.]

A. TANAKADATE.

September 3, 1927.

SECOND REPORT ON MAGNETIC CHARACTERISATION OF DAYS

(*Continuation of Preliminary Report published in Bulletin* No. 6. *Section of Terrestrial Magnetism*)

I.—For the further investigation of the question of magnetic characterisation of days, Table IV has been prepared. It is intended to shew the effect of applying the following criteria to the data obtained for the month of January 1920 :—

(1) ΣR ; i.e. the sum of the absolute daily ranges of the three elements, H, D (expressed in force units), V ; or N, W, V.

(2) $\frac{\Sigma R^2}{100}$; i. e. $\frac{1}{100}$ of the sum of the squares of the absolute daily ranges of the three elements or components.

(3) $\frac{HR_H}{10\,000}$; i.e. $\frac{1}{10\,000}$ of the product of the mean horizontal force for the day and the absolute daily range of the horizontal force.

(4) $\frac{HR_H + VR_V}{10\,000}$; i.e. the quantity tabulated under 3, together with a similar product for the vertical component.

(5) $\frac{\Sigma \bar{X} r_x}{1\,000}$; i.e. $\frac{1}{1\,000}$ of the product of the mean value of a component for fhe day, and the mean hourly range of that component for the day ; the products for three components (X, Y, Z) being summed together.

(6) $\Sigma \alpha$; i.e. the sum for three components of the differences between the greatest and least hourly values.

(7) $\Sigma(R_x - R_{xm})^2$; i.e. the sum, for three components, of the squares of the difference between the absolute daily range and the least absolute daily range during the month.

The first four apply to the 21 stations referred to in the Preliminary Report ; the fifth refers to Eskdalemuir alone ; the sixth to Seddin and Eskdalemuir ; the seventh to De Bilt and Eskdalemuir.

To carry out a similar tabulation for the other months of the year 1920 would have involved very considerable labour and would not have added much to our knowledge of the subject.

II.—The first column of Table IV gives the days of the month. The international quiet days (5Q) are indicated here by Roman numerals, I being the day with the lowest, V being that with the highest, mean character figure. In the other columns, the 5q days of lowest value are similary marked.

The entries in the columns headed "Characteristic Ratios" are obtained by dividing each number under a given criterium by the mean value for the month.

III.—The entries under the first four criteria may be first examined. The following conclusions are immediately obvious.

(1) With one exception, all four criteria give the same selection of the five quietest days.

(2) This selection agrees with the international quiet days in four cases out of five.

(3) The range of values in the different columns are as follows :—

ΣR	157
$\frac{\Sigma R^2}{100}$	250
$\frac{HR_H}{10\,000}$	172
$\left(\frac{HR_H + VR_V}{10\,000}\right)$	328

One effect of these differences when they are small is that in the case of a quiet month, the difficulty of discriminating the five quietest days by means of ΣR or HR_H is increased.

(4) As might be expected, and as is shewn by the characteristic ratios, the ΣR^2 criterium tends to depress the value, relatively, on quiet days and enhance the value on disturbed days.

(5) The characteristic ratios for ΣR, HR_H, and $HR_H + VR_V$, agree with each other fairly well. Those for ΣR^2 are lower on quiet days and higher on disturbed days.

IV.—The tabulation of $\Sigma\overline{X}\overline{r}_x$ relates to Eskdalemuir alone. It forms a small part of an extensive tabulation extending over the years 1914 to 1925 which will be published shortly.

For January 1920, the selection of five quiet days by means of this criterium agrees with four of the international quiet days and with three of the five days given by the first four criteria. It will be noted however (*a*) that the entry for 3rd January is a roughly estimated figure based on imperfect record, and might easily be much lower; also, (*b*) that the differences between the entries for 13th, 19th, and 20th January are small.

It may not be inappropriate to state here one result deduced from the 12 years' record to which reference has been made above. The following table contains a comparison between the selection of 5q days from $\Sigma\overline{X}\overline{r}_x$ and the international quiet days during 11 of these 12 years.

Year	No. of days common to 5Q and *5q*	Mean value of $\Sigma\overline{X}\overline{r}x$ on		Diff.	Mean Value of $\Sigma\overline{X}\overline{r}x$ for year	Mean Date for	
		5Q	*5q*			5Q	*5q*
1914	38	175	160	15	335	16.9	17.6
1915	43	192	176	16	476	14.2	11.7
1916	39	250	225	25	597	15.2	15.8
1917	45	237	224	13	576	16.3	16.2
1918	47	265	250	15	694	16.6	16.5
1919	52	248	241	7	694	15.7	15.8
1920	41	232	215	17	551	15.3	14.9
1921	45	211	200	11	512	14.6	15.5
1922	44	233	221	12	552	14.8	16.0
1923	39	163	149	14	337	15.4	16.4
1924	37	152	140	12	321	15.4	14.3
Mean	43	214	200	14	513	15.5	15.5

It should be explained, in connection with the foregoing table, that there is no intention here of setting up the international quiet days as an ideal standard with which all other criteria are to be compared. At the same time it must be pointed out that the selection of these days is based upon estimates from a large number of stations and that it has always been made with the greatest care. These considerations justify the use of the international quiet days as a set of results with which others of a similar kind may be, at least, contrasted.

It will be noted from the foregoing table that the number of days common to the two methods averaged 43 per annum; that is, nearly 3 out every 4 days are common to both. The extent of agreement appears to be greater during the more disturbed years. The mean values of $\Sigma\overline{X}\overline{r}_x$ on 5Q and 5q days differ very slightly; generally, by less than 3 per cent of the mean monthly value. The mean date of the 5Q and 5q days agree closely, the difference in any year never exceeding 2.5 days.

The general result of applying this criterium $\Sigma\overline{X}\overline{r}_x$ is thus to provide a selection which is in close accord with the international quiet days.

V.—Among other criteria of activity which have been employed, there is the sum of the differences, for three components, between the greatest and least *hourly values* for the day. This quantity under the designation α, has been tabulated for Seddin since 1918. In order to compare its results with others, I have extended the tabulation backwards to 1914, using the published maximum and minimum hourly values of each day. For the 11 years, 1914 to 1924, the five quietest days in each month, selected by this criterium, agree with the international quiet days (5Q) in 303 cases out of 660, and with the 5q days from $\Sigma\overline{X}\overline{r}_x$ at Eskdalemuir in 344 cases. This extent of agreement with the 5Q days is much less than that of the $\Sigma\overline{X}\overline{r}_x$ days at Eskdalemuir, which amounted to 470 cases. This is not due to any peculiarity in the Seddin results, for similar results are given by the quantity α when calculated for Eskdalemuir which agrees closely with Seddin in its values of α. It is due to the fact that the use of hourly values (not extreme instantaneous values) in this connection must necessarily bring other factors into consideration. On this point, the valuable paper published by Dr. G. van Dijk (Verhand. Konink. Nederland Met. Inst. 1922) should be consulted. Among others, the method must fail to give expression to much activity which may be present. For instance, it has been observed at Eskdalemuir that some considerable disturbances, believed to be associated with distant aurorae, exhibit large hourly ranges but relatively small diurnal range. Again, the method brings into prominence the amplitude of the diurnal variation, and although it is known that this amplitude increases with disturbance, the use of this increase as a measure of disturbance appears to lack directness. Lastly, it may be mentioned that in regard to its component parts and their seasonal distribution, α obeys laws which different from those of ΣR or $\Sigma \overline{X r_x}$.

VI.—The last criterium tabulated for January 1920 is $\Sigma(R_X—R_{MX})^2$, and applies to De Bilt and Eskdalemuir alone. The five quietest days in the month are the same at both stations and are in complete agreement with those of ΣR, ΣR^2, $HR_H + VR_V$, from 21 stations. It will be observed that this criterium brings the quiet days into prominence by giving them very low values. Whatever may be its validity as a measure of disturbance, there is no doubt that as a means of selecting the quietest days, it has decided advantages.

VII.—Dr. van Dijk's paper, referred to above, contains a large amount of informative matter on this subject of magnetic characterisation of days, chiefly relating to the year 1915. I have extracted from it the figures in the subjoined table which compares together the five quietest days in each month of 1915, selected according to the five following criteria :—(i) C (sum of character figures from 35 stations ;) (ii) ΣR^2, (iii) HR_H, (iv) α ; (v) ΣR ; the last four referring to De Bilt alone.

Criterium	No. of days in 1915 in common with				
	C	ΣR^2	HR_H	α	ΣR
C	...				
ΣR^2	36	...			
HR_H	37	43	...		
α	31	49	41	...	
ΣR	35	52	46	49	...

This table shews that the character figures agree with the other criteria less completely than do these latter agree among themselves.

VIII.—There remain one or two minor points to which reference may be made. The first is that the criterium HR_H does not take into consideration the vertical force changes during the day. It has been shewn in the first part of this Report that these changes are by no means negligible. Further, a study of the data supplied from different observatories for 1920 will convince any one that the vertical force range, especially at high latitude stations, is a most valuable test as to the presence or absence of disturbance. Take, for instance, Sitka or Eskdale-

TABLE

January 1920

Day	ΣR	$\frac{\Sigma R^2}{100}$	$\frac{HR_H}{10\,000}$	$\frac{(HR_H + VR_V)}{10\,000}$	$\frac{K\bar{A}\bar{r}_x}{1\,000}$	Σα Seddin	Σα Eskdalemuir
1	169	121	183	341	563	127	119
2	163	157	162	318	419	107	(105)
3	90 III	34 III	80 III	143 II	(275)	50 I	(46) II
IV 4	89 II	32 II	80 II	152 IV	157 I	58 IV	(53) III
I 5	82 I	28 I	78 I	136 I	163 III	50 II	(45) I
6	111	47	111	181	221	82	86
7	167	138	179	306	397	123	145
8	124	68	152	241	206	61 V	70
9	164	116	174	298	403	150	162
10	208	210	202	378	642	146	164
11	168	118	167	267	587	147	164
12	138	83	131	231	391	95	152
II 13	93 IV	35 IV	86 IV	147 III	197	61	59 V
14	118	58	120	191	271	90	104
15	138	75	127	215	374	76	86
16	133	68	138	228	353	84	79
17	177	123	193	336	549	142	163
18	126	64	121	223	263	83	85
V 19	116	54	125	200	192 IV	78	84
20	121	68	113	186	193 V	69	90
21	239	278	250	464	868	171	185
22	141	78	137	263	312	103	120
23	158	99	151	271	479	105	133
24	167	118	171	311	387	109	110
25	116	56	118	211	275	65	(72)
26	138	73	151	248	267	105	93
III 27	103 V	44 V	106	174	158 II	54 III	55 IV
28	177	128	209	343	567	125	144
29	116	57	115	195	295	74	94
30	194	173	210	382	527	157	151
31	104	45	99 V	176	249	73	68

Figures in brackets ( )

V

Charactéristic Ratios

$\Sigma(R_x - R_{xm})^2$ De Bilt	$\Sigma(R_x - R_{xm})^2$ Eskdalemuir	ΣR	ΣR^2	HR_H	HR_H+VR_V	$\Sigma \overline{X} r_x$	$\Sigma \alpha$ Seddin	$\Sigma \alpha$ Esk.	$\Sigma(R_x - R_{mx})^2$ De Bilt	$\Sigma(R_x - R_{mx})^2$ Esk.
101	81	1.21	1.32	1.28	1.36	1.56	1.31	1.12	1.87	1.52
44	52	1.17	1.71	1.13	1.27	1.16	1.10	(.99)	.81	.98
4 IV	3 III	.66	.37	.56	.57	.76	.51	(.43)	.09	.01
7 V	3 IV	.64	.35	.56	.61	.44	.59	(.50)	.13	.06
0 I	1 I	.59	.31	.55	.54	.46	.51	(.42)	.00	.02
27	14	.80	.51	.78	.72	.61	.84	.81	.50	.26
58	51	1.19	1.50	1.25	1.22	1.10	1.26	1.37	1.07	.96
17	10	.89	.74	1.06	.96	.57	.63	.66	.31	.19
130	104	1.17	1.25	1.20	1.19	1.12	1.54	1.53	2.41	1.96
151	110	1.49	2.29	1.41	1.51	1.78	1.44	1.55	2.80	2.07
158	148	1.18	1.29	1.17	1.07	1.63	1.51	1.55	2.93	2.78
74	83	.96	.90	.92	.92	1.08	.98	1.43	1.37	1.56
3 III	2 II	.66	.38	.60	.59	.54	.64	.56	.06	.04
42	37	.84	.63	.84	.76	.75	.92	.98	.78	.69
34	52	.96	.82	.89	.86	1.04	.78	.81	.63	.98
19	20	.95	.74	.97	.91	.98	.86	.74	.35	.38
124	170	1.26	1.34	1.35	1.34	1.52	1.46	1.54	2.30	3.20
16	15	.90	.70	.85	.89	.73	.85	.80	.30	.28
9	9	.83	.59	.87	.80	.53	.80	.79	.17	.17
14	15	.86	.74	.79	.74	.53	.71	.85	.26	.28
255	241	1.71	3.03	1.75	1.86	2.40	1.76	1.74	4.72	4.53
21	45	1.01	.89	.96	1.05	.86	1.06	1.13	.39	.85
54	62	1.13	1.08	1.06	1.08	1.32	1.08	1.25	1.00	1.16
35	42	1.19	1.29	1.20	1.24	1.07	1.12	1.04	.65	.79
8	8	.83	.61	.83	.84	.76	.67	(.68)	.15	.15
41	27	.96	.80	1.06	.97	.74	1.08	.88	.76	.51
1 II	4 V	.74	.48	.74	.70	.44	.55	.52	.02	.08
86	122	1.26	1.39	1.46	1.37	1.57	1.28	1.36	1.59	2.30
35	37	.83	.62	.80	.78	.82	.76	.89	.65	.69
98	74	1.39	1.88	1.47	1.53	1.46	1.61	1.42	1.81	1.39
8	8	.74	.49	.69	.70	.69	.75	.64	.15	.15

are approximate estimates.

muir. On any genuinely quiet day, the vertical force range at these stations is exceptionally small. But if there be even a slight degree of disturbance, it rises at once. In fact, it is not an exaggeration to say that quiet days could be selected with quite sufficient accuracy by reference to the vertical force records of either of these observatories, and to no others.

The second point is that in any selection of quiet days, consideration should be paid to the magnitude of the non-cyclic change in H or N, in order to obtain diurnal inequalities as free as possible from this effect. It would be well also, if days immediately preceding or immediately following those of large disturbance were avoided.

The third is that some freedom sould be allowed in the selection of quiet days so as to bring the mean day as near as possible to the middle of the month. This is of particular importance in February, March, October, and November.

A. Crichton MITCHELL.

REMARKS ON SECOND REPORT ON MAGNETIC AND ELECTRIC CHARACTERIZATION OF DAYS

At the Madrid meeting of the Section of Terrestrial Magnetism and Electricity, held on October 4, 1924, a resolution was passed empowering the Executive Committee to appoint any necessary committee to inquire into methods of characterizing days and of estimating degress of activity or disturbance in the terrestrial-magnetic and electric fields. The Executive Committee finally appointed me to act as Reporter, to collect information on the subjects dealt with resolution and to prepare a report for this meeting of the Section. The method adopted in preparing this report, printed as a Preliminary Report in the Secretary's Bulletin No. 6, was as follows :

The absolute ranges of declination, horizontal force, and vertical force, or alternatively, of N, W, and V, and the daily means of H or N for each Greenwich civil day of the year 1920, were obtained from twenty-one observatories. Of these eighteen are in the northern hemisphere and three in the southern hemisphere. Their mean position in longitude lay between Rude Skov and De Bilt. I am especially obliged to Prof. Maurain for the detailed tabulation which he sent to me for Val Joyeux Observatory.

The first tabulation contains the value of ΣR, *i.e.*, $R_D + R_H + R_V$, or, $R_N + R_W + R_V$ where R is the absolute range in γ. The mean value of ΣR for all stations east of the mean longitude was obtained for each day, also the mean value for all stations west of the mean longitude and thirdly for all twenty-one stations. From the tables so prepared (see Table I, Preliminary Report) the five days of least mean value of ΣR in each month were marked ; these days are shown in Table I of the Preliminary Report.

A similar selection of days *for each station* in each month was also made as shown in Table II of the Preliminary Report and these selections were compared with the selection from the mean results in Table I, and also with the five International Quiet Days.

A third table was prepared to show the percentage contributions to ΣR from the three components. This was done for each station for each month and for the year. Its object was to show in particular that the contribution to the vertical-force range to the total was not negligible.

The more obvious deductions from these three tables are given in detail with the Preliminary Report and may be summarized as follows :

(1) The selection of ten quiet days instead of five would raise the mean value of ΣR by about six per cent but this increase in mean value of ΣR would be much more pronounced in the more disturbed years. So much that the selection of ten really quiet days would be impossible. It is suggested, however, that a sixth day should be selected in addition to the five for use in those cases when the record of the observation for one of the selected quiet days is absent or incomplete.

(2) There is some slight reason to believe from the data received that the selection of five days from the lowest values of ΣR is affected by difference in longitude but the data are insufficient to establish this.

(3) The five quiet days selected at individual stations from the lowest values of ΣR agree with the selection from the mean of all in thirty cases out of sixty. But the extent of agreement is much better for those stations which are near to the mean longitude. For instance, Rude Skov, De Bilt, Val Joyeux, and Eskdalemuir, in about 75 per cent of the possible cases, whereas such stations as Watheroo, Antipolo, and Honolulu agree out to the extent of one third. The extent of agreement may be expressed by means of a ratio which is equal to unity in the case of complete agreement and rises in proportion to the extent of disagreement. The values of the ratio are given in Table D of the Preliminary Report.

For the investigation of other criteria the month of February 1920 was taken. A table is shown appended to the typed additional report showing the effect of applying to each day the following criteria :

(1) ΣR, (2) ΣR^2, (3) $H \cdot R_H$ and (4) $H . R_H + V \cdot R_V$

These are given as the mean of twenty-one stations.

There are also shown in the table the values for each day for Eskdalemuir alone of $\Sigma \bar{X} r_X$, *i.e.*, the mean value of a component multiplied by the mean hourly range of that component and the summation referring to the three components.

Another table gives the value of Σz as tabulated for some years recently at Seddin. This quantity is the sum for three components of the differences between the greatest and least hourly values. This table applies to Seddin and Eskdalemuir alone.

The seventh and last criterium used is $\Sigma(R_X - R_{XM})^2$, *i.e.*, the sum for three components of the squares of the difference between the absolute daily range and the least absolute daily range during the month.

The entries in the columns headed characteristic ratios are obtained by dividing each number under a given criterium by the mean value for the month.

Taking the first four criteria, the following conclusions are immediately obvious :

(1) With one exception all four criteria give the same selection of the five quietest days.

(2) This selection agrees with the International Quiet Days to the extent of 80 per cent.

(3) ΣR and HR_H give smaller ranges of value than do ΣR^2 and $(H.R_H + V.R_V)$. Smallness of range of value enhances the difficulty of discriminating the five quietest days in a quiet month.

(4) As might be expected the ΣR^2 criterium tends to depress the value relatively on quiet days and to enhance it on disturbed days.

(5) $\Sigma \bar{X} . r_X$ agrees well with the International Quiet Days. During the eleven years 1914 to 1924 the agreement has been roughly three-fourths of the cases and has reached higher proportions (83 per cent) in some years.

(6) With regard to the criterium Σz, its results do not agree with the International Quiet Days as well as the other criteria. This is borne out not only for Seddin but also for Eskdalemuir, although for these two stations Dr. van Dijk has already pointed out that this method must fail to give expression to much activity which may be present.

(7) The last criterium, $\Sigma (R_X - R_{XM})^2$ gives for January 1920

results which are very similar to the first four criteria. It brings the quiet days into prominence by giving them very low values and whatever may be its validity as a measure of disturbance there is no doubt that as a means of selecting the quietest days it has decided advantages.

Dr. van Dijk has published in his paper already referred to a large amount of informative matter on this subject relating to 1915. Some of his data are compared in a table given in the additionnal report.

The only other points dealt with in the report are the following three :

(1) The criterium $H.R_H$ is unsuitable on the ground that it does not take into consideration the vertical-force changes during the day. Further the data supplied for 1920 if carefully studied will convince anyone that the vertical-force range at high-latitude stations is a most valuable test as to the presence or absence of disturbance.

(2) In any selection of quiet days consideration should be paid to the magnitude of the non-cyclic changes in H or N. It would be well also if days immediately preceding or immediately following days of large disturbance were avoided.

(3) Some freedom would have to be allowed in the selection of quiet days so as to bring the mean day as near as possible to the middle of the month. This is of particular importance in February, March, October, and November.

Have no recommendations of a general kind to make except to suggest that the Section has now sufficient data before it to decide between six different criteria (the fifth is not suggested as a practicable measure) and is now in a position to take some step towards a decision on this subject. That decision would seem to be the selection of a criterium, the date of its introduction, and the manner in which it can be applied.

A. Crichton MITCHELL.

NOTE ON INSTRUMENT DESIGNED FOR THE COMMITTEE

Referring to the second paragraph of Professor Tanakadate's report, two sensitive magnetometers have been constructed and are undergoing tests at Eskdalemuir Observatory. They are at present arranged so as to record changes in the north and west components of force. Their scal value is about 1.2 per millimetre, and the time scale is .1 centimetre per minute.

The first difficulty experienced with these instruments was that the silvering of the mirrors was affected by the damp air in the underground magnet house at Eskdalemuir. This has been overcome by using mirrors in which the silvering is given a copper backing which protects it from damp.

The second difficulty is that the only photographic paper immediately available for use was so thick that it moved (off the "supply" spindle on to the recording drum) in minute jerks, and not in a continuous manner. This will be remedied by using thinner photographic paper.

Two records, illustrative of those obtained from the instruments were exhibited to the Section : one being for a quiet day, the other for a disturbed day. No base line has been shewn on these records, but this can be easily added. On a disturbed day, or when the recorded element is well above or well below the value represented by the middle line, the trace goes off the sheet. But this can be obviated by the use of fixed side mirrors or by the suspended mirror having several faces at suitable inclinations.

A. Crichton MITCHELL.

PROPRIETÀ E CONDIZIONI DELLE ROCCE MAGNETICHE, STUDIATE IN SITO ED IN LABORATORIO

I.—Anomalie Magnetiche e Loro Distinzione

Nei rilievi magnetici che si fanno allo scopo di ricercare in quale modo i valori degli elementi del campo terrestre sono distribuiti alla superficie della Terra, coll'intendimento di darne dippoi la rappresentazione grafica (*carte magnetiche*), si riscontrano numerose irregolarità od *anomalie*, le quali si possono distinguere in due categorie :

a) Nei terreni vulcanici e nell'immediata vicinanza di molte specie di rocce antiche eruttive, è frequentissimo il caso in cui si ottengono valori anormali per gli elementi del magnetismo terrestre, con questo particolare carattere : che detti valori non si mostrano vincolati alla posizione geografica del luogo, e sono invece tali che con lo spostare anche di pochissimo la stazione di misure, tosto variano in un modo del tutto saltuario, e per così dire, da passo a passo, senza che si manifesti una determinata legge di continuità. In casi siffatti, il tracciare sulla carta un sistema rappresentativo di linee isomagnetiche non riesce generalmente possibile, o per lo meno, diventa molto difficile.

b) Vi sono poi anomalie le quali, pur dando luogo a valori indipendenti, o quasi, dalle coordinate geografiche dei diversi luoghi, presentano però nella successione dei valori (su di una regione o distretto relativamente vasto) un certo carattere di continuità, che offre la possibilità di rappresentare graficamente, con curve continue su di una carta, sia pure topografica a grande scala, l'andamento del fenomeno. Perturbazioni siffatte non si mettono in evidenza nelle ordinarie misure differenziali di magnetismo, se non operando in stazioni diverse che siano distanti l'una dall'altra qualche chilometro ; all'opposto di ciò che si verifica per le altre anomalie di cui sopra si è parlato, per le quali, ad esempio, una variazione in declinazione può spesso già rendersi sensibile con lo spostamento della bussola per pochi metri.

Nel caso delle anomalie *a*, la causa agente è troppo evidente, per farne oggetto di discussione. Si tratta di terreni o di rocce, emergenti dal suolo, che hanno proprietà magnetiche, e pertanto essi esercitano necessariamente un'azione sugli aghi magnetizzati ed i magneti degli strumenti posti sopra il terreno o portati in vicinanza delle rocce. Il terreno od il masso roccioso può esercitare azione nel suo insieme, ma bene spesso la cosa si complica con le azioni dovute a parti od a zone singole delle rocce aventi speciale magnetizzazione propria.

È noto che su molte rocce (lave, serpentine, certi graniti) si trovano delle aree ristrettissime, quasi puntiformi, ove è concentrata una magnetizzazione così intensa da dare luogo a veri poli magnetici capaci di deviare di 180° l'ago di una piccola bussola che ad essi si avvicini. Questi poli, a giorno sulle rocce, il KELLER (*Rend. Accad. Lincei*, Vol. V, 1889) li ha denominati *punti distinti*, e noi pure li chiameremo così.

Le anomalie della categoria *b* si presumono anch'esse legate alla costituzione geologica del suolo, ed in genere sono spiegate coll'ammettere che esistano, nascosti in profondità più o meno grande, cospicui giacimenti di minerale magnetico ; ma l'azione perturbatrice che ne risulta alla superficie, magari attraverso a strati rocciosi affatto non magnetici, riesce più regolare, sì da non togliere significato alla rappresentazione per curve isomagnetiche. C'è chi ritiene che anomalie siffatte siano dipendenti da correnti elettriche telluriche circolanti nella crosta terrestre e modificate da fratture geologiche o da dislocamenti di strati ; ma l'ipotesi, assai semplice, di masse magnetiche profonde appare di gran lunga la più probabile (1).

Il REICH (*Pogg. Ann.*, Vol. 77, 1849) ha introdotto il concetto di *magnetismo di monte* in opposizione al *magnetismo di rocce* (Gebirgs- und Gesteinsmagnetismus). Noi interpretiamo tale concetto nel senso che il primo corrisponda, più o meno, alle anomalie, regionali o distrettuali, da noi prospettate sotto la categoria *b* ; invece riserbiamo la denominazione di magnetismo di rocce alle anomalie della specie *a*, dovute all'influenza palese ed immediata del materiale del terreno o delle rocce prossime agli strumenti di misura. Certo è che queste distinzioni in magnetismo di monte e magnetismo di roccia non sono da intendersi in senso assoluto, perchè non è possibile stabilire una linea netta di demarcazione fra l'una e l'altra specie di feno-

(1) È celebre l'anomalia magnetica riconosciuta fin dal 1872 da I. N. Smirnow nel Governatorato di Kursk in Russia, ripetutamente studiata da Tillo, Piltschikow, Sergijevsky, Rodd, Moureaux, Leyst, Lazareff. Il prof. Zaborowski, nell'ipotesi che essa fosse dovuta a giacimenti magnetici sottostanti, aveva calcolato una profondità di 490 metri. Orbene, recentemente, mediante perforazioni assai spinte, si è constatata la reale esistenza di masse ferromagnetiche profonde (magnetite con ematite). La quantità del deposito di ferro nel sottosuolo di Kursk pare aggirarsi intorno agli 8 miliardi di tonnellate.

meni, ed in molti casi si passa gradatamente dall'una all'altra. Tuttavia nel presente rapporto noi lascieremo da banda il magnetismo di monte, o per dire meglio, non tratteremo delle anomalie distrettuali, e ci limiteremo a considerare soltanto il magnetismo delle rocce, così come vuole il tema assegnato a me dal precedente Congresso di Madrid, per essere svolto nell'attuale di Praga.

II.—Alcuni Cenni Storici-Bibliografici Relativi Alle Indagini Sul Magnetismo Delle Rocce

Gmelin e Bouguer sembra siano stati i primi ad osservare l'azione magnetica delle rocce. Gmelin (*Reisen durch Sibirien*; Göttingen, 1751-52), nei viaggi che fece in Siberia dal 1733 al 1743, scoprì che il monte Ulnutassa-tau aveva parti esposte intensamente magnetiche. Bouguer (*La figure de la terre determinée par les observations*, etc., Paris, 1749), nel 1744 o poco prima, trovò nella Colombia rocce che producevano forti irregolarità nella declinazione. Questo fu il punto di partenza, ed in seguito le osservazioni analoghe si fecero più frequenti.

G. M. Della Torre (*Incendio del Vesuvio accaduto il* 19 *ottobre* 1767, Napoli, 1767) fa parola di esperimenti eseguiti coll'ago magnetico in vicinanza della lava vesuviana. H. B. De Saussure (*Voyages dans les Alpes*, Neuchâtel, 1779-96), con determinazioni di azimut magnetici dai due estremi di un allineamento, rilevò l'azione della montagna di Crammont in Svizzera sull'ago di una bussola, e noi possiamo attribuire a Saussure il merito di avere trovato per primo, e praticato il metodo più sicuro e più comodo per rintracciare il magnetismo delle rocce. Breislak (*Voyages physiques et lithologiques dans la Campanie*, Paris, 1801) nel 1785 rinvenne il magnetismo polare su di un tufo vulcanico del Lazio, in contrada Rossilli tra Segni e Gavignano. Trebra (*Gilbert's Ann. d. Physik*, Vol. V, 1800) verso l'anno 1790 nel Harz in Germania osservò su di alcuni scogli di granito una polarità assai pronunziata, e più tardi nuove osservazioni su di essi aggiunse il Wächter (*Gilb. Ann.*, Vol. V, 1800). Rocce magnetiche consimili furono notate da Humboldt (*Journal of nat. philosophy, etc., by Nicholson*, Vol. I, 1797; *Green's neues Journal d. Phys.*, Vol. IV, 1797) presso Münchberg (porfido) e presso Heidberg (serpentina) nel Fichtelgebirge, e ciò sembra nel 1794; anche presso il vulcano Pasto nelle Ande Humboldt trovò un porfido argilloso rosso polare (*Gilb. Ann.*, Vol. XVI, 1804). Fino dall'anno 1809 erano noti, come dotati di polarità bene riconoscibile, i blocchi di basalto presso Annaberg in Sassonia, studiati dippoi più dettagliatamente dal già citato Reich (*Pogg. Ann.*, Vol. LXXVII, 1849).

Troppo spazio occuperebbe nel presente rapporto una bibliografia che si volesse dare più estesa sull'argomento delle rocce magnetiche ; a me basta di averne additato lo sviluppo nel primo periodo fin verso l'inizio del secolo XIX.

In seguito, le notizie apprese si trovano ripetute in un grande numero di pubblicazioni e di trattati ; ma sopravvenne un periodo in cui l'interesse per la ricerca originale sulle rocce magnetiche parve raffreddarsi alquanto. Tuttavia accennerò ancora, fra le ricerche che mi sembrano più notevoli, nei primi 3/4 dello scorso secolo, alle seguenti : di TENORE e GUSSONE (*Memoria sulle peregrinazioni eseguite nel* 1834-1838, Napoli, 1842) sull'influenza magnetica delle lave del Vulture ; di A. DELESSE (*Ann. de Ch. et Phys.*, Vol. XXV, 1849 ; *Ann. des Mines*, Vol. XIV, XV, 1849) sul magnetismo polare nei minerali e nelle rocce ; di ZADDACH (*Verhandlung. des naturhist. Vereines d. preuss. Rheinlandes und Westphalens*, anno VIII, 1851) sulla polarità delle colonne basaltiche e granitiche ; di PALMIERI e SCACCHI (*Relazione alla R. Accad. di Scienze*, Napoli, 1852) ancora nella regione vulcanica del Vulture. MACEDONIO MELLONI, direttore dell'Osservatorio al Vesuvio, pubblicò, in una serie di Memorie (*R. Accad. d. Scienze Napoli*, 1853 ; *Comptes Rendus*, Vol. XXXVII, 1853), numerose osservazioni sul magnetismo delle lave vesuviane e flegree, studiate anche nel laboratorio ; il FÖRSTEMANN (*Pogg. Ann.*, Vol. CVI, 1859), nel dare un sunto dei lavori di Melloni, aggiunse osservazioni proprie.

Ma un risveglio potente in questo ordine di studi in Italia si ebbe per opera di FILIPPO KELLER, tedesco di Norimberga, trasferitosi da giovane a Roma, ove dimorò fino alla morte. Egli, animato da viva passione, dedicò quasi l'intera esistenza ad illustrare il Lazio dal punto di vista magnetico, percorrendo indefessamente a piedi tutte le campagne per trovare rocce magnetiche ed indagarne il comportamento. Gli innumerevoli suoi scritti in materia si stendono fra gli anni 1877 e 1900 (veggansi specialmente i *Rendiconti della R. Accademia dei Lincei*). In siffatta parte della geofisica, il Keller si può ben dire che ha fondato una scuola, avendo egli promosso con consigli, aiuti, incoraggiamenti di ogni sorta questi studii fra tutti i giovani che l'hanno avvicinato ; e fra i suoi allievi o seguaci che portarono contributi, più o meno ampi, alla magnetologia delle rocce, sono da annoverarsi Folgheraiter, Oddone, Sella, Franchi, Cancani, De Angelis d'Ossat, Palazzo, Pacini, Palagi (1).

(1) Di qui il giustificato elogio che, sull'opera degli scienziati italiani, espresse il Günther (*Handbuch der Geophysik*, zweite Auflage, Stuttgart, 1897) con le parole : " Gegen Schluss des XIX Jahrhunderts muss Italien fraglos als das Land gerühmt werden, welchem die Lehre von Eigenmagnetismus der Gesteinen die meisten Bereicherungen danken hatte. "

III.—Studio Delle Rocce Magnetiche Sul Posto

Noi dobbiamo ora passare in breve rassegna i metodi con cui si investiga il comportamento magnetico delle rocce sul posto stesso ove esse si trovano ; diremo in appresso degli esperimenti e studi che si possono fare su frammenti staccati dai massicci rocciosi e portati in un gabinetto di ricerche fisiche, cioè in laboratorio.

Già si è detto che esistono in natura delle rocce con *punti distinti*. Per la definizione stessa che ne dà il Keller, questi punti distinti sono da ricercarsi mediante una semplice bussolina da tasca, munita di ago della lunghezza di circa 3 cm. ed avente un momento magnetico circa eguale a 3, in unità c. g. s. Tenendo orizzontale il piano della bussola, la si porta in immediata vicinanza delle pareti, spigoli e creste delle rocce ove si sospetta l'esistenza dei poli, e si segnano i punti, ove l'ago della bussola viene deviato di 180° dalla posizione in cui si trova nel campo terrestre. Si prende nota della distanza a cui il rovesciamento dell'ago avviene, e del segno della polarità, nord o sud. Talvolta ad un polo nord si trova vicinissimo un polo sud ; altre volte invece non viene fatto di trovare il polo o la zona di polarità opposta. Più poli si possono rinvenire disposti in serie secondo linee o bande ; ed assai istruttive al riguardo sono le osservazioni fatte sulle lave etnee dai professori Giov. e Gaet. Platania e Trovato-Castorina (*C. R. Acad.*, Paris, XIIbre 1905 ; *Mem. Accad. Zelanti*, Acireale 1906) ; *Atti Accad. Gioenia*, Catania, 1906 e 1907).

Molto si è discusso sulle cause che hanno dato origine a queste magnetizzazioni così intense e così ristrettamente localizzate sulle rocce ; ma oramai non si mette più in dubbio che i punti distinti sono determinati dalle folgorazioni, cioè dai fulmini che hanno colpito, generalmente nelle parti più elevate od esposte, le rocce magneticamente suscettive. In alcuni casi, in cui si è osservata una doppia polarità a nastro, fu possibile seguire la via percorsa dal fulmine nello scaricarsi sulla roccia, e dedurre il senso della scarica, cioè stabilire se i fulmini siano stati ascendenti dalla terra alle nubi temporalesche, ovvero discendenti. Si è cercato anche di misurare l'intensità di siffatte scariche deducendola dalla magnetizzazione prodotta dalla corrente di scarica su blocchi di basalto (Pockels, *Meteor. Zeits.*, 1898 ; *Drude Ann.*, 1898 ; *Physikal. Zeits.*, 1901).

Però non tutte le rocce magneticamente suscettive presentano punti distinti, e anche se questi mancano, il geofisico si interesserà sempre a ricercare in quale misura, per la presenza di esse, riesca modificato il naturale campo magnetico terrestre ; in altri termini, si vuole conoscere l'azione perturbatrice delle rocce sull'uno o sull'altro o su tutti e tre gli elementi che caratterizzano il campo : declinazione *D*, inclinazione *I* e forza orizzontale *H*.

Naturalmente, la più completa indagine può farsi coll'adoperare gli strumenti mediante i quali si sogliono determinare tutti e tre gli elementi in valore assoluto, disponendo gli strumenti in molti e molti punti a piccole, determinate distanze dalle rocce in istudio. Per la facilità del trasporto, e per potere moltiplicare a piacimento le stazioni di osservazione intorno alle rocce, è ovvio che nella scelta degli strumenti si dìa la preferenza a quelli più leggeri e di più celere maneggio ; inoltre conviene che i magneti abbiano piccole dimensioni affinchè si possano considerare, almeno nel limite dello spazio da essi occupato, come immersi in un campo magnetico uniforme, anche nei casi in cui ci si metta nelle immediate adiacenze delle rocce. Per tali riguardi, mi paiono molto appropriati i minuscoli apparecchi : teodolite-bussola e bussola d'inclinazione (i magneti non superano la lunghezza di cm. 6.5) costruiti dai F.lli Brunner secondo le direttive di Mascart ed impiegati in Francia pei rilievi magnetici in campagna (*Ann. Bureau Centr. Météor. de France*, 1884).

Il Wolff (*Veröff. d. preuss. meteor. Inst.*, N. 227, 1914) studiò l'anomalia del monte Zobten presso Breslau con uno speciale magnetometro costruito da Schulze di Potsdam dietro le indicazioni di Ad. Schmidt, e che nel modo più semplice e rapido fornisce tutti e tre gli elementi *D*, *H* e *I*.

Ma per le investigazioni sul magnetismo delle rocce, le misure assolute e complete di *D*, *H* e *I* non sono necessarie ; anzi il più delle volte ci si accontenta di fare misure semplicemente differenziali di *D* ovvero misure relative di *H*.

Le misure differenziali di declinazione consistono nello stabilire successivamente una bussola munita di diottre o di cannocchiale (bussola azimutale) su due punti *A* e *B* del terreno preso in esame, più o meno distanti l'uno dall'altro (*A* vicino alla roccia e *B* lontano, possibilmente su terreno neutro), determinando gli angoli tra la direzione del magnete e la visuale diretta rispettivamente da *A* e da *B* ad un terzo punto *C* lontano assai ed allineato coi primi. Se gli azimut magnetici della mira *C* vista da *A* e da *B* risultano identici, allora è da escludersi la perturbazione magnetica, almeno nella declinazione ; nel caso contrario la differenza degli azimut esprime, in certo modo, l'entità della perturbazione. Questo è il metodo largamente applicato dal Keller, e che egli chiamava *dei tre punti*.

Il metodo su accennato può modificarsi nel senso di mirare dal punto *A* su *B* e poscia da *B* su *A*, verificando se la somma dei due azimut magnetici così determinati dìa o no 180°. Come già ebbimo occasione di ricordare, è in questa forma (metodo *dei due punti*) che Saussure mise in evidenza la perturbazione del massiccio di Crammont.

Le misure relative della forza orizzontale possono farsi o col determinare le durate di oscillazione di uno stesso magnete posto successivamente in *A* ed in *B*, ovvero coll'osservare, nei due punti, le deviazioni che un magnete od un sistema di magneti deflettenti producono su di un ago magnetico, sospeso ad un filo o sostenuto da punta, e centrato sul cerchio graduato orizzontale. Vi sono poi delle correzioni da apportare ai dati osservati, ma su queste sorvolo.

Fra i due metodi, delle *oscillazioni* e delle *deflessioni*, è difficile dire quale sia da preferirsi; ognuno dei due ha i suoi sostenitori. Forse più rapida e comoda riesce l'osservazione di deflessioni, ma certo è che la misura di durate di oscillazione è in se stessa assai semplice e conduce ad una grande precisione.

Il KELLER, nelle sue molteplici peregrinazioni pel Lazio, portando seco una semplice scatola pel magnete oscillante attaccato al filo di seta entro un tubo di sospensione, ha fatto esclusivo uso delle oscillazioni. Lo scrivente PALAZZO (*Ann. Uff. Centr. Meteor. e Geod.*, Vol. XV, 1893), a scopo di analoghe ricerche, fece costruire un piccolo magnetometro da viaggio, che serve per osservazioni di declinazione e di intensità orizzontale con le sole oscillazioni.

Degli apparati con magneti deflettori se ne sono costruiti moltissimi, e tanti che sarebbe troppo lungo ricordarli tutti.

Per la ricerca delle perturbazioni locali, sono molto adatti i due variometri del KOHLRAUSCH, quello con quattro magneti deviatori (*Wied. Ann.*, Vol. XIX, 1883) e quello con un unico magnete deviante (*ibidem*, Vol. XXIX, 1886).

O. E. MEYER (*ibidem*, Vol. XL, 1890) ha posteriormente modificato il secondo intensimetro del Kohlrausch, disponendone le parti girevoli su di un asse orizzontale e facendo oscillare l'ago in piano verticale, in modo da renderlo atto a misurare anche la componente verticale.

ESCHENHAGEN (*Archiv d. deutschen Seewarte*, XVI Jahrgang, 1894), per indagare le influenze locali nelle vicinanze dell'Osservatorio magnetico di Wilhelmshaven, ha adoperato un declinatorio di marina di Neumayer, a cui, per ottenere la determinazione relativa della componente orizzontale, aveva applicato due deflettori alle estremità di un'asta orizzontale, fissata normalmente alla cassetta di declinazione.

LAZAREFF in Russia (*Acad. des Sciences*, 1921 ; *Journal de Phys.*, Vol. V, 1924 ; *Gerland's Beiträge*, Vol. XV, 1926), nel più recente e più completo studio sulla già ricordata anomalia di Kursk ha impiegato una bussola, su cui si collocava il deflettore di COLLONGUE (*Hydrogr. Sapiski, St. Petersb.*, 1889).

Fra i variometri di *H* che possono adottarsi per lo studio delle perturbazioni magnetiche di rocce, dobbiamo anche comprendere la doppia bussola di BIDLINGMAIER (*Deutsche Südpolar-expedition*, Bd. V, Berlin, 1907), costruita sul principio di Heydweiller

(*Wied. Ann.*, Vol. LXIV, 1898), secondo cui due aghi magnetici, entrambi girevoli intorno ad un medesimo asse verticale, essendo sospesi l'uno sopra l'altro, si deviano reciprocamente dal meridiano magnetico ; ad ogni cambiamento dell'intensità orizzontale si ha una corrispondente divaricazione degli aghi (¹). La bussola di Bidlingmaier invero già fu applicata opportunamente da LUYKEN (*Zeits. angew. Geophys.*, Bd. I, 1923) per la determinazione di anomalie locali.

Nell'ultimo rilievo magnetico dell'Inghilterra G. W. WALKER (*Proc. Roy. Society*, Vol. XCII, 1916) ha impiegato, per misure relative di H, un variometro portatile con filo di quarzo, che certo deve prestarsi bene anche per il minuto esame del magnetismo di roccia.

Altri variometri di H sono basati su metodi elettrici, cioè l'azione del campo terrestre su di un magnete viene compensata con una corrente elettrica di cui si misura l'intensità. Apparati di tal genere sono stati escogitati da G. MEYER (*Wied. Ann.*, Vol. LXIV, 1898), da A. WAGNER (*Sitz.-berichte Akad. d. Wiss.*, Wien, Bd. CXIV, 1905), da SCHUSTER (*Terr. Magn.*, Vol. XIX, 1914), da JENKINS (*Phil. Mag.*, Vol. XXIII, 1913).

Invece di investigare le variazioni locali di H, conviene in molti casi adoperare variometri per la componente verticale Z, come la « Feldwage » bilancia da campo di AD. SCHMIDT (*Veröffentl. d. preuss. meteor. Instituts*, Berlin, 1914-1916), quale fu usata da HEILAND (*Zeits. f. Instr.-kunde*, Vol. XLV, 1925) ovvero con la modificazione apportata da AMBRONN (*Methoden d. angew. Geophysik*, 1926). KÖNIGSBERGER (*Zeits. f. Geophys.*, Heft 6, 1925) nella bilancia magnetica, in luogo dell'appoggio dell'ago su coltelli, sostituì la sospensione con filo ; ANGENHEISTER (*Zeits. f. Geophys.*, Heft 1, 1926) ridusse la misura con la bilancia a quella della torsione di un siffatto filo-asse di sospensione. Ed ancora sullo stesso principio della bilancia HAALCK ha testè costruito un perfezionato « localvariometro universale », cosidetto perchè serve pei rilievi delle variazioni in tutti e tre gli elementi : declinazione, componente orizzontale e comp. verticale (*Zeits. f. Instr.-kunde*, gennaio 1927).

Infine, in tutti i casi in cui indagando il magnetismo delle rocce, non si miri ad ottenere una grande finezza, penso che si potrebbero sempre utilmente adoperare anche gli strumenti di tipo svedese : tali il magnetometro Thalén-Tiberg, col braccio di Dahlblom, il magnetometro Thomson-Thalén ; essi da molto tempo vengono usati nella Svezia e nella Lapponia per la localizzazione dei depositi di minerali di ferro (vedi anche le note di CARLHEIM-GYLLENSKÖLD in *Ark f. Mat. Astr. Fys*, Vol. 10 e 11, 1915 e 1916).

(¹) Come è noto, con lo stesso sistema dei magneti incrociati, diede Ebert un variometro per la misura di H in pallone.

IV.—Problemi Che Offre Lo Studio Del Magnetismo Delle Rocce

Come si vede dalla precedente, per quanto affrettata ed incompleta, rassegna di strumenti adatti alle indagini sulle rocce magnetiche lasciate in posto, il geofisico può disporre di molti e svariati metodi e strumenti, fra cui non ha che l'imbarazzo della scelta.

Il campo di studio è assai vasto ; si può dire che non v'è paese al mondo in cui non esistano massicci rocciosi dotati di proprietà magnetiche ; ogni Stato può avere scienziati competenti in questo ramo della geofisica, e pertanto si fa caldo appello alla cooperazione di tutti.

Caso per caso, si possono con sufficiente minuzia ricercare le modalità con cui si presenta il fenomeno. Le rocce magnetiche sono tali perchè nella loro composizione entrano minerali magneticamente suscettivi (aventi a base i metalli Fe, Ni ecc.) ; essi, immersi nel campo magnetico terrestre, ne subiscono l'induzione, oltre che possono essere magnetizzati permanentemente per altre cause. A parte la questione dei punti distinti, cioè delle polarità speciali strettamente localizzate e di cui già trattammo, noi possiamo domandarci se un massiccio di roccia agisce, nel suo insieme, all'esterno come un solo magnete ; ed in tal caso conviene indagare dove risiedono i poli (superfici polari) e quale è l'asse della magnetizzazione.

Riguardo alla magnetizzazione permanente che si riscontra nelle rocce vulcaniche, ed eruttive in genere, pare oramai assodato che esse si siano magnetizzate, allorchè dallo stato di fusione ad alte temperature, sono passate allo stato solido e si sono raffreddate, subendo l'azione del campo magnetico terrestre ; esse pertanto hanno acquistata una magnetizzazione permanente con la stessa direzione che il campo aveva in quel momento, ossia nell'epoca della loro solidificazione. Per tale modo, studiando la magnetizzazione in posto delle rocce eruttive, si otterranno indicazioni circa la direzione che aveva il campo terrestre nelle più remote età ; ed ognuno comprende quanto preziose siano queste indicazioni che, permettendoci di estendere le nostre cognizioni circa le variazioni secolari assai al di là dei nostri tempi, contribuiranno vieppiù allo sviluppo delle teorie del magnetismo terrestre.

È probabile che l'influenza magnetica di una roccia cambi alquanto con le variazioni della temperatura secondo le ore e le stagioni (è sopratutto la temperatura del suolo sotto l'irradiazione del sole, quella che conta), allo stesso modo che un magnete si indebolisce con gli innalzamenti della temperatura, e riacquista forza se si raffredda ; ma ricerche in proposito sulle rocce, non credo che ancor siano state fatte. E se si considera poi, non la magnetizzazione permanente acquistata dalla roccia, ma quella temporanea per induzione, sarebbe da verificare se l'influenza di una roccia sugli strumenti magnetici e l'anomalia derivante, variano col tempo.

V.—Studio Delle Rocce in Laboratorio

Fin dai primi tempi che l'attenzione dei fisici e dei naturalisti fu rivolta alle rocce magnetiche, divenne pratica comune quella di determinare la percentuale delle sostanze magnetiche contenute in un dato peso di campione di roccia. A tale intento le rocce finamente triturate, ovvero anche le sabbie incoerenti o le polveri terrose, vengono saggiate con una potente sbarra magnetica, oppure con un'elettrocalamita, che, attirando a sè tutte le particelle magnetiche, opera la separazione del materiale magnetico da quello non magnetico, e mediante pesate si determina la percentuale del primo sul peso totale. Si può così stabilire una specie di scala fra le rocce, da quelle più ricche di elementi magnetici a quelle più povere.

Questo procedimento, in se stesso assai ovvio, è da annoverarsi fra le prove di laboratorio che si possono fare a proposito di rocce magnetiche. Il mineralogo ed il chimico potranno poi assumersi il cómpito di analizzare ed individuare le specie e gli elementi costitutivi della porzione magnetica estratta.

Il Melloni (*Mem. Accad. Scienze*, Napoli, 1853) fece molti esperimenti di laboratorio sui campioni di rocce vulcaniche provenienti dal Vesuvio e dalle province napoletane. Ne saggiava la polarità servendosi del suo *magnetoscopio*, delicato sistema di aghi magnetici astatizzati. Fu così che egli mise fuor di dubbio l'esistenza nelle lave di una magnetizzazione permanente, oltre a quella indotta dal campo terrestre e dai magneti avvicinati alla roccia.

Ma, coi metodi che insegna la fisica per lo studio delle proprietà magnetiche del ferro e degli acciai, si possono altresì cimentare le rocce magnetiche. Sulle rocce polari si può studiare il coefficiente magnetico-termico, la forza coercitiva ; e su campioni, ridotti ad un'adatta forma, si può determinare il coefficiente d'induzione sia sotto l'azione del campo terrestre, sia con campi artificiali molto più intensi.

In particolare, importa conoscere la permeabilità e suscettività magnetica delle diverse specie di rocce, e le relative misure si possono fare in molti diversi modi : — con la bilancia di torsione nella forma data da G. Wiedemann (*Pogg. Ann.*, B. CXXVI, 1865), in cui mediante la torsione di un filo di sospensione si annulla lo spostamento prodotto da un elettromagnete su di un braccio di leva al quale è attaccato il campione di minerale; — con la bilancia ordinaria di pesate, secondo la primitiva proposta di W. Thomson, Lord Kelvin (*British Assoc. Report.* 1890), nella quale bilancia il corpo da cimentare, in forma di sbarra allungata, è sospeso ad una estremità del giogo e viene parzialmente introdotto in un forte campo magnetico, cioè fra le estremità polari di un potente elettromagnete; — o con la bilancia ad induzione di Hughes (*Proc. Roy. Soc. London*, Vol. XXIX, 1879); — o col dispositivo di Rücker (*ibidem*, Vol. XLVIII, 1890) (1), — o col metodo ideato da P. Curie (*Journal d. Phys.*, Vol. II, 1903).

Affatto recentemente Ambronn ha descritto (in *Methoden der angew. Geophysik*, 1926) una disposizione da lui adoperata fin dal 1921 per determinare la permeabilità magnetica di materiali, valendosi di rocchetti percorsi da corrente continua disposti ai lati di un magnetometro; dentro uno di essi si introduce il minerale, che modifica il campo del rocchetto, ed allora si opera con metodo di riduzione a zero dell'ago magnetometrico.

A causa della difficoltà di ottenere campioni di rocce di conveniente forma e grandezza da introdurre nei solenoidi o rocchetti inducenti, invece di pezzi rocciosi si usano tubi racchiudenti il minerale ridotto in grana fina, ed affinchè non resti aria interclusa fra i grani, questi vanno immersi in campioni liquidi convenientemente preparati (miscugli di polvere finissima di ossido magnetico Fe_3O_4 con glicerina) in modo da avere permeabilità magnetica pressochè eguale a quella del materiale che si mette a cimento.

Anche con le correnti alternate, misurando l'autoinduzione di rocchetti aventi per nucleo il minerale, si arriva alla determinazione della permeabilità di questo; sono metodi applicati da Heydweiller (*Ann. d. Physik*, Vol. XII, 1903) e da Bavink (*Neues Jahrb. f. Min., Geol. u. Paläon.*, Beil.-Bd. XIX, Stuttgart, 1904).

Ma sono poi anche da considerarsi come ricerche in laboratorio quelle che si fanno su campioni, opportunamente tagliati e squadrati dalle rocce in posto, dopo avere preso diligente nota della loro orientazione, e poi presentati a magnetometro di gabinetto per esplorare la direzione che aveva il campo terrestre

(1) Rücker con la collaborazione di White (*Proceed. R. Society*, Vol. LXIII, 1898) sperimentò sopra un grande numero di rocce, specialmente delle isole Britanniche, ed i valori delle permeabilità trovate servirono a lui come base di calcoli, coi quali sviluppò interessanti considerazioni relativamente alle perturbazioni magneticthe locali. Col procedimento ad induzione Stutzer, Gross e Bornemann determinarono la suscettività magnetica per molte specie minerali (*Metall und Herz*, B. XV, 1918). Altro bell'esempio di ricerche sistematiche sul magnetismo delle rocce, a mezzo di una bilancia di torsione, ci è offerto da Pfaff (*Geogn. Jahreshefte*, München, 1913) che studiò tutta una serie di rocce della riva destra del Reno in Baviera. *Vivant sequentes* !

nel tempo che la roccia è colata fusa e poscia si è solidificata, deducendone i valori della declinazione e dell'inclinazione nei tempi remotissimi, cose a cui già ho accennato nel precedente paragrafo. Queste interessantissime esperienze, iniziate da FOLGHERAITER sulle argille cotte (*Rend. Accad. Lincei*, dal 1896 al 1899) furono riprese con felicissimi risultati da BRUNHES e DAVID in Francia (*Comptes Rendus*, Vol. 133, 137, 138, 141, 146, dal 1901 al 1908 ; *Journal de Phys.*, Vol. V, 1906) sulle lave dell'Alvergna e sulle argille cotte sottogiacenti ; dal MERCANTON in Svizzera (*C. R.*, Vol. 151, 165, 166, 174, 182, dal 1920 al 1926 ; — *Archives Génève*, Vol. 23, 1907 ; Vol. 44, 1917 ; Vol. 8, 1926) anche su basalti dello Spitzberg, della Groenlandia e dell'Australia. Abbiamo infine il recente magnifico lavoro di R. CHEVALLIER (*Journal de Phys.*, Vol. IV, 1923 ; *Ann. de Phys.*, Vol. IV, 1925) sulle lave dell'Etna, con campioni ben segnati nella loro orientazione sul posto, tagliati da varie colate, o storiche od anche di antiche epoche incerte. R. CHEVALLIER, invece del metodo magnetometrico adoperato dagli autori precedenti, scelse per l'esame dei campioni il procedimento per induzione (metodo balistico e metodo di risonanza col galvanometro), avendo il vantaggio di poter operare pure su blocchi di forma non geometrica, ma qualunque, e di determinare altresì l'intensità di magnetizzazione dei blocchi [1].

Pertanto le ricerche, condotte nei laboratori di fisica, sulle proprietà e condizioni delle rocce magnetiche, di cui esistono innumerevoli specie, sottospecie e varietà alla superficie e nella crosta della Terra, sono pur esse da raccomandarsi caldamente alla buona volontà degli studiosi.

L. PALAZZO.

R. Ufficio Centrale di Meteorologia e Geofisica, Roma, Italia.

[1] Interessanti confronti fra il metodo magnetometrico ed il metodo balistico, applicati all'esame di campioni cilindrici della roccia magnetica di Kursk, ha eseguito N. STSCHODRO (*Beitr. z. Geophys.*, Vol. XVII, 1927).

DEUXIÈME RAPPORT PRÉLIMINAIRE SUR LA FOUDRE

Ce rapport de E. Mathias a été imprimé à part en juillet 1927 et distribué au moment du Congrès. Les membres de la Section qui ne l'auraient pas reçu pourraient en demander un exemplaire au Secrétaire de la Section.

REMARQUES SUR LES MÉTHODES GÉOPHYSIQUES DE LA PROSPECTION SOUTERRAINE

A l'occasion du dernier Congrès Géologique qui a eu lieu en Espagne (1926), on a pu constater l'énorme importance que les méthodes modernes géophysiques ont pour la prospection des masses et couches souterraines. Il a été présenté plusieurs travaux et le Congrès accorda la nomination d'un Comité International de Géophysique Appliquée qui doit s'occuper d'une étude de comparaison de tous les travaux que les différentes nations inscrites voudront bien lui envoyer afin de rédiger un rapport dans lequel on pourra se prononcer sur les avantages des procédés pour les différents cas de prospection qui peuvent se présenter.

Vu l'importance du mouvement géophysique, comme conséquence du Congrès, le Gouvernement espagnol a octroyé un crédit de Pts. 500,000 pour cette année pour un essai sur une grande échelle de l'application de ces méthodes à la prospection du pétrole dans la Province de Burgos, du charbon à Séville, et de l'eau souterraine dans le bassin de Madrid.

On a réuni tous les éléments officiels et particuliers qui s'intéressent à ces travaux et c'est justement mon Collègue M. R. Gil qui devra diriger toute la partie physique de ces travaux et les spécialistes de l'Institut Géologique qui feront l'interprétation des résultats obtenus.

L'importance que les sociétés pétrolifères américaines et les miniers d'autres pays ont accordée aux études géophysiques prouve l'urgence de former ce comité proposé par M. Gil lequel doit commencer ses travaux avec toute l'activité possible.

Ce comité devra s'adresser au comité nommé à Madrid pour leurs relations communes.

MILAIS DEL BOSCH.

REPORT OF THE COMMITTEE APPOINTED BY THE INTERNATIONAL RESEARCH COUNCIL TO FURTHER THE STUDY OF SOLAR AND TERRESTRIAL RELATIONSHIPS.

The Committee was appointed provisionally by the Executive Committee of the International Research Council in June 1924, and originally consisted of

ABBOT, C. G.
CHAPMAN, S. (Chairman).
DESLANDRES, H.
FERRIÉ, G.
SIMPSON, G. C.
ST. JOHN, C. E.
STÖRMER, C.

The Committee was given power to add to their number.

In October 1924 the President of the Section of Terrestrial Magnetism of the International Union for Geodesy and Geophysics,

CHREE, C.

was added to the Committee at the request of the Section.

The Committee presented a report to the International Research Council in 1925, July, when the nomination of the Committee by the Executive Council was confirmed. The Committee was re-appointed for three years, with the addition of

ABETTI, G.,

as a preliminary Committee, and was asked to prepare regulations for a suitable form of standing organization in collaboration with those interested in the field.

The report of the Committee reviewed the state of knowledge of solar and terrestrial relationships, and made various recommendations with a view to extending that knowledge. These have since been communicated to the organizations and institutions concerned.

By means of a grant from the International Research Council the Committee in 1926 published a volume, printed in French and English, containing :—

(i) the report of the Committee to the International Research Council,

(ii) a number of memoranda by various writers on many aspects of solar and terrestrial relationships,

(iii) a summary and bibliography of recent papers on solar relationships with meteorology, kindly prepared by C. E. P. Brooks in continuation of the bibliography by Helland-Hansen and Nansen.

This volume was circulated to libraries, institutions and individuals by, or in co-operation with, the Secretaries of the International Unions of Astronomy, Geodesy and Geophysics, and Radio-telegraphy.

In regard to the future of the Committee the following points are relevant :—

(1) The Committee deals with matters affecting three International Unions, namely, those of
Astronomy,
Geodesy and Geophysics,
Radiotelegraphy.

(2) It has been suggested by the Executive Committee of the International Union for Astronomy that the Committee should be a joint committee of the three Unions, and not be appointed directly by the International Research Council.

(3) In such a matter as the publication of a report and bibliography the fact that the Committee could obtain the necessary funds direct from the International Research Council was of advantage as compared with the longer and more complicated procedure involved in obtaining funds from the three Unions.

(4) If the three Unions approve of the existence of a committee on solar and terrestrial relationships, the best course might be for the International Research Council themselves to appoint the Committee, but in doing so to seek the advice of the Unions, or their Executive Committees and those of their Sections, regard being had, however, to the desirability of keeping the Committee small.

S. Chapman, *Chairman.*

PART III

REPORTS OF NATIONAL COMMITTEES

AUSTRALIA

NATIONAL COMMITTEE OF GEODESY AND GEOPHYSICS OF AUSTRALIA

Toolangi Magnetic Observatory

The regular magnetic observations (1) both with absolute and self-recording instruments have been carried on continuously during 1926. The *Hourly Values of the Magnetic Elements at Toolangi* for 1924 were published and distributed during the year ; those for 1925 are printed and will shortly be distributed.

E. F. J. LOVE, *Honorary Secretary.*

Melbourne, May 5, 1927.

AZORES

REPORT OF THE METEOROLOGICAL SERVICE OF THE AZORES

Though the Agenda for the Prague meeting of the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union was rendered to me in due

(1) Atmospheric-electric observations are being made as the Cantrera Observatory. — *Ed.*

time, it is only today that I am able to write to you on the matter to say that unfortunately the bulk of administrative and other work on my shoulders has been such that I feel it impossible to give any views on the items of the Agenda, namely on those which concern the Observatory Work which I feel of a very special interest to this Service.

I feel it necessary to inform you that the status of the work in terrestrial magnetism in the Azores has not changed since the last report of Col. Chaves, dated March 20, 1924, to the Madrid meeting.

Some observations of D, H, and I were made on several stations in the islands, on the piers specially set by Chaves. Of these I feel as more interesting the observation of I that I made in Terceira on March 5, 1927. The station of Thorpe was occupied (at Angra, 6 meters to the north of the Monument to D. Pedro) and the value found for I was 60°57'5. Thorpe on September 16, 1880 had found I = 64°10'3 and Chaves on June 5, 1899 had found I = 62°56'7.

Intercomparisons were made by the late Col. Chaves on May 31, June 1 and 10, 1925 between his field magnetometer No. 28 (which I am using now) and the field instruments of Observer James E. Sanders of the Department of Terrestrial Magnetism. Results were as follows :

(Chaves-Sanders) = + 0'53 in declination;
(Chaves-Sanders) = + 47 γ in horizontal intensity.

The final comparisons of the instruments of Mr. Sanders with I. M. S. will not be available until after comparisons are made at Washington upon his return from field work in Africa.

Comparisons of the same Magnetometer No. 28 with Elliot Magnetometer No. 40 of the Geophysical Institute of Coimbra were made by Col. Chaves on September 26 and 27, 1925, with the following results :

(Chaves-Coimbra) = + 1'15" in declination.
(Chaves-Coimbra) = + 47 γ in horizontal intensity.

Comparisons were also made on September 28, 1927 between our Abbadie-Brunner Dip Circle No. 15 and Dover Dip Circle No. 27 of Coimbra. Results follow :

(Abbadie-Brunner-Dover) = — 3'21".

J. Agostinho,
Director, Meteorological Service of the Azores.

Ponta-Delgada, July 31, 1927.

BRAZIL

OBSERVATORIO NACIONAL DO RIO DE JANEIRO

Ministerio da Agricultura, Industria e Commercio

Nous n'avons rien de nouveau à présenter. Le rapport général des dernières années du travail recueilli à la station de Vassouras est à l'impression et va être envoyé dans les délais marqués.

Les conditions de budget s'étant légèrement améliorées pour l'année qui commence, j'ai l'espérance de pouvoir envoyer une équipe qui continuera les déterminations, probablement suivant le parallèle de Bahia ou de Pernambuco.

Henrique MORIZE, *Directeur.*

Rio de Janeiro, le 5 *janvier* 1927.

CANADA

NATIONAL COMMITTEE OF CANADA (1)

Magnetic Work Accomplished by the Topographical Survey of Canada in 1924-25-26

The magnetic survey of the Topographical Survey of Canada was described in detail on pp. 63-64 of Bulletin No. 5, Transactions, Section of Terrestrial Magnetism and Electricity, Madrid, 1924.

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 1924-25-26, during which nearly 3,000 observations have been obtained, principally in districts not previously covered. In the Northwest Territories very many observations have been made along the Taltson, Snowdrift, Marian and Yellowknife

(1) These reports for the National Committee of Canada transmitted by Noel J. Ogilvie, President of the Committee.

rivers ; around Great Slave, Artillery, Clinton-Colden, Mackay, de Gras, Selwyn and Wholdaia lakes ; and on the Alberta-Northwest Territories boundary. In the West, along the Cochrane, Black, Churchill, Foster, Montreal, Berens and Bloodvein rivers ; and around Oxford, God's, Reindeer, Wollaston, Island, La Ronge, Deschambault and Montreal lakes. In New Ontario, along the English, Severn, Albany, and Berens rivers ; and around Nipigon, St-Joseph, Seul, Island and Red lakes. In Quebec, from Fort Coulonge on the west to Ste. Anne des Monts on the east. In New Brunswick, throughout the Province, especially the St. John Valley ; and throughout Nova Scotia. During the northward cruise of the *Arctic* in the summer of 1924, observations were obtained at Ponds Inlet and North Devon Island.

Repeat observations were made at many points throughout the country ; and a large number of new repeat stations established, especially in the East, and permanently marked with fine bronze monuments cemented into rock.

Bulletin 52, "Magnetic Results in Western Canada", was published, covering all the magnetic work of this Survey up to the end of 1922, accompanied with four isomagnetic maps. A research entitled, "The Diurnal Inequality of the Declination at Aklavik, N. W. T.", was published on the hourly readings obtained by this Survey in 1922-23 ; and another research entitled, "The Accuracy of the Theodolite Compass" was published on the analysis of the accuracy of 100 theodolite-compasses used by this Survey over many years. A paper entitled, "Magnetic Surveying, with Recent Developments in British Columbia" covering a research into the secular variation in declination, dip and horizontal force in British Columbia was contributed to the Pan-Pacific Science Congress, Tokio, Japan, 1926. Bulletin 58, "the March of the Compass in Canada and Daily Variation Tables" was published. It contains tables giving the declination of the compass at ten-year periods from 1750 to 1900 and thereafter at five-year periods for over 150 places in Canada, Newfoundland, etc. Included also are daily variation tables giving declination at hourly intervals for the different months of the year for twenty-four stations in Canada and contiguous territories. These tables are the first ever published for Canada, and being carefully tied-in with the similar tables of the United States Coast and Geodetic Survey for the United States and Alaska, they form an important part of a set of homogeneous tables covering most of North America.

F. H. Peters, *Surveyor General.*

Ottawa, January 21, 1927.

Actions Taken With Regard to Resolutions of the Madrid Meeting, 1924

In regard to resolution 5(*a*) of the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union, Madrid, 1924, concerning the standardization of instruments; all instruments used on the magnetic surveys of the Topographical Survey of Canada as in the past, 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 15 of the Section of Terrestrial Magnetism and Electricity of the International Geodetic and Geophysical Union, Madrid, 1924, calling attention to the need of additional magnetic and electric observations in high latitudes, especially north of 60° N.; observations for magnetic declination, dip and force were obtained by the Topographical Survey of Canada at Ponds Inl et and North Devon Island in the Arctic Islands; and at Taltheilei Narrows, Lockhart River, Artillery Lake, Tha-Na-Koie Narrows, Ptarmigan River, Taltson Thelon Portage, Star Lake, Lady Grey Lake, Nonachoh Lake and Taltson River in the Northwest Territories, and magnetic declination observations at many hundred stations as well, all being north of 60° N. latitude; while a great many magnetic observations were made south of but near 60° N. latitude.

F. H. PETERS, *Surveyor General.*

Ottawa, January 21st, 1927.

Action Taken with regard to resolutions made at the Madrid Meeting

In regard to resolution 6, curve measurements at the Agincourt and Meanook Observatories are made according to 75th, Meridian time and 105th, Meridian Time respectively. Mean values for an hour centering on the hour.

In regard to resolution 10 full equipment for photographic registration of the Declination, Horizontal Force and Vertical Force will be put in operation at Meanook in the early Summer.

Observatory Work

There have been no changes made in the regular work of the Agincourt and Meanook Observatories since the Madrid Meeting.

The Agincourt Observatory has been used as the Standard for all Canadian Observers, who have made intercomparisons with their field instruments and the Agincourt Standards at the beginning and ending of each Season's work.

In addition the compasses attached to Surveyor's Theodolites have been compared with the Agincourt Standard Declinometer for the Surveyor-General.

The publication of Results of Observations which were held up during the war are now being rapidly brought up to date. Those for the years 1920 and 1921 were issued last year, 1922 results are almost ready for distribution, and the 1923 results are in course of preparation.

Intercomparisons were made between the Agincourt Standards and those of the Department of Terrestrial Magnetism, Carnegie Institution Washington, in Washington, during November and December 1924.

W. E. W. JACKSON,
Magnetician, Meteorological Service of Canada.

Toronto, March 2, 1927.

Magnetic Survey Work in Canada by the Dominion Observatory, 1924-1926

The magnetic work accomplished by the Dominion Observatory up to 1923 was described in reports presented at the Rome Meeting in 1922 and the Madrid Meeting in 1924 (see Bulletin No. 3, p. 34 and Bulletin No. 4, p. 64-65).

During the three seasons 1924-1926 the work was carried on primarily for the purpose of securing secular change data by taking observations at points where magnetic data had already been secured. In addition, however, a number of new stations were occupied. Some of these were in the vicinity of repeat stations which were found unavailable, or appeared unlikely to be suitable for future use, while others were selected in localities where there were no stations, in accordance with the policy of improving, when possible, the uniformity of the distribution of stations.

During 1924 one observer only was in the field. Twenty-three stations, representing twenty distinct localities, were occupied. Of these, eight are in Yukon Territory, four being exact and two approximate locations of stations occupied by the Carnegie Institution. The remaining fifteen, four of which are repeat stations, are in British Columbia, fourteen being along the coast or on islands adjacent to the coast.

The work during 1925 and 1926 was confined to the area lying between the Atlantic sea-board and longitude 101° W., and between the Canada-United States boundary and latitude 57° N. In order to secure magnetic data applicable to Eastern Canada, appart of the country not easily accessible, the Newfoundland Government very kindly granted permission to occupy a number of stations along the Labrador coast and in Newfoundland, including the repeat stations at Battle Harbour and West Turnavik. The total number of stations occupied during the two seasons was seventy-two, comprising fiftyseven repeat and fifteen new stations and representing sixtythree distinct localities.

Observations were obtained with two instruments of types designed by the Carnegie Institution and Dover dip circle No. 212. Combined magnetometer-dip circle No. 20, one of the C. I. W. types which was purchased from them in 1916, was used throughout the three seasons for declination and horizontal intensity, but as a dip circle during 1924 only. Owing to the erratic behaviour of the dipping needles the use of this instrument was discontinued. Inclination observations were obtained during 1925 and 1926 with Dover dip circle No. 212. The other C. I. W. type of instrument is a combined magnetometer-earth inductor, which was constructed by the Precise Instrument Company of New-York. This, which is designated P. I. C. No. 104, was used during 1925 and 1926.

Comparisons observations were made as in former years in the spring and fall at the standard magnetic observatory at Agincourt, with the exception that there was but one comparison in 1925 between magnetometer-earth inductor P. I. C. No. 104 and standards. The first series of comparisons between this instrument and standards was made indirectly. In August 1925, just after it was received from the maker, it was compared for declination and horizontal intensity with magnetometer Cooke No. 15, and for inclination with earth inductor Toepfer No. 1911. The latter instruments were standardized respectively at Agincourt in June 1925 and at Washington, D. C., in 1915.

A report covering the results of observations for the three seasons 1921-1923 will, it is expected, be ready at an early date for distribution. The results of the observations taken during the three seasons 1924-1926 are at present being prepared for publication.

C. A. French.

Dominion Observatory, Ottawa, March 15, 1927.

Comparisons of magnetic instruments with standards by the Dominion Observatory, 1924-1926

As in former years the magnetic instruments used by the Dominion Observatory on field work were compared with standards at the beginning and end of each season's work. The first comparison observations made with the new magnetometer-earth inductor P. I. C. No. 104, which is one of the C. I. W. types and made by the Precises Instrument Company of New-York, were carried out at Ottawa. With this exception and a series of inclination observations at Ottawa in November, 1925, all standardizing comparisons were made at the standard magnetic observatory at Agincourt. The results of these comparisons for the period 1924-1926 are summarized in Tables 1-3.

In view of the accuracy (1) expected in results obtained with instruments of the types used, namely, 0'.2 for declination and inclination with an earth inductor, and 0.00015H in horizontal intensity, the results are a little disappointing, though they compare favourably with results obtained prior to 1923.

TABLE 1. — *Summary of results of declination comparisons, 1924-1926*

Date	Magnetometer	I. M. S.-Magnetometer	No. of observations	Place of comparaison
1924, April-May.	C. I. W. No. 20 (magnet No. 20L)	— 0.68	16	Agincourt
1924, Oct......		— 0.78	12	
1925, June		— 0.98	16	
1925, Nov......		— 0.98	15	
1926, June.....		— 0.49	15	
1926, Oct......		— 0.56	12	
1926, June	C. I. W. No. 20 (magnet No. 20S)	— 1.75	7	Agincourt
1926, Oct......		— 1.24	13	»
1925, Jan......	Cooke No. 15	— 1.30	4	Agincourt
1925, June		— 1.46	14	»
1925, Aug.	P. I. C. No. 104 (magnet No. 104L)	— 1.35 (1)	11	Ottawa
1925, Nov.		— 1.32	15	Agincourt
1926, June		— 0.90	15	
1926, Oct		— 0.97	12	
1926, June.....	P. I. C. No. 104 (magnet No. 104S)	— 0.95	7	Agincourt
1926, Oct......		— 0.46	10	»

(1) I. M. S. values of declination were obtained with Dominion Observatory magnetometer, Cooke No. 15, using the results obtained at Agincourt in January and May. 1925, namely :

(I. M. S. — Cooke No. 15) = — 1'.4.

Before proceeding with the discussion of the results it may be well to describe briefly the method followed in making the

(1) *See Researches Department of Terrestrial Magnetism*, Vol. II, p. 16 ; also, Vol. V, p. 475.

comparisons at the standard magnetic observatory. The field instrument is mounted on one of the piers of the absolute room of the observatory. Simultaneous with the observations taken with this instrument eye readings of the scale of the variometer are made, which are reduced after the base-line has been determined. The observations of declination and horizontal intensity are as a rule distributed over a period of not less than three days.

While the results of declination comparisons, which are given in Table 1, are in fair agreement, the series of November, 1925 and June, 1926, with C. I. W. No. 20, magnet 20L, indicate that some change may have taken place in one of the instruments. Comparing with these the corresponding results obtained with P. I. C. No. 104, magnet 104L, it will be noted that there was a change which differs from that obtained with C. I. W. No. 20 by only 0′.1. These results suggest, therefore, the possibility of a change in the standard instrument.

The inclination results are given in Table 2. The comparisons made in May and October, 1924, with C. I. W. No. 20, show marked discrepencies. The use of this instrument for determining inclination was discontinued, though no investigation has been made to determine the cause of the discordant values. The results with Dover dip circle No. 212, which has since been used in place of C. I. W. No. 20, as well as Dover dip circle No. 145, are as satisfactory as can be expected with this type of instrument. The results obtained with the earth inductor are not in satisfactory agreement, in view of the accuracy expected with this type of instrument. It is hoped that the cause of the discrepencies will be ascertained before further field observations are taken.

Horizontal intensity results are given in Table 3. In the case of C. I. W. No. 20 there appear to be some rather large discrepencies among the different series, though the mean values for each of the three seasons are in good agreement. In view of the change in the value of (I. M. S.-C. I. W. No. 20), which had been fairly gradual between 1916 and 1923, this uniformity in the mean values for the three seasons was somewhat unexpected. The change prior to 1923 can be accounted for, at least to a large extent, by the change which has taken place in the moment of inertia of magnet 20L. In contrast to the fairly accordant results obtained with C. I. W. No. 20, the results with P. I. C. No. 104 show a gradual change in the value of (I. M. S.-P. I. C. No. 104). From the preliminary computation of the observations with P. I. C. No. 104 in 1926 there was evidence of some instrumental change. This change was such as to indicate a decrease in the moment inertia of the magnet. It was decided, therefore, to make a redetermination of this factor. The values of log π^2K at 20°.0 C. determined in

November 1925 and October 1926 are, respectively, 2.80554 and 2.80543, the change being only 0.00011 in the logarithm. While the change observed in the moment of inertia is in the right direction it accounts for lass than 20 per cent of the change in (I. M. S.-P. I. C. N° 104) as determined from the comparisons with standards. The remainder appears to be too large to be attributed to errors of observation. For the present the problem of fully accounting for the changes observed with these magnetometers remains unsolved.

TABLE 2. — *Summary of results of inclination comparisons, 1924-1926*

a) Results with dip circles

Date	Dip circle	I. M. S. — Dip circle Needle No. 1	2	5	6	No. of observations	Place of comparison
1924, May..	C. I. W. No. 2c	— 0.8	— 0.1	+ 1.6	+ 0.5	6	Agincourt
1924, Oct...	»	+ 0.1	— 5.9	0.0	+ 3.0	6	
1925, May..	Dover dip circle No. 212	0.0	— 0.1	—	—	6	
1925, Nov...		+ 0.5	+ 0.1	—	—	6	
1926, June .		+ 0.2	— 0.5	—	—	6	
1926, Oct...		+ 0.6	+ 0.1	—	—	6	
1925, June .	Dover dip circle No. 145	+ 0.6	+ 0.8	—	—	6	

b) Results with earth inductor

Date	I. M. S. No. 104	No. of observations	Place of comparison
1925, Aug.	— 0.6 (1)	3	Ottawa
1925, Nov.	— 2.2 (1)	8	»
1925, Nov.	— 2.3	12	Agincourt
1926, June	— 1.2	12	
1926, Oct.	— 1.1	14	

(1) I. M. S. values were obtained with Dominion Observatory earth inductor, Toepfer No. 1911, using the results determined at Washington, D. C in 1915, namely :

I. M. S. — No. 1911 = — 0'.25

TABLE 3. — *Summary of results of horizontal intensity comparisons, 1924-1926*

Date	Magnetometer	I. M. S. — Magnetometer	No. of observations	Place of comparison
1924, April-Mai.	C. I. W. No. 20	— 19.4 γ = — 0.00123 H	8	Agincourt
1924, Oct......		— 13.7 γ = — 0.00087 H	6	
1925, May......		— 17.3 γ = — 0.00110 H	6	
1925, Nov......		— 14.5 γ = — 0.00092 H	8	
1926, June......		— 13.3 γ = — 0.00085 H	6	
1926, Oct......		— 17.5 γ = — 0.00111 H	6	
1925, May-June.	Cooke No. 15	+ 13.1 γ = + 0.00083 H	10	Agincourt
1925, Aug......	P. I. C. No. 104	+ 07.5 (1) γ = + 0.00050 H	2	Ottawa
1925, Nov.		+ 09.0 γ = + 0.00057 H	12	Agincourt
1926, June		+ 03.6 γ = + 0.00023 H	12	
1926, Oct......		— 02.3 γ = — 0.00018 H	6	

(1) I. M. S. values were obtained with Dominion Observatory magnetometer, Cooke No. 15, using the results determined at Agincourt in May-June, 1925, namely :

I. M. S. — Cooke No. 15 = + 0.00083 H.

C. A. FRENCH.

Dominion Observatory, Ottawa, March 15, 1927.

DENMARK

I. — The steps to be taken for realizing the calling of the Section for additional magnetic and electric observations north of 60° and for the establishment of new observations in high latitudes bring several questions specially connected with investigations in the Arctic more in the foreground than they have been before.

Besides the value of the records from the individual high-latitude observatories for the general subject of the terrestrial magnetism and electricity, an appropriate collaboration between such observatories may be of use in different ways.

It therefore seems to me to be a near consequence of the resolutions already taken by the Section, that the questions connected 1) with the equipment of arctic observatories and 2) with a near collaboration between them would be facilitated and supported by considerations of the Section.

Looking forward, perhaps the creation of a sub-commission to deal with arctic questions would be the best way to go, but until that may happen, the view of the Section on some important questions would probably be of great use for the development of the reseau of high-latitude observatories, and for those engaged with such ones.

A) Among these questions of general interest, that of the necessity of obtaining absolutely simultaneous components of the magnetic force is very important for the study of perturbations.

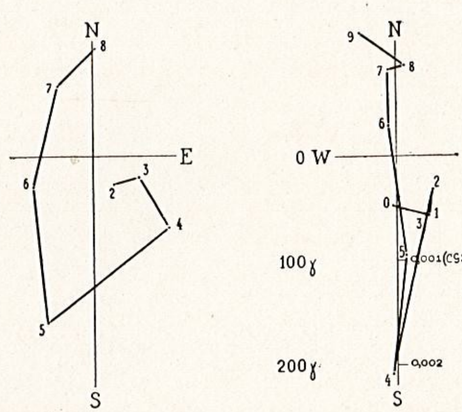


Fig. 1.

In the figure the vector to the left shows the variation of the magnetic horizontal force in Godhavn on March 5. from 10,00 to 10,09 G. M. T., while the diagram to the right shows how the variation would have manifested itself if there had been an error of 1 minute of time either for ΔD or for ΔH. In view of the importance of simultaneity I propose the following article to be taken on the agenda : Which degree of simultaneity is desirable for records of the components of the magnetic force

1) at the individual observatory ?

2) all over the world ?

To meet the requirements I personally should find the following statement adequate :

It is considered highly desirable that each individual magnetic observatory should be able to give simultaneous components of the earth's magnetic force. Such components ought to represent the magnetic force within the limits of 2 seconds from the whole minute of the G. M. T.

B) Another question of special interest for the magnetic observatories in the Arctic is that of the standards for determining the magnetic force (1). Often magnetic measurements in the Arctic have to be made within magnetic fields or at temperatures for which the corrections f. inst. for induction an temperature are known only by extrapolation. Further the questions connected with the transport and preservation of the standards are otherwise for the observatories in the Arctic than for most of the observatories in lower latitudes.

The questions of the magnetic standards in the Arctic is to some extent relative to the question already put before the subcommittee for international comparisons of magnetic standards. According to my experience, I am of the opinion that, in the Arctic, suitable electric standards will turn out to serve best for intercomparisons and preservation of magnetic standards.

I therefore take leave to propose the following article to be put on the agenda :

Transport and preservation of standards.

In view of the importance of getting experience concerning the practice of intercomparisons of magnetic standards by means of electric standards, I should find the following statement of the Section adequate :

It is considered highly desirable to organize international comparisons of magnetic standards over the world by circulating among the magnetic observatories such electric standards by means of which the components of the force of the earth's magnetism may be determined. The Section invites the Directors who may be willing to participate in such an attempt to address themselves to the subcommittee for international comparisons.

II.—The regular recordings of the Rude Skov observatory have been continued uninterrupted with two sets of D-, H- and V-magnetographs. The magnetograph of the Mascart type has been in function only for having a reserve, and its curves have only been read off when desirable.

The results of the records have been published for the years 1923 and 1924, while the publication of the records for 1922 from special reason has been delayed. Together with the records from 1925 the records from 1922 are under the press

(1) The absolute determination of D may always be tested by a skilled observer himself.

for publication. In wiew of the resolution taken in 1923 in Utrecht by the International Meteorological Conference of Directors, the above mentioned publications, contrary to previous annuals of the Rude Skov observatory, give information concerning the determination of the base-line value and of the scale-value of the traces.

Regarding the funds available and the fact that the curves from Rude Skov usually nearly have the same aspect as the curves from Potsdam, there will ordinarly be no more copies of disturbed magnetic curves in the annuals for 1925 and for the following years. The Danish Meteorological Institute, however, should be ready to furnish anybody, who might wish to obtain details of the records from Rude Skov, with suitable reproductions of fragments of the curves.

The buildings of the observatory have been added to by transferring of the pavillons of the old Magnetic Observatory of Copenhagen (see : Adam Paulsen : Communications de l'Observatoire Magnétique de Copenhague. Bulletin de l'Académie Royale des Sciences et des Lettres de Danemark, Copenhague 1892) to the site of the Rude Skov Observatory.

For absolute determinations of the magnetic force the equipment of the observatory has been augmented with a H-Z Mutual Inductance Magnetometer (see my article in Terrestrial Magnetism, December 1926). For the same purpose the observatory has been equiped with an appurtenance of instruments and standards for exact measurements of electric currents.

Beside the ordinary work at the Rude Skov observatory the years 1925 and 1926 have been characterized by the establishment of the Godhavn Magnetic Observatory, for the equipment of which the Rude Skov observatory has acted as a birthplace.

The history of the Godhavn Observatory is briefly as follows :

Supported by the resolution 8, taken by the Section at its meeting in 1924 in Madrid, I managed to get the promise of the Danish Government for the establishment of a permanent magnetic observatory at the westcoast of Greenland. Very many circumstances of different kinds had to be taken in consideration for choosing the place for the new observatory. The choice of Godhavn for the site of the observatory was made in the hope that the outer conditions for the establishment and for the maintainance of the observatory in Godhavn in connection with a special instrumental equipment of the observatory would more than compensate for the inconveniences of Godhavn originating mainly from the magnetic condition of its surroundings.

The building of the observatory was constructed in Copenhagen.

The establishment of the observatory already in the year

1925 should not have been possible, had not Dr. Ljungdahl of the Swedish Kungliga Sjökarteverket in Stockholm by kind permission of his chief, Captain G. Reinius, and of the Swedish Government, with great enthusiasm participated in the work. Dr. Ljungdahl arrived to the Rude Skov observatory the Ist of May 1925. He left Copenhagen on board the S/S. "Hans Egede" belonging to the Government of Greenland on June 7 accompanied by his son Staffan aged 16 years and an "altmuligmand" (a jack of all trade). Arrived at Godhavn on June 24 Dr. Ljungdahl put up a variometer for direct eye reading and performed a provisional survey of the neighborhood of the settlement of Godhavn. Then he selected the place for the observatory and arranged for the beginning of the building of it. On July 1 I left Copenhagen, on board a trading vessel extraordinarily sent to Godhavn, in order to take personally part in the establishment of the observatory. On September 7 the Danish Minister N. C. Hauge, visiting Greenland that summer, immured in the concrete-socle of the observatory a copper box containing a paper written in the Danish and the Esquimau languages gibing a description of the comming into existence of the observatory. After I left Greenland, Dr. Ljungdahl continued to complete the observatory and to test its instruments, From February 1926 the Godhavn Observatory may be considered as being in working order, although the adjustment of the instruments was not quite perfect during the first months.

From August 1925 Dr. Joh. Olsen of the Physical Laboratory of the Polytechnicum at Copenhagen had trained at the Rude Skov observatory for taking over the charge of the Godhavn observatory. He left Copenhagen with his family on May 30, 1926 and succeeded Dr. Ljungdahl as chief of the observatory. Dr. Ljungdahl returned to Copenhagen on July 21 and was honoured by H. M. the King of Denmark as knight of Danebrog for excellent service in Greenland.

The Godhavn observatory is a wooden building fastned by copper-bolts to non-magnetic concrets founded on the naked ice-cut gneis-rocks of the Godhavn island. The observatory consists of a pavillon for absolute determinations, a well insulated pavillon for magnetographs and a small pavillon with a brass stove for the restoring of the observer. All three pavillons are connected with shut corridors divided in several rooms serving different purposes. In view of the atmospheric conditions up there, the observatory may be entered as well from the east as from the west side and once entered, the observer is able to fulfill his work without leaving the observatory.

The main instruments in the observatory are :

Two complete sets of magnetographs recording D, H and Z, one set being much less sensitive than the other,

A magnetometer fitted with microscope-reading of the azimuth

A vertical-intensity magnetometer (Terr. Magnetism, Decbr. 1926).

Further the observatory is fitted with variometers for direct eye readings and furnished with a reserve-magnetometer, recording apparatus, dip circles, Weber's earthinductor, chronometers, wireless telegraphy, recording galvanometers, potentiometer and standards of electric units permitting to make absolute electric measurements with an accuracy of about 2×10^{-5}.

All the main-instruments of the observatory are either fully or partly of original construction aiming at service in high magnetic latitudes. Of the same reason several of the methods of measurement of the observatory are elaborated to give high accuracy in spite of the conditions up there — so unfavorable for exact measurements taken in the ordinary ways. Thus special attention has been drawn : 1) to the methods of accurate determinations of the value of the base line in spite of magnetic disturbances, 2) to a direct, explicite and accurate determination of the scale-value of the variometers (by a special "diffeential method"), 3), to obtain absolutely simultaneous records of mutual corresponding components of the magnetic force, 4) to obtain records of the force within 2 seconds from every whole minute of G. M. T. and 5) to displace mutually the records of the three elements in such a way, that simultaneous great disturbances of all the magnets do not mix their trace on the paper in an undeterminable confusion.

To what degree the equipment and the methods of the observatory have proved to be convenient under the nearly contineous magnetic disturbances in Greenland is shown by the following table.

TABLE. — *Godhavn* 1926-27

1926	Febr.	Mars	April	Maj	Juni	Juli
D(11) ...	± 90	± 16	± 9	± 11	± 11	± 3
H(γ)	± 9,1	± 3,6	± 2,7	± 1,6	± 1,5	± 1,3
Z(γ)	± 160	± 134	± 108	± 103	—	—

1926	Aug.	Sept.	Oktb.	Nov.	Déc.	1927	Janv.
D(11) ...	—	—	—	—	± 4	D	± 4
H(γ)	— 1,7	—	—	—	± 0,8	H(γ)	± 0,5
Z(γ)	—	—	—	± 1,3	± 1,5	Z(γ)	± 2,0

The table contains the mean error $\left(\pm\sqrt{\frac{\Sigma(O - m)^2}{n(n - 1)}}\right)$ of each monthly mean determined by means of the departures of the absolute measurements from an assumed constant base-line value. While the figures for the months May to August show a gradual amelioration of the determinations due to the successive adjustment of the instruments, the figures for Dec. 1926 and Jan. 1927 (transmitted pr radio) show the accuracy attained at present. The considerable decrease of the mean error ot the determination of the vertical force is due to the introduction of the new Vertical Intensity Magnetometer.

III. — The following 12 resolutions have not claimed special consideration from the part of Denmark viz : Resolution nº 1, 2, 3, 4, 9, 10, 11, 12, 13, 14, 18 and 22.

As to the other 10 resolutions the following information should be given :

Resolution 5. — *a)* The Rude Skov Observatory is the observatory in Denmark where comparisons of magnetic instruments could be made. For that purpose there has been established at the Rude Skov observatory beside its three pavillons for the ordinary work :

1) a pillar in open air,

2) a pavillon for absolute determinations,

3) a pavillon for variometers (for direct eye reading or recording).

The observatory possesses standards for absolute electric measurements of current or tension corresponding to an accuracy of abt. 2.10^{-5} (6 specially stored Weston cells) and sensitive galvanometers (also for ballistic work). Further the observatory possesses two standards for mutual inductance for comparisons of "areas" of coils.

The intercomparison of the magnetic standards between the Rude Skov and the Godhavn observatory may be effected whenever navigation permits by interchanging of standards 1) of resistance, 2) of tension and 3) of areas of coils (for mutual inductance) between the two observatories.

b) While observations of atmospheric electricity taken at the Rude Skov observatory presumably might be of inferior interest, such observations taken at the Godhavn observatory are considered to be of great value. However neither time nor funds have permitted to establish such observations up to the present time, but I am anxious to do so.

Resolution 6. — Both the Rude Skov and the Godhavn observatory are working according to G. M. T.

Resolution 7. — A vertical intensity magnetometer has been built, see Terrestrial Magnetism, Dec. 1926. The magnetometer has been in regular use at the Godhavn observatory from October 20, 1926. During the first 31 days the determinations made with the vertical intensity magnetometer, on 9 days at temperatures between + 4,2 and — 10° C, show a mean departure from an assumed constant base value of 2,5γ. During the month of December the corresponding mean error was 1,5γ and during January 1927 it was 2γ.

Resolution 8. — The magnetic observatory in Godhavn recognizes its origin from that resolution.

Resolution 11. — The Godhavn observatory is relatively near to Northeast America.

Resolution 16. — The National Committee of Denmark wish to direct the attention upon the results obtained by Professor P. O. Pedersen by studying the propagation of radio-waves. These results are published in P. O. Pedersen : « *The Propagation of Radio Waves* along the surface of the earth and in the atmosphere » (Published by « Denmarks Naturvidenskabelige Samfund » and sold by G. E. C. Gad, Vimmelskaftet 32, Copenhagen).

Resolution 17. — There has been no possibility for making observations of terrestrial electricity.

Resolution 19. — Because the Godhavn observatory is a permanent observatory it will be able to furnish magnetic data from high latitudes in years near sun-spot maximum (whenever such years occur).

Resolution 20. — Although the question of the magnetic properties of rocks is of very great interest in connection with magnetic investigations in Greenland, there has been no opportunity to deal with the matter.

Resolution 21. — The Rude Skov observatory has supported the magnetic survey of the Baltic, commenced by Sweden and Finland, by furnishing data for reduction at all the moments at which observations have been taken either on sea or shore.

From the above it may be seen, that from the side of Denmark it has not been possible hitherto to carry out or to arrange investigations according to the resolution 5 b, 17 and 20.

D. LA COUR.

Copenhagen, August 1927.

FINLAND

MAGNETIC WORK IN FINLAND

Referring to the reports concerning the status of the magnetic work in Finland, given at the Meetings in Rome and Madrid, I shall only make mention of the magnetic measurements in the last three years 1925-1927. In cooperation with the Hydrographic Service of Sweden the Meteorological Headoffice of Finland had leased from Captain von Gernet in Esthonia a non-magnetic ketchrigged launch "Cecilie" with their magnetic instruments for the measurements on sea. With this vessel the mentioned offices have made observations in South Quarken and on the northern part of the Baltic Sea in the year 1925 at 47 and in 1926 at 70 sea stations. For the sea measurements in the year 1926 the Director of the Magnetic Department of the Carnegie Institution of Washington, Dr. L. A. Bauer has kindly lent to the expedition a Lloyd Creak Dip Circle. The constants and corrections of the magnetic sea instruments were determined at the repeat stations on the coast, bounded to the sea work. Observations with the land magnetic instruments were made at these repeat stations for the determination of the secular change. The report of the sea measurements of the first year 1925 was published in 1925 (Magnetic Measurements in the Baltic Sea. South Quarken). The report of the measurements of the year 1926 will be published in this year.

In the year 1925 magnetic observations were made at 10 stations on the islands of the Gulf of Finland by Dr J. Keränen.

He has also in this year made magnetic observations in Petsamo (the new territory of Finland) at 23 stations of which five are situated on the coast of the Arctic Ocean. The distance between two neighbouring stations was so far as possible the same, 20 km., as by the former magnetic work in Finland. At the new repeat station Parkina on the coast of the Gulf of Petsamo many measurements were made. This repeat station was by measurement connected to the repeat station at Tormänen in Inari.

These Observations show that this part is less disturbed than the other parts of the north of Finland. Only at one station a more remarkable anomaly was found.

The magnetic land observations in Finland are thus finished. Only some completing observations in the north part of our land will be made and the disturbed countries will be especially studied in the neat future.

Measurements have been made at about 900 land stations of which about 180 are situated to north of the polar circle.

Our next attempt will be to make magnetic observations with land instruments on the ice cover in the Gulf of Finland and the Gulf of Bothnia and in the Ladoga Sea. It is impossible to say when these observations can be made because in some winters we have no ice at all in the Gulf of Finland but at strong winters all the Gulf is covered. I hope that these observations may be better than observations made with sea instruments on a little vessel, which is always sensible to the motions of the waves.

New observations will naturally be made at all repeat stations. The secular change of the earth's magnetic force in Northern Europe seems to be a very interesting question as the last publication of Dr. Keranen shows (On the secular change of the earth's magnetic force in Northern Europe during the period 1910-1925. *Annales Academiae Scientiarium Fennicae* Ser. A. Tome XXVIII No. 3).

The Magnetic Observatory of the Finnish Academy of Science at Sodankylä is still in operation. M. E. Sucksdorf is the observer in charge.

The results of the field observations are already nearly completely published in the nos. 1—15 of the Series:— Earth Magnetic Researches of the Meteorological Headoffice of Finland (Erdmagnetische Untersuchungen der Meteorologischen Zentralanstalt des Finnischen Staates). Of the yearbooks of the observatory at Sodankylä is in the year 1926 printed No. 3, containing the results of the year 1916. The publishing of these Yearbooks will be hurried on in the next future.

G. MELANDER.

September 1927.

FRANCE

RAPPORT SUR LES TRAVAUX DE LA SECTION DE MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES DU COMITÉ FRANÇAIS DE GÉODÉSIE ET DE GÉOPHYSIQUE

Nous examinerons successivement les travaux relatifs au magnétisme terrestre et ceux qui se rapportent à l'électricité atmosphérique.

1° **Travaux relatifs au magnétisme terrestre.** — Depuis le Congrès de Madrid (1924), la 6me section française a continué les campagnes de mesures en vue du nouveau Réseau Magnétique de la France en 1924, 1925 et 1926, malgré toutes les difficultés qui se sont présentées et qui provenaient de l'extrême fatigue de deux de nos meilleurs collaborateurs, MM. Dongier et Eblé, et d'autres difficultés dans le détail desquelles il n'est pas nécessaire d'entrer.

L'année 1926 a exigé un immense effort et la constitution de 7 groupes d'observateurs qui ont visité 18 départements, plus la Corse, en tout 294 stations.

A quelques stations près qui seront complétées cette année, le Tableau suivant donne la distribution des observations dans le futur Réseau français.

N°	Département	Stations	Années	Observateurs
1	Ain	15	1921, 1922, 1923	Baldit, Dongier.
2	Aisne	18	1924, 1925	Eblé, Service géographique de l'armée.
3	Allier	18	1925	Mathias.
4	Alpes (Basses)	6	1921	Dongier.
5	Alpes (Hautes)	6	1921, 1923	Dongier, Ct Gendre.
6	Alpes (Maritimes)	5	1921	Dongier.
7	Ardèche	8	1921, 1922, 1923	Baldit.
8	Ardennes	14	1925	Eblé.
9	Ariège	9	1924	Bélus et Maurel.
10	Aube	13	1924	Mathias.
11	Aude	5	1924	Bélus et Maurel.
12	Aveyron	15	1921, 1923	Baldit.
13	Bouches-du-Rhône	12	1921, 1922	Baldit, Dongier.
14	Calvados	23	1924	Tabesse.
15	Cantal	17	1921, 1925	Baldit.
16	Charente	14	1926	Jacquet et Bellocq.
17	Charente-Inférieure	14	1926	Tabesse.
18	Cher	17	1924	Eblé.
19	Corrèze	12	1925	Baldit.
20	Corse	42	1926	Jacquet et Bellocq.
21	Côte d'Or	16	1922, 1924	Baldit, Mathias.
22	Côtes-du-Nord	23	1922, 1923	Maurain.
23	Creuse	14	1926	Mathias.
24	Dordogne	14	1926	Mathias.
25	Doubs	12	1924	Dongier.
26	Drôme	9	1921, 1922	Baldit, Dongier.
27	Eure	22	1921, 1922	Brazier, Eblé.
28	Eure-et-Loir	17	1921, 1922, 1923	Eblé.
29	Finistère	32	1922, 1923	Maurain.
30	Gard	12	1921, 1923	Baldit.
31	Garonne (Haute)	14	1923, 1924	Mathias.
32	Gers	16	1923, 1924	Mathias.
33	Gironde	14	1925, 1926	Jacquet et Bellocq.
34	Hérault	11	1921, 1923	Baldit.
35	Ille-et-Vilaine	23	1923	Tabesse.
36	Indre	14	1925	Tabesse.
37	Indre-et-Loire	15	1925	Tabesse.
38	Isère	9	1921, 1922	Baldit, Dongier.
39	Jura	16	1921, 1924	Baldit.
40	Landes	14	1925, 1926	Jacquet et Bellocq.
41	Loir-et-Cher	14	1924	Eblé.
42	Loire	8	1921, 1922, 1623	Baldit.
43	Loire (Haute)	17	1921, 1922, 1925	Baldit.
44	Loire (Inférieure)	19	1923, 1924	Tabesse.
45	Loiret	17	1921, 1922, 1923	Eblé.
46	Lot	14	1925	Baldit.
47	Lot-et-Garonne	13	1926	Baldit.
48	Lozère	14	1921, 1923	Baldit.
49	Maine-et-Loire	15	1925	Tabesse.
50	Manche	23	1924	Tabesse.
51	Marne	16	1922, 1924, 1925	Eblé, Mathias.
52	Marne (Haute)	13	1924	Dongier, Mathias.
53	Mayenne	13	1925	Maurain.
54	Meurthe-et-Moselle	14	1926	Gibault et Rougerie.
55	Meuse	14	1926	Gibault et Rougerie.

No	Département	Stations	Années	Observateurs
56	Morbihan..........	25	1923	Maurain.
57	Nièvre............	14	1924	Eblé.
58	Nord	14	1926	Labrouste.
59	Oise	18	1922–1923	Eblé, Service géographique de l'armée.
60	Orne..............	16	1924	Maurain.
61	Pas-de-Calais......	14	1926	Labrouste.
62	Puy-de-Dôme	25	1925	Mathias.
63	Pyrénées (Basses)...	14	1925	Jacquet et Bellocq.
64	Pyrénées (Hautes)..	7	1923	Mathias.
65	Pyrénées-Orientales.	8	1924	Bélus et Maurel.
66	Rhône	10	1921, 1922, 1923	Baldit, Dongier.
67	Saône (Haute)	12	1924	Dongier.
68	Saône-et-Loire.....	19	1924	Baldit, Mathias.
69	Sarthe	18	1925	Maurain.
70	Savoie............	11	1922	Dongier.
71	Savoie (Haute).....	12	1922	Dongier.
72	Seine	»	»	»
73	Seine-et-Marne	17	1921, 1922, 1923	Eblé.
74	Seine-et-Oise	24	1921, 1922, 1923	Eblé.
75	Seine-Inférieure	23	1922	Brazier.
76	Sèvres (Deux)	14	1926	Tabesse.
77	Somme............	18	1923, 1924, 1926	Labrouste, Service géographique de l'armée.
78	Tarn..............	14	1921, 1926	Baldit.
79	Tarn-et-Garonne...	16	1926	Baldit.
80	Var...............	7	1921	Dongier.
81	Vaucluse	8	1921, 1922	Dongier.
82	Vendée............	14	1925	Maurain.
83	Vienne	14	1926	Tabesse.
84	Vienne (Haute).....	14	1926	Mathias.
85	Vosges	13	1924	Dongier.
86	Yonne	15	1923	Eblé.
87	Bas-Rhin..........	15	1923, 1924, 1926	Maurain, Service géographique de l'armée.
88	Haut-Rhin	19	1924, 1926	Maurain, Service géographique de l'armée.
89	Moselle............	18	1926	Maurain.
90	Territoire-de-Belfort.	3	1926	Maurain.
	Total.........	1327		

Le total de 1300 stations, qu'on s'était promis d'obtenir, a donc été atteint. Sur ce nombre, 15 stations ont été faites en deux points (Ambérieu, Bourg-en-Bresse, Moulins, Istres, Rognac, La Châtre, La Tour-du-Pin, Cholet, Saumur, Barfleur, Carentan, Compiègne, Noyon, Lyon-Bron, le Creusot et Albi) ; deux autres ont été faites trois fois (Condé-sur-Noireau et La Hague). Il reste, quand même, plus de 1300 stations distinctes, dont 700 environ sont nouvelles.

— Les difficultés de toute sorte rencontrées, qu'il a fallu surmonter pour atteindre à tout prix ce résultat, ne nous ont malheureusement pas permis de faire, en 1926, la campagne complémentaire qui nous aurait permis de calculer directement les variations séculaires. En effet, de 1921 à 1926, à fort peu d'exceptions près, les stations françaises n'ont été vues qu'une fois. Pour obtenir les variations séculaires qui permettront de ramener le nouveau Réseau à la date du 1er janvier 1924 (le minimum des taches solaires s'étant produit en décembre 1923), il suffira qu'un ou deux observateurs d'élite mesurent à nouveau, en 1927, les éléments D, I, H en 25 stations convenablement distribuées à la surface de la France et choisies parmi celles qui n'ont pas d'anomalie magnétique sensible et qui sont faciles d'accès.

Carte magnétique de l'Algérie et de la Tunisie. — M. Lasserre a fait, en une cinquantaine de stations, des mesures magnétiques qui n'ont encore été l'objet d'aucune publication.

Projet de carte magnétique de l'Indo-Chine. — Sur l'invitation du Comité indo-chinois de géodésie, de géophysique et d'astronomie, le secrétaire de la 6me section française a élaboré le plan du futur Réseau magnétique de l'Indo-Chine.

Jusqu'à présent, des mesures magnétiques ont été faites dans cette région par M. de Vanssay et, après lui, par la « Carnegie Institution ». Environ 40 stations magnétiques doivent être conservées pour constituer le canevas du futur Réseau ; ces 40 stations principales donneront les variations séculaires des éléments D, I, H en fonction des coordonnées géographiques.

A ces anciennes stations, il est nécessaire de joindre de nouvelles stations choisies de manière à définir, d'une façon précise en position, les *isomagnétiques*. Celles-ci ont des formes très variées : angulaires pour les isogones, ovales pour les isodynames, rectilignes pour les isoclines. Il est probable que le maximum de la composante horizontale sur le globe terrestre est voisin du cap de Carnau, tandis que l'inclinaison suit la relation linéaire

$$I = a + b\lambda,$$

où λ est la latitude géographique, a et b étant des constantes.

Pour toutes ces raisons, la carte magnétique de l'Indo-Chine a de l'intérêt. Aux 40 stations anciennes, j'ai ajouté environ 65 nouvelles stations, grossièrement équidistantes dans toutes les parties de l'Indo-Chine. La distribution de ces stations est la suivante :

Tonkin = 20, Annam = 21, Laos = 20,
Cambodge = 21, Cochinchine = 24.

Le Magnétisme terrestre dans les Archipels français de l'Océan Pacifique. — L'atlas magnétique, publié sous la direction de M. Maurain et celle de M. Eblé, par Mme de Madinhac et Mlle Homery montre, à la date du 1er janvier 1921, que les Archipels français de la partie centrale de l'Océan Pacifique présentent une particularité magnétique unique dans le monde.

Généralement, dans une station, l'isodyname et l'isocline sont peu différentes, l'ensemble étant peu incliné sur le parallèle géographique de la station ; au contraire, l'isogone est grossièrement perpendiculaire à l'ensemble des deux autres lignes.

Au contraire, dans les archipels français du centre du Pacifique, les trois isomagnétiques sont grossièrement confondues avec les parallèles géographiques ; les isomagnétiques suivent donc ici une triple loi d'exception. On a : $I = a' + b'\lambda$ comme en Indo-Chine. De plus, entre 5° et 40° de latitude sud et entre 135° et 180° W de longitude de Paris, la loi de distribution de la déclinaison est probablement de la forme :

$$D = \alpha + \beta\lambda + \gamma\lambda^2.$$

L'importance de cette dernière relation pour la navigation exige la vérification des données magnétiques qui ont servi à construire l'Atlas de Mme de Madinhac et de Mlle Homery.

M. le Ministre de la Marine a donné ordre à l'officier commandant le Stationnaire « Cassiopée » du Pacifique de faire procéder à de nombreuses mesures des éléments D, I, H à l'aide de boussoles préalablement étalonnées à l'Observatoire Magnétique du Val-Joyeux. Au cours des mesures, les boussoles seront comparées, le plus souvent possible, aux Observatoires de Melbourne et Watheroo (Australie), d'Apia (Samoa), de Christchurch (Nouvelle-Zélande) et d'Antipolo (Philippines).

Les mesures magnétiques françaises du Centre du Pacifique ont commencé le 1er octobre 1926.

2° **Travaux relatifs à l'électricité atmosphérique.** — Le secrétaire de la 6me section française a continué ses travaux sur la foudre en portant plus particulièrement ses efforts sur l'étude de la *Matière fulminante*. Ceux-ci étant exposés dans les *Rapports préliminaires* soumis au Congrès de Prague, il n'y a pas lieu d'insister plus longuement sur eux.

— Au cours de 1926, M. Ch. Jacquet, météorologiste à l'Institut et Observatoire de Physique du Globe du Puy-de-Dôme, a publié deux *Notes* à l'Académie sur les sources radioactives du département du Puy-de-Dôme.

Dans la première, il a établi que l'eau de la source minérale de Châteldon-Montagne présente une radioactivité de 105,75 millimicrocuries par litre.

Dans la seconde, il montra que la radioactivité de la source des Loches, près du pont de Mirefleur, atteint 85,4 millimicrocuries par litre.

Ces deux eaux sont de beaucoup, à l'heure actuelle, les eaux les plus radioactives de France. M. Jacquet continue ses recherches, qui sont pleines d'intérêt et de promesses.

Pour le président de la 6^{me} section et par ordre,

Le secrétaire,

E. MATHIAS.

Paris, Mars 1927.

OBSERVATIONS ET PUBLICATIONS RÉGULIÈRES CONCERNANT LE MAGNÉTISME TERRESTRE

Des observations régulières (mesures absolues de D, I, H, enregistrement des variations de D, H, Z) sont faites dans les deux stations magnétiques de l'Institut de Physique du Globe de Paris, au Val-Joyeux près Paris et à Nantes (Loire-Inférieure).

Jusqu'en 1922 les observations du Val-Joyeux étaient seules publiées. Depuis 1923 les observations des deux Stations sont publiées dans les *Annales de l'Institut de Physique du Globe et du Bureau central de Magnétisme Terrestre* (tome III, 1925 ; IV, 1926 et V, 1927), par L. Eblé pour le Val-Joyeux et par L. Tabesse pour Nantes. L'observateur en résidence au Val-Joyeux est J. Itié.

On a installé au Val-Joyeux en 1926 deux lignes pour l'étude des courants telluriques, de directions sensiblement N. S. et E. W., et un grand cadre hozizontal pour l'étude par induction des variations de la composante verticale du champ magnétique terrestre. Les Services des Postes et Télégraphes ont apporté une aide précieuse pour ces installations. Il a été établi deux enregistreurs photographiques, avec une vitesse du papier de 6 millimètres par minute pour l'un et 60 millimètres pour l'autre.

Le travail relatif à l'établissement de Tableaux et de Cartes des éléments magnétiques pour les possessions françaises a été continué. Dans le tome II des *Annales* avait paru ce qui concerne l'Algérie, la Tunisie, le Maroc, l'Afrique Occidentale et l'Afrique Équatoriale Françaises ; le tome III contient l'Indo-Chine et Madagascar, le tome IV la Syrie. — Un Altas magnétique établi sous ma direction et celle de L. Eblé par M^{lle} Homery et M^{me} de Madinhac, et contenant, avec les cartes précédentes, des cartes relatives à l'ensemble du Globe et à la France, et la Déclinaison en Europe, a paru à Paris (Les Presses Universitaires) en 1925.

Dans les *Annales* ont été publiées les mesures faites par divers observateurs pour l'établissement du nouveau réseau magnétique de la France sous la direction de M. Mathias, et aussi celles faites en dehors de la France par les Services militaires :

par le Service Géographique de l'Armée en Syrie, par le Service géographique de l'Afrique Occidentale Française, par la mission Ouadaï-Darfour.

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

MESURES RELATIVES A L'ÉLECTRICITÉ ATMOSPHÉRIQUE

L'Institut de Physique du Globe de Paris effectue à sa station du Val-Joyeux des mesures relatives à l'électricité atmosphérique comprenant : 1° l'enregistrement du champ électrique de l'atmosphère, simultanément par deux dispositifs de sensibilités différentes ; 2° mesures régulières de la conductibilité électrique de l'atmosphère ; 3° au début de 1927 ont été ajoutées aux observations précédentes, qui sont faites depuis plusieurs années, des mesures du nombre des gros ions et des petits ions. — Les appareils ont été installés par M. E. Salles.

L'observateur en résidence au Val-Joyeux est G. Gibault.

Ces mesures n'ont encore donné lieu qu'aux publications suivantes : Ch. Maurain, E. Salles et G. Gibault, *Comptes-Rendus de l'Acad. des Sciences de Paris*, t. 178, p. 2112 ; 1924 et t. 180, p. 1955 ; 1925. — E. Salles, *Annales*, t. III, p. 138 ; 1925.

Des mesures du nombre des gros ions et des petits ions ont été faites au Service Central de l'Institut de Physique du Globe de Paris par J. C. Mac Laughlin pendant les années 1924 et 1925. Les résultats en seront publiés dans les *Annales*.

L'enregistrement du champ électrique de l'atmosphère fonctionne maintenant aux deux stations de l'Institut et Observatoire de Physique du Globe du Puy-de-Dôme.

CH. MAURAIN,
Directeur de l'Institut de Physique du Globe de Paris.

HELMAN OBSERVATORY OF THE PHYSICAL DEPARTMENT, MINISTRY OF PUBLIC WORKS, EGYPT

The routine work at the Helwan Observatory has been continued, continuous records of D, H, and V being obtained from a set of Watson magnetographs controlled by absolute observations taken weekly with a Kew-pattern magnetometer and Dover Dip Circle. No field magnetic work has been done during the year and no atmospheric-electricity observations have been made.

Greenwich Time is used for the magnetic character, but hourly values are given for local time which is 2 hrs 5 min. fast on G. M. T.

P. A. Curry,
Director, Helwan Observatory.

Helwan, February 24, 1927.

ITALIA

RELAZIONE SULL'ATTIVITA DELL'ITALIA NELLE RICERCHE DI MAGNETISMO E DI ELETTRICITA TERRESTRI

(*Dalla riunione di Madrid* 1924 *alla riunione di Praga* 1927)

A. — Magnetismo terrestre

Rilievi magnetici. — Il nuovo rilevamento magnetico d'Italia, che dopo i lavori eseguiti da Palazzo negli anni 1921, 22, 23, 24, rimaneva a compiersi in alcune provincie, venne temporaneamente interrotto perchè Palazzo fu impegnato in altre missioni, di vario carattere, ma pur esse concernenti il magnetismo terrestre. Ci riferiamo alla missione espletada da Palazzo col prendere parte in qualità di geofisico alla spedizione astronomica italiana, che partita da Napoli il 14 novembre 1925 si recô nell' Oltregiuba, per osservare l'eclisse totale di Sole, il quale dovera avere luogo il 14 gennaio 1926. Data l'occasione di simile viaggio, pavre opportuno al Ministero della Marina di affidare altresì a Palazzo il cómpito di eseguire rilievi magnetici nelle nostre Colonie Est-africane, in modo da estendere, anche nell'interno del continente, la carta magnetica, di cui lo stesso Palazzo aveva già dato un primo abbozzo fin dal 1912, ma limitato alla regione costiera del Benadir.

Palazzo contribuì con osservazioni meteorologiche, attinometriche e magnetiche allo studio dell'eclisse ; dopo di che egli intrappresе una sistematica esplorazione magnetica della Somalia, dalla costa sull'Oceano Indiano fin quasi alla frontiera meridionale dell'Abissinia. Egli fece ritorno dall'Africa solo alla fine di aprile 1926. Il rapporto su tale rilievo magnetico, sotto il titolo di : *"Risultati di una esplorazione magnetica nei territori del giuba e dell'uebi scebeli"* è già dato alle stampe, e nella riunione di Praga ne saranno presentati e distribuiti gli estratti.

Variazioni magnetiche secolari. — Nel viaggio di ritorno dall'Africa, Palazzo volle fare una nuova serie di misure magnetiche a Massaua, per riprendere lo studio delle variazioni secolari nella regione eritrea, a continuazione di sue pubblicazioni precedenti. Il nuovo lavoro è uscitoda pocco, e porta per titolo : *"Variazioni magnetiche secolari a Massaua col contributo di recenti misure"* ; di esso saranno distribuiti estratti nella riunione di Praga.

Sempre sull'argomento delle variazioni secolari, Palazzo ha recato altro apporto con una memoria intitolata : *"Variazioni magnetiche secolari a Tunisi, Cartagine e Malta"*, che sarà distribuito a Praga.

Ricerche speciali. — Fra le ricerche speciali di geomagnetismo fatte da Italiani, devonsi menzionare anche quelle effettuate dal prof. Arturo Palagi per lo studio della distribuzione della forza magnetica orizzontale nella regione dei soffioni boraciferi in Toscana, lavoro intrappreso per impulso e coll'appoggio del Principe Senatore Ginori Conti, il quale desiderava fossero investigate tutte le possibili relazioni fra l'attività dei soffioni ed i varii fenomeni geofisici.

B. — Elettricita atmosferica

Nell'estate del 1924 furono continuate dal prof. Pacini a Sestola, sul l'Appennino Modenese, le osservazioni tendenti a studiare come varia la corrente verticale di conduzione atmosfera-terra, al variare delle condizioni meteoriche.

I risultati di queste ricerche e le conclusioni in cui è contenuta una spiegazione sul fenomeno della caduta del potenziale per effetto della foschia o della nebbia, sono esposti in una pubblicazione di Pacini, apparsa nel 1925 nei Rend. R. Accad. Lincei col titolo : *"Osservazioni sulla corrente verticale di conduzione atmosfera-terra"*.

Il Segretario,	*Il Presidente della Sezione,*
D. Pacini.	L. Palazzo.

JAPAN

NATIONAL COMMITTEE OF JAPAN (1)

The Kakioka Magnetic Observatory

Kakioka is a small town in Ibaraki Prefecture, Eastern Japan. The nearest railway station is Isioka at a distance of about 12 km from Kakioka, and can be reached by a moter-car in about 30 minutes. The Magnetic Observatory is situated on the top of an elevated farm field near the southern outskirt of the town.

The geographical coordinates of the Observatory are

$\lambda = 140^o 11' 21''$ E. $\varphi = 36^o 13' 51''$ N. H = 28.2 m.

The western and northern parts of the district, at the centre of which the Observatory is situated are rather hilly. The range of the hills forming the western barrier has an average height of about 400 meters, the peak being Mt. Tukuba, the top of which is 876 meters above sea level. On the sunsmit of Mt. Tukuba there is a meteorological Observatory attached to the Central Meteorological Observatory, Tokyo. The hills to the north of Kakioka are not so high as those in the west, the highest peak being about 550 metres. The land to the southeast and east of the town froms an extensive plain.

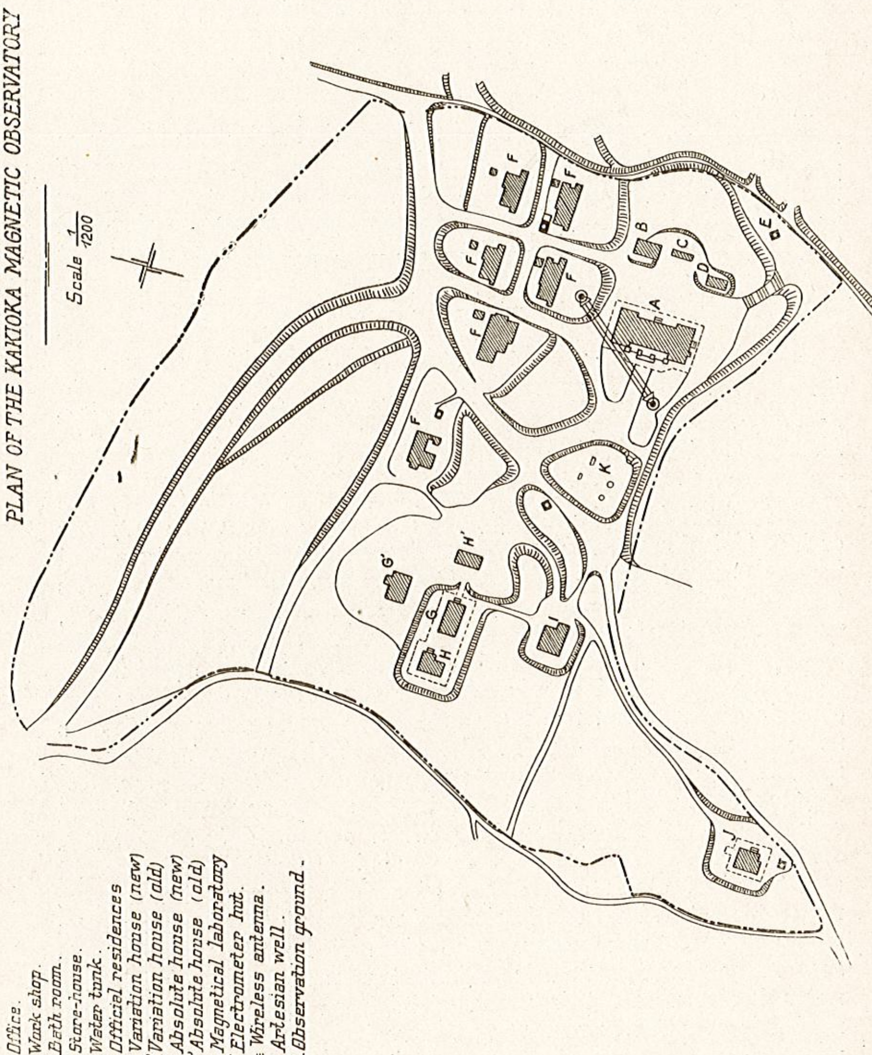
The site of the Magnetic Observatory is quite free from any electric disturbance, the nearest electric trafic being cable-cars in Tukuba at a distance of 12 km, and the nearest moter-car road being about 400 metres apart from the Observatory.

The main building of the Kakioka Observatory is a re-enforced cement concrete building with seven rooms beside a kitchen and a bath room. In the clock room is installed Riefler's normal astronomical clock and a set of switch boards. In a next room are set Wiechert's horizontal and vertical seismolographs and Omori's tromometer. The time is kept by a Riefler's secondary clock which is adjusted to synchronise with the normal clock. In this room a Richard barograph of large model is constantly recording the variation of the atmospheric pressure.

In the old variation house the Eschenhagen-Toepfer magnetographs are working. In 1925 a set of variation apparatus constructed by the Askania Werke, Berlin has been purchased.

(1) This and following two reports transmitted for the Committee by A. Tanakadate.

They are put into function in the new variation house parallel with Eschenhagen's variometers in the old house to prevent loss of record or for the purpose of getting a duplicate record.



PLAN OF THE KAKIOKA MAGNETIC OBSERVATORY

A Wild-Edelmann declinometer, earth-inductor, and magnetometer are placed in the old absolute house, always being ready for observations at any time. In the new absolute house a set of magnetometer of the Indian Survey pattern constructed by Cook & co, London, and an earth-inductor

Vue de l'Observatoire magnétique de Kakioka.

are placed. A set of field magnetic instruments also forms part of the outfit of the Observatory.

A time is kept by the Riefler's astronomical clock and a marine chronometer constructed by Ulysse Nardin, Le Locle, Switzerland. Their daily rates are determined by catching the Radio time signals at 9pm,ie, the Greenwich noon broadcasted from the Funabasi Wireless Station. The time signals are issued by a remote control method from the Tokyo Astronomical Observatory.

In 1926 a set of a very sensitive magnetographs has been designed by Dr. S. Ono of the Central Meteorological Observatory for the investigation of the sudden commencement of magnetic storms. The magnetogram is set in the Magnetic laboratory.

T. OKADA.

Tokyo, February 24,1927.

OBSERVATIONS OF ATMOSPHERIC ELECTRICITY

The Central Meteorological Observatory of Japan is now going to commence the regular observations of atmospheric electricity at Kakioka. Dr. Ono and Mr. Kawano were occupied with preliminary investigations in determining and finding the ways of eliminating various disturbing effects in such observations :—

a) *Charactistics of various kinds of collectors* were tested, water droppers, smoking collectors and of radio active collectors. The observed values depend upon the collecting power of a particular collector and the rate of leakage of the electrified system. In the laboratory of the said observatory, an arrangement consisting of two plane parallel nets of wire covering 16 square meters is made. Their distance apart is 1 metre. This gives any desired potential gradient in which the collector can be tested.

b) *The rate of leakage of the electrified system* is equally important. It is very difficult to keep this rate constant especially in wet climate. The instrument will now be arranged in such a way that this rate can be determined at any desired moment.

c) *Irregularities of the ground* is practically smoothed to plane level, in electrical sense, by providing a plane wire net extending to a distance of five times the hight of the observing house, its height above the ground as well as its mess being such that the growth of grass bellow will not affect the required ground condition.

d) *Reduction to ground level.* — To eliminate the effect of the house, the observed value is compared with that obtained in free flat field not too far from the observatory. A new plan is now conceived to envelope the observing house completely in a hemispherical wire cage and to calculate the reduction factor theoretically.

A. Tanakadate.

Tokyo, February 24, 1927.

A NEW DESIGN OF HIGHLY SENSITIVE MAGNETIC VARIOMETER (1)

The purpose of the present instrument is to investigate the problems of sudden commencement of magnetic storms as well as their variability. For the purpose of these investigations, its sensibility should be such as to detect a change of 1/10 gamma. It is designed to have a sensibillity about 1/2 gamma per mm, or 0.2 mm, will correspond to 0.1 gamma.

The instrument in its general aspect is an improved form of those used by Prof. A. Tanakadate, Prof. T. Terada and Dr. H. Kadooka, described in the paper, "On rapid periodic variations of terrestrial magnetism" (2). The important point of the present improvements is to simplify adjustment and handling, that is absolutely necessary for continuous rutine work in ordinary observatories.

The top part of the instrument for horizontal intensity H and declination D is supported with three rods which stand vertically on the main circular base plate, and the whole part on this main disc is protected with a cylindrical glass cover. By removing this protecting cover, we can handle the suspended parts such as needle and mirror very freely, and adjust their orientations with ease. Since the cylindrical cover is constructed to be air-tight, the variometer will be kept perfectly dry with a little amount of desiccating material put in it. The quartz fibre

(1) See Ono's later article published *in the Geophysical Magazine*, Vol. I, N° 3 mai. 1927, pp. 63-67.

(2) *Journal of the College of Science, Tokyo Imperial University*, Vol. XXXVII, Art. 9, May 1917.

which suspends the needle and mirror is fixed mechanically at its ends after varnishing with shellac. Simple attachment with shellac is often found to yield to torsional stress of the fibre, especially when it is moistened, causing an irregular variation of the zero point.

The instrument for the vertical component has a needle suspended with a horizontal quartz fibre. This suspension shows very good result compared to ordinary pivot support. The method of fixing the fibre is the same as that for the H-instrument described above.

In the case of putting two or more images on a sheet of photographic paper there is a difficulty of adjusting the height of images. This adjustment is made in general by dipping the reflecting mirror. But this is very hard work since the mirror is attached to the needle system suspended by the fine fibre, especially so when it is made very fine for high sensibilities. Recent design by Ad. Schmidt has a large screw work by which the instrument is made capable of up and down motion as the whole. But since the mirror moves without deflection by this method the adjustable range of the image is exceedingly restricted. The present author is now going to utilize a lens system with which one light source is refracted as four beams of rays, each of which is adjustable in azimuth as well as altitude with ample ranges.

Model instruments are being made in the workshop of the Central Meteorological Observatory, Tokyo. The cost is estimated to amount to about 200 yen for each instrument.

SUMINOSUKE ONO.

Tokyo, February 24, 1927.

MEXICO

REPORT OF MAGNETIC WORK AT THE TEOLOYUCAN OBSERVATORY, MEXICO

Since my last report, observations of absolute values of the magnetic elements and the daily photographic records of variations have been carried out systematically and steadily at the Teoloyucan Observatory of the Astronomical Observatory of Tacubaya.

The principal and most important change is the substitution of a new combined magnetometer and earth-inductor, type of the Carnegie Institution of Washington, made by the Precise

Instrument Company, for the old magnetometer, Dover No. 123, and dip circle, Fauth No. 73. The new instrument was destined for field work, but as the financial condition of the Observatory could not provide for the organization of any expedition this year, the instrument is used now for absolute determinations.

When Messrs. Green and Lindsay, from the Carnegie Institution of Washington, came to Mexico in 1924 to make magnetic observations, our instruments at Tooloyucan were compared with the one, C. I. W. No. 26, they brought. The comparison gave the following results :

	Decl'n. D	Hor. int., H	Incl'n. I
(I. M. S. — Dover 123)	+ 0'1	— 0.00126 H	—
(I. M. S. — Fauth 73)	—	—	— 1'0

Our observations were reduced according to these values, until September 1926, when the new instrument, C. I. W. No. 107 was received.

Corrections to reduce the results from the new instrument to I. M. S. were deduced from comparisons made at the Carnegie Institution of Washington, thanks to the Director, Dr. Louis A. Bauer.

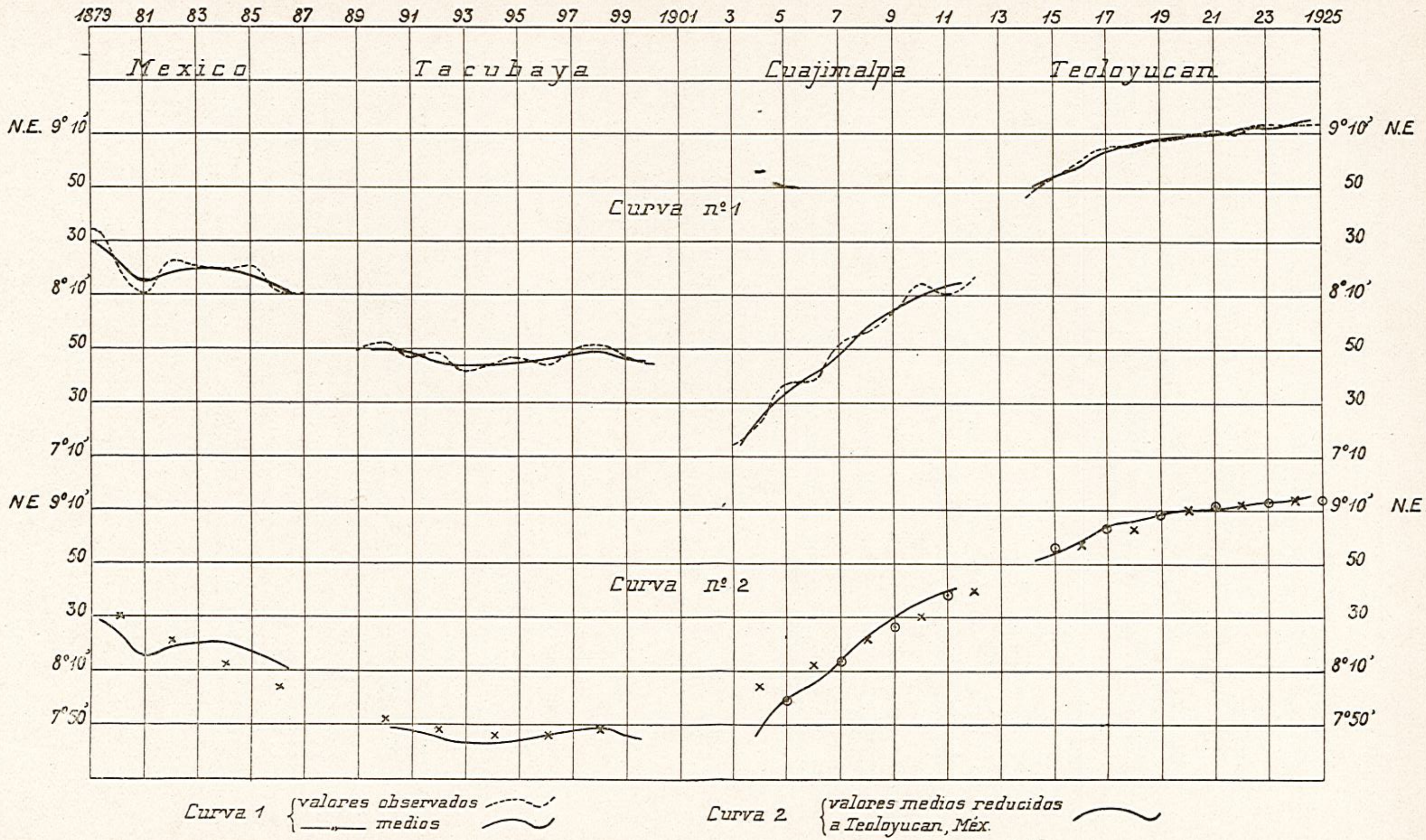
Comparisons between the instruments C. I. W. No. 107 and Dover No. 123, were made several times in Teoloyucan yielding results differing but little from those obtained by Messrs. Green and Lindsay. The resulting values for (I. M. S.-Dover 123) are : Declination + 0'.8, horizontal intensity — 0.00286 *H* (1). Our absolute observations with magnetometer C. I. W. No. 107 are reduced to I. M. S. using the corrections determined by the Carnegie Institution of Washington.

The observations of declination are the most complete since 1878, and though there are some failures due to moving the instruments from Mexico City to Tacubaya (1887), from Tacubaya to Cuajimalpa (1901), and Cuajimalpa to Teoloyucan (1912), we have been able to control the form of the variation.

The results were reduced all the Teoloyucan by making a series of observations at Tacubaya, Cuajimalpa, and Teoloyucan in 1926. No observations were made in the National Palace of Mexico City because of great masses of iron in the buildings.

In Figure I, curve No. 1 in discontinued represents the observed values of declinations and the one in continued the

(1) I believe that the difference over the comparisons made in 1924 with instruments C. I. W. No. 26 and Dover 123, is due to three observations with Dover No. 123. There is no good reason to reject these although the oscillation-periods look suspicious ; if however they are rejected we have (I. M. S. — Dover 123) = — 0.00248H. No comparisons were made in inclination between C. I. W. No. 107 and dip circle Fauth No. 73 because the dip circle was being repaired. — J. Galle, August 6, 1927.


1879 81 83 85 87 89 91 93 95 97 99 1901 3 5 7 9 11 13 15 17 19 21 23 1925
Mexico
Tacubaya
Cuajimalpa
Teoloyucan
N.E. 9°10'
50
30
8°10'
50
30
7°10'
N.E 9°10'
50
30
8°10'
7°50'
9°10' N.E
50
30
8°10'
50
30
7°10
9°10' N.E.
50
30
8°10'
7°50'
Curva nº 1
Curva nº 2
Curva 1 {valores observados
medios
Curva 2 {valores medios reducidos
a Teoloyucan, Méx.

mean annual values. Curve No. 2 represents the mean annual values reduced to Teoloyucan. The equation

$$(1) \qquad D = 8^{\circ}30' + 44'5 \sin [6^{\circ}(t - 1910)]$$

represents the secular variation of declination fairly well. We have computed for every two years the points marked ×. For the observations made at Cuajimalpa and Teoloyucan, points marked ⊙ represent the values of function

$$(2) \qquad D = 8^{\circ}56'3 + 3'77\,(t - 1915) - 0'205\,(t - 1915)^2$$

which may be considered as a first approximation only, but which gives an idea of values of the annual and secular variations.

According to the foregoing equations, the maxima should be in 1925 and though the observed value of declination has increased up to 1927 a tendency of diminish is now apparent (June 1927). But, as I said before, equations (1) and (2) give morely an idea of the form of the variations.

As the observations of inclination and horizontal component are not so complete, and unfortunately, are missing for some years between 1877 and 1917, I hesitate to treat them by the same methode as used for declination.

Field Work

As stated in my report of 1924, magnetic observations were made in the year 1925 at 18 points in the Mexican Republic. The results obtained are given in Table I. They show strong local perturbations in Chihuahua and Sonora States as found by J. P. Ault of the Carnegie Institution of Washington in 1906. There are some smaller but decided perturbations in Querétaro and San Luis Potosí States.

The field work of the short season of 1925 was executed in Veracruz; the results reduced to I. M. S., are also in the same Table I. These observations were made by Mr. Rosendo O. Sandoval, who was in charge of the Magnetic Section until his resignation in August 1926. Since that time Mr. Adolfo Orive Alba has been in charge of the Section. No other field work has been done, on account of the financial condition of the Observatory, but I hope, that in the last part of this year, the field work will be resumed.

TABLE I. — *Magnetic elements observed at different places reduced to I. M. S.* [1]

Place	Latitude North	Longitude West	Altitude	Date	D(East)	Incl'n	Hor. Int.
	° ′	h. m. s.	m.	1924	° ′	° ′	γ
Lagos, Jal.	21 21.0	6 47.42	1871	Aug.	9 49.5	47 49.6	31562
Tepic, Nay.	21 29.7	6 59.37	915	Dec.	10 20.6	47 21.2	31311
Zacatecas, Zac.	22 46.6	6 50.17	2612	Aug.	10 07.1	50 11.3	31265
Mazatlán, Sin.	23 11.3	7 05.43	7	Nov.	11 04.3	50 16.8	30834
Durango, Dgo.	24 01.2	6 58.39	1893	Aug.	10 32.4	51 03.4	30909
Yerbanís, Dgo.	24 43.9	6 55.22	1880	Sep.	11 53.5	52 12.8	30853
Culiacán, Sin.	24 48.6	7 09.35	520	Nov.	11 37.6	52 01.7	30371
Santiago, Dgo.	25 02.7	7 01.12	1716	Sep.	10 55.4	52 13.5	31051
Torreón, Coah.	25 32.2	6 53 52	1137	Sep.	10 18.3	52 53.2	30870
Jiménez, Chih.	27 07.9	6 59.42	1381	Sep.	11 41.3	54 33.7	30470
Navojoa, Son.	27 34.0	7 17.48	—	Nov.	12 35.9	54 5.0	30166
Miñaca, Chih.	28 27.4	7 09.56	2053	Oct.	11 29.3	—	30149 ?
Chihuahua, Chih.	28 37.2	7 04.19	1430	Sep.	13 20.1	55 32.8	30597
Villa Aldama, Chih.	28 49.9	7 03.34	1430	Oct.	11 45.6	56 16.3	30123 ?
Hermosillo, Son.	29 04.5	7 23.51	237	Nov.	12 46.7	55 37.4	30101 ?
Madera, Chih.	29 16.0	7 11.28	—	Oct.	12 15.8	56 13.3	29346 ?
Nogales, Son.	31 20.0	7 23.46	1179	Oct.	13 53.4	57 22.5	29654 ?
Chihuahua *, Chih.	28 38.2	—	—	Oct.	12 02.8	—	—
				1925			
Puerto México, Ver.	18 09.0	6 27.36	12	Sep.	7 54.2	45 54.9	31683
Cosamaloapan, Ver.	18 21.8	6 23.14	90	Sep.	8 04.4	45 13.6	32106
Córdoba, Ver.	18 53.4	6 27.42	827	Oct.	8 29.3	46 25.4	31725
Veracruz, Ver.	19 10.9	6 24.33	0	Sep.	8 10.1	46 49.3	31593
Jalapa, Ver.	19 31.5	6 27.36	1427	Sep.	8 38.3	46 34.5	31617
				1926			
Cuajimalpa, D. F.	19 21.5	6 37.12	2400	May	8 48.9	46 17.1	32233
Tacubaya, D. F.	19 24.3	6 36.47	2297	Apr.	9 18.8	47 02.1	32101
Teoloyucan, Méx.	19 44.8	6 36.44	2265	May	9 15.5	46 43.2	31552

* Local perturbation; this station is about one mile north of the firts station of the same name in the table.
? Doubtful.

[1] Instruments used for field work in 1923, 1924, and 1925, were : Magnetometer Dover No. 126, dip circles Chasselon 64, and Negretti and Zambra 265. Corrections applied to observations are :

	Dover 126 D	H	Chas. I	N and Z I
1923	— 4′.0	— 0.00328 H	— 2′.2	—
1925	— 2′.0	— 0.00280 H	— 4′.3	—
1926	— 1′.6	— 0.00335 H	—	+ 9′.9

These corrections determined comparing with Magnetometer Dover 125 and using to reduce to I. M. S. : (I. M. S. — Dover 123) = — 0.00126H.

Publications

At present, the results of magnetic observations at Teoloyucan and at field stations have been published in several numbers of the "Boletin del Observatorio Astronomico Nacional de Tacubaya" and also in the "Anuario" of the same Institution (see Anuario for 1927, pp. 252-261).

I am planning the publication of results in a special bulletin and I hope that very soon, the results of two or three years can be published.

Joaquin CALLO, *Director.*

Observatorio Astronómico, Tacubaya, 30 juin 1927.

NEW ZEALAND

PROGRESS OF TERRESTRIAL MAGNETISM AND ATMOSPHERIC ELECTRICITY IN NEW ZEALAND

The Dominion of New Zealand maintains magnetic observatories at Christchurch and at Apia, Samoa. At Christchurch a second installation has been made about 40 km. distant at Amberley owing to the disturbance caused by a local tramway system. A Benndorf electrometer has been purchased for continuously recording atmospheric electric potential and it is hoped that regular observations of the electric potential will soon be commenced.

Magnetic observations have been made at Apia from 1904 to the present time. Dr. H. Angenheister has completed for the New Zealand Government the reduction of the records for 1913-1920 inclusive. Through a substantial subsidy from the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, atmospheric electric potential measurements have been made at two stations for the past three years.

Andrew THOMSON,
Director, Apia Observatory.

Prague, September 3, 1927.

NORWAY

REPORT ON MAGNETIC AND ELECTRIC WORK OF THE GEOPHYSICAL INSTITUTE OF TROMSO (1)

Magnetic registrations during the last two years have been made : (1) at Haldde till ultimo August 1926 ; (2) at Tromsö from ultimo August 1926 ; (3) at Dombås.

Absolute magnetic measurements have been made at Haldde, at Tromsö in East-Finmarken, at Oslo, and at different other places.

Earth-currents have been registered in a telegraph-line in Finmarken, between Alta and Skoganvarre.

As far as I know no regular observations of atmospheric electricity have been made in the last years.

The reduction of the collected material has been effected in part at Tromsö and at Oslo.—This work will be continued at a special magnetic bureau in Bergen that will be erected in July 1928.

Special magnetic registrations have been undertaken in Tromsö in two strongly locally-disturbed places in order to study if the local disturbance had some influence on the magnetic variations of short duration. No effect of this kind was found.

The long series of measurements of the horizontal intensity in Oslo are being reduced by Professor Saeland with Mr. Wasserfall as assistant. Presumably this work will be finished in 1928.

We have tried to get some magnetic registrations at the island of Jan Mayen. A satisfactory arrangement, however, is not yet attained, and it is doubtful therefore what worth these registrations may have. As soon as possible we will try to put the apparatus in a more satisfactory order.

I regret that this report has been delayed so long because of my absence on a voyage.

O. KROGNESS.

Tromsö, August 1927.

POLAND

THE MAGNETIC WORK IN POLAND in 1925-1927

As I have already mentioned in my last report submitted to the Congress in Madrid, I have resumed in 1923 the surveying in

(1) Prepared at the request of Dr. Hesselberg.

our country, which has been interrupted by the war in 1914. I was not able to resume this work earlier, as the Observatory has been filled up with current work and the working staff was not sufficient. As well as at present we don't have a satisfactory number of assistants and this is the reason of our publications being issued to late. Because of lack of funds for bigger publications I have been able to publish untill now only approximate average annual values of the elements for the Swider Observatory for the years 1921-1924 ; besides this I have published last year the results of magnetic surveying in 1923-1924. At present the results of magnetic surveys for 1925 and 1926 are almost ready for printing, and the first map of the magnetic declinations in Poland for 1927 which I am enclosing herewith, has been just edited. This map does not include the isogones, because of the insufficient number of observations, nevertheless it was advisable to publish it for practical reasons.

Beginning with this year I intend to publish every year maps, which will contain more details, depending on the progress of our investigations. They will appear by the end of every year for the following year. Of course this publication has only a practical aim, as anybody who wants to use the map is interested to know the present values of magnetic elements and does not care to know what they have been some time ago.

Besides this the exact dates naturaly will be included in a special publication similar to what has been published on the results of the surveys made before the war and in the years 1923 and 1924.

The map of declinations does not include all points of surveys on the territory of former Congress (Russian) Poland. A part of them has been omitted because of the uneven position of these points the reason of this being that before the war I had in view a different territory from what I had in view after the war, and did not have untill now any opportunity to augment sufficiently the number of points of observations on that part of our country where the serveys have not been made at all before the war.

The second map shows all those points, for which the magnetic elements are already known ; it does not include the new points where the surveys have been made this year.

My desire being to hasten this work as much as possible, I had succeded during the last few years to collect the necessary funds for buying two new equipments of travelling apparatus (made by the firm Chasselon in Paris) : two magnetometers and two dip-circles-medium type. With these new apparatus and with the equipment I am using now, I shall be able to organize next year three surveying expeditions in the country instead of one. If the new equipments ordered in France will arrive here soon enough, as I am expecting, I hope that I shall be able to organize a second surveying expedition already this year. The first expedition is working already for a few months since we have good weather for surveying. St. KALINOWSKI.

Warsaw, August 26, 1927.

SIAM

RESULTS OF MAGNETIC OBSERVATIONS IN SIAM 1924-1926 (1).

Station	Lat. N.	Long. E.	Date	Declination (Mean of Day)	Dip		Horizontal Int.	
					Time	Value	Time	Value
	° '	° '		° '	h	° '	h	c. g. s.
Sēn Sēb	13 46	100 39	Aug. 6, 1924	0 05 1 W	16	11 20 N	12	0,40156
			Dec. 5, 1925	0 09 2 W	17	11 18 N	15	0,40207
M. Rājburī	13 31	99 49	Sep. 24, 1924	0 14 4 W	14	10 43 N	10	0,40152
M. Shajeunzao (Padriw)	13 41	101 05	Aug. 16, 1924	0 03 8 W	12	11 08 N	10	0,40106
Lobhburī	14 48	100 37	Aug. 21, 1924	0 00 3 E	14	13 50 N	10	0,40021
M. Nagorn Sawarn	15 41	100 08	Aug. 23, 1924	0 12 9 W	14	15 40 N	10	0,39926
Korat	14 58	102 05	Aug. 12, 1924	0 08 6 W	14	14 18 N	10	0,39832
M. Prachūab Girikhan (Koh Hlak)	11 49	99 48	Sep. 27, 1924	0 14 4 W	12	6 36 N	10	0,40297
M. Nagorn Sridharmarāj	8 26	99 59	Oct. 13, 1924	0 10 5 W	12	1 26 S	10	0,40280
			Feb. 24, 1925	0 11 8 W	14	1 31 S	12	0,40195
M. Bhichit	16 26	100 20	Aug. 27, 1924	0 12 0 W	14	17 38 N	10	0,39842
M. Jumbhorn	10 30	99 11	Sep. 30, 1924	0 19 7 W	12	3 28 N	10	0,40371
			Feb. 15. 1925	0 22 6 W	14	3 22 N	10	0,40416
M. Utaradith	17 37	100 06	Aug. 31, 1924	0 19 6 W	12	19 59 N	9	0,39506
			Jan. 30, 1925	0 22 2 W	17	20 01 N	15	0,39533
Nagorn Lampāng	18 17	99 30	Sep. 5, 1924	0 19 8 W	14	21 34 N	9	0,39380
			Feb. 2, 1925	0 26 9 W	17	21 42 N	16	0,39471
M. Chiengmai	18 48	99 02	Sep. 11, 1924	0 29 3 W	14	22 44 N	10	0,39238
			Feb. 5, 1925	0 35 2 W	15	22 51 N	12	0,39346
M. Surāsdhānī	9 07	99 17	Oct. 7, 1924	0 18 4 W	14	0 08 N	10	0,40312
			Feb. 18, 1925	0 22 9 W	15	0 04 N	12	0,40406
Krabintrburī	13 57	101 41	Dec. 18, 1925	0 00 5 E	15	11 54 N	11	0,40265
Aranyapradhes	13 42	102 31	Dec. 25, 1925	0 10 6 E	16	11 09 N	10	0,40207
Kēng-gōi	14 34	101 01	Jan. 16, 1925	0 32 9 W	12	13 28 N	10	0,39486
Buriram	14 59	103 06	Jan. 20, 1925	0 00 4 W	16	14 13 N	12	0,39814
Samud-sagorn	13 33	100 17	Dec. 9, 1925	0 13 0 W	13	10 46 N	10	0,40152
Kantang	7 24	99 34	Feb. 22, 1925	0 14 5 W	12	3 07 S	11	0,40037
Sattahib	12 40	100 55	Jun. 21, 1926	0 05 6 W	15	8 37 N	11	0,40322
Chandhaburī	12 35	102 08	May 25, 1926	0 00 4 E	15	8 31 N	11	0,40312

(1) Submitted by Colonel Phra Salwidham Nidhes, Assistant Director, Royal Survey Department, Bangkok, Siam.

SOUTH AFRICA

PHYSICS DEPARTMENT, UNIVERSITY OF CAPE TOWN, SOUTH AFRICA

Were are proposing to undertake a series of measurements of the magnetic elements at a number of places in the Union of South Africa, Rhodesia, and South West Protectorate, with a view to obtaining an up-to-date knowledge of the present values and the rate of secular variation. The observations will be taken by Mr. E. N. Grindley, a Lecturer in this Department, in the next long vacation (Dec. 1927—Mar. 1928).

A detailed magnetic survey of South Africa was made in 1903 by Sir Carruthers Beattie. He continued to make measurements at intervals until 1913. The last systematic observations in this country were those made by your expeditions in 1916 and 1920.

We have Kew magnetometer No. 73 (by Elliott), and Dover dip circle No. 142, which were used by Beattie ; this University is providing several accessories (theodolite, chronometer, wireless set for time-signals, etc.). An application is being made to the Research Grants Board of the Union of South Africa for a grant to cover travelling expenses and the purchase of a non-magnetic tent.

We feel that more satisfactory measurements of dip could be made by means of an earth-inductor, but are unable to purchase so expensive an instrument.

The proposed programme includes 14 stations, 7 in the Union of South Africa, 4 in Rhodesia, and 3 in South West Protectorate.

A. Ogg, *Professor of Physics.*

Cape Town, June 10, 1927.

SPAIN

CARTE MAGNÉTIQUE DE L'ESPAGNE

Le réseau magnétique de l'Espagne comprend 286 points, dans lesquels on a mesuré les trois eléments, déclinaison, inclinaison et force horizontale. Les mesures ont été effectuées avec deux théodolites magnétiques construits dans les ateliers

Sartorius de Goettingen et comparés à Potsdam. Les observations commencées par Mrs. Gil et Fort, ont été continuées par Mrs. Gil et Azpiazu. Toutes les années au commencement et à la fin des travaux on a comparé les instruments employés à l'Observatoire de l'Ebro. Les méthodes d'observation et calculs suivis sont les mêmes employés pour le levé de la Prusse. Toutes les valeurs obtenues ont été réduites à la date du 1er janvier 1924, considérée comme la plus favorable.

Avec ces valeurs réduites on a construit les cartes des isogones, isoclines et isodinamiques, mais on n'a pas utilisé les valeurs trouvées dans deux régions volcaniques des Pyrénées, lesquelles doivent être l'objet d'une étude postérieure plus détaillée.

La situation des points où l'on a fait des mesures est donnée graphiquement parce qu'on croyait ainsi faciliter l'usage des cartes ; mais à l'occasion de la publication des lignes de la composante verticale et de la force totale, qui aura lieu très prochainement, il sera donné aussi une liste des coordonnées géographiques des stations.

R. Gil.

Prague, 8 *Septembre* 1927.

SUÈDE

MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES EN SUÈDE

Levé magnétique de la Suède. — Le levé magnétique de la terre ferme de la Suède est à peine commencé. Un théodolite de voyage sorti des Ateliers Askania, à Berlin-Friedenau, vient d'être livré à l'Institut de Physique de l'Université d'Upsala ; il doit servir, entre autres, pour les mesures en campagne. L'observatoire magnétique de l'Université, qui n'a pas fonctionné depuis plusieurs années, a été remis en état et des comparaisons de divers instruments magnétiques ont été établies par M. Molin. Cet observatoire servira de point de repère aux mesures en campagne dans le centre.

D'après le plan du levé magnétique détaillé de la Suède adopté par le Comité national suédois de Géodésie et Géophysique, la surveillance des travaux sera exercée par le Service géologique de la Suède, à cause de la liaison intime qui existe entre les manifestations de la force magnétique terrestre et les phénomènes géologiques.

La connaissance de la force et de la variation du magnétisme terrestre est un complément important de la science de la structure de l'écorce terrestre obtenue par les méthodes d'examen géologiques, et elle prend, dans notre pays, une importance capitale, étant donné les espèces si variées de roches et de minéraux de son fond rocheux et sa tectonique si riche en détails.

Au point de vue de l'exploitation des mines, un examen magnétique de notre pays aura une réelle importance, non seulement à cause des éclaircissements qu'il donnera en ce qui concerne l'existence et les formes des minerais de fer qui n'affleurent pas à la surface du sol, mais aussi pour la recherche des minerais de cuivre, de plomb, de zinc et d'or ainsi que des pyrites, etc.

Dans les régions de notre pays où ces minerais peuvent être recherchés avec chances de succès, en premier lieu au Nord de la Suède, ils se trouvent si mélangés de pyrrhotine ou quelquefois de magnétite, ou bien si rapprochés de minerais magnétiques que, dans la plupart des cas, un examen magnétique aide puissamment même à la découverte des dépôts de minerai non magnétique.

Au cours de recherches de grande envergure de minerais non magnétiques faites au Nord de la Suède ces dix dernières années, recherches couronnées de succès, des déterminations magnétiques furent effectuées sur une grande échelle, conjointement à des recherches électriques.

Le Service géologique de Suède a publié sur les méthodes de recherches des gisements de minerais par des méthodes électriques les Mémoires suivants :

1° Electrical Prospecting in Sweden. By K. Sundberg, H. Lundberg and J. Eklund. Stockholm 1925.

2° Om undersökningarna vörande Sulfidmalmer i Västerbottens län. Af Axel Gavelin. Orebro 1926. (En suédois).

Un observatoire magnétique permanent à Abisko. — Des observations magnétiques régulières sont faites à l'observatoire géophysique et biologique d'Abisko, en Laponie, par 68°21' de latitude Nord, et 18°49' de longitude Est de Greenwich. Un observatoire magnétique temporaire fut d'abord établi en ce lieu depuis le 1er juillet 1921, pour prendre part aux travaux internationaux en collaboration avec l'expédition polaire d'Amundsen. L'observatoire fut muni de variomètres enregistreurs, de Toepfer, à Potsdam, appartenant à l'Institut de Physique de l'Académie des Sciences de Stockholm. Ces observations ont été continuées jusqu'au 30 juin 1925. Après cette date les travaux magnétiques furent continués encore pendant une année aux frais de la Société dite Station scientifique de Vassijaure ; et, depuis le 1er juillet 1926, les fonds nécessaires pour la continuation des enregistrements magnétiques ont été accordés par l'Etat. L'emplacement un peu provisoire des magnétographes a été amélioré, et ils ont été placés sur un fondement solide en béton, dans une cave, qui permet de tenir la température assez constante. L'amplitude de la variation diurne de la température n'excède pas 1/10^e de degré, et un chauffage électrique pendant l'hiver empêche que la température ne baisse au-dessous de 9° centigrades.

Depuis le 11-18 août 1926 des déterminations absolues des éléments magnétiques ont été faites à Abisko par M. Rolf, qui s'est servi pour cela d'un théodolite de voyage Lamont appartenant à l'Institut de physique de l'Université d'Upsala, et d'une boussole d'inclinaison de Dover (n° 60), de l'Académie des Sciences de Stockholm. Les instruments furent comparés immédiatement avant avec les instruments principaux de l'Institut de Physique de l'Université. M. Rolf a trouvé les valeurs suivantes : pour la déclinaison, 2°26'.7 O, pour l'inclinaison, 76°6'.0, et pour la composante horizontale, 0.12300 unités C. G. S. Les observations ont été faites au point même où M. Ljundgahl avait fait ses déterminations absolues des éléments magnétiques le 28 juin 1921. Une comparaison des valeurs trouvées alors (D = 3°52'.0., I = 76°1', H = 0.1230) avec celles trouvées 5 ans plus tard donne pour la variation annuelle de la déclinaison — 12'.3, de l'inclinaison + 0'.8 ; la composante horizontale n'a pas sensiblement varié.

Mesures magnétiques sur les côtes de la Suède et dans la mer Baltique. — Le levé magnétique du littoral de la Suède et de la mer Baltique a de beaucoup devancé celui de la terre ferme de notre pays. Le Service hydrographique de la marine, chargé depuis 1922 de faire des observations magnétiques sur nos côtes et les voies navigables à l'intérieur, poursuit ces recherches et en a publié les résultats dans un Recueil, dont les derniers fascicules (n^{os} 4 et 5) ont paru après la Conférence de Madrid.

Le capitaine de vaisseau Reinius, chef du Service Royal hydrographique, nous fait part des travaux de magnétisme terrestre exécutés par le service hydrographique de 1924 à 1927.

L'inclinaison, la déclinaison et l'intensité horizontale ont été déterminées sur 72 points situés le long de la côte de la mer Baltique entre Oregrund et Kråkelund.

En 1925 la déclinaison, l'inclinaison et la composante horizontale furent déterminées sur 33 points de l'archipel de Stockholm en corrélation avec la détermination des mêmes éléments faite à 47 points différents de la mer d'Åland par le service hydrographique suédois et l'Institut Central météorologique finlandais à bord du Yacht esthonien non-magnétique Cecilie.

Dans le courant de l'année 1926 les déterminations de la déclinaison, des composantes horizontale et verticale sur 76 nouveaux points de la mer d'Åland furent effectuées dans les mêmes conditions que celles de l'année précédente.

Au cours de 1927 il n'a pas été effectué, jusqu'à présent, d'autres mesures de magnétisme terrestre que celles qui étaient exigées par la recherche d'un terrain convenable pour l'établissement d'une station magnétique d'enregistrement. L'endroit approprié a été trouvé dans le parc domanial de Lovö (lat. 59 N, long. 18°50′ E. de Greenwich), où, au cours du printemps, trois pavillons destinés aux travaux magnétiques ont été construits. Les instruments enregistreurs y seront placés dans une cave voûtée en béton non magnétique, revêtue à l'extérieur d'une agglomération de pierres et de terre afin d'obtenir de très faibles variations de températures ; le pavillon destiné aux déterminations absolues est complètement non-magnétique, construit en bois. Les piliers de ces deux bâtiments sont en marbre cristallin non magnétique. L'enregistrement se fera à l'aide du procédé employé à l'observatoire de Godhavn, connu sous le nom d'enregistrement à points (1 point par minute de temps). La pendule, nécessaire pour les contacts de l'enregistrement à points, est accrochée à un pilier du troisième pavillon. Ces différents pavillons sont reliés l'un à l'autre par un câble souterrain à 8 fils revêtu de plomb. Les appareils enregistreurs seront, en principe, du même type que ceux qui sont employés à Rude Skov et comprendront la déclinaison, les composantes horizontale et verticale. Les déterminations absolues seront faites à l'aide d'un magnétomètre et d'un inducteur combinés du type de celui de l'Institut Carnegie. On prévoit l'achèvement définitif et l'entrée en fonctions de la Station pour le 1^er^ janvier 1928. Le service hydrographique a publié, pendant la période de septembre 1924 à septembre 1927, les fascicules 4 et 5 des publications de magnétisme terrestre suivantes :

Nr. 4. — Recherches sur le magnétisme terrestre dans le Nord et dans le Centre de la Suède de 1913 à 1921 par Gustaf S. Ljungdahl.

Nr. 5. — Publié en collaboration avec l'Institut Central de Météorologie de l'État finlandais, Maamagneettisisa Tutkimuksia N° 1, Magnetic Measurements in the Baltic Sea, South Quarken. First Report. (Magnetic work by J. Keränen and H. Odelsiö). Le fascicule suivant, comprenant la continuation des travaux magnétiques dans la mer d'Åland en l'année 1926 paraîtra à l'automne. De plus, le travail préparatoire de la publication des résultats d'environ 250 déterminations des éléments magnétiques terrestres dans le Sud de la Suède se poursuit actuellement.

Courants telluriques. — L'Administration des Télégraphes a organisé, depuis 1922, un réseau de courants telluriques en Suède

La station télégraphique de Lund a procédé entre les mois d'août 1924 et juillet 1927 à des recherches sur les courants telluriques à l'aide d'instruments enregistreurs. De telles recherches ont été également entreprises à Haparanda (Laponie) à l'aide d'appareils semblables. Des recherches préparatoires du même genre ont été faites aussi à Jokkmokk et à Overtorneå.

Durant l'éclipse totale de soleil du 29 juin 1927, des recherches sur les variations des courants telluriques ont été faites à Jokkmokk.

Le laboratoire d'expériences de la Direction Royale des Télégraphes a reçu, depuis 1921, des rapports émanant de différentes stations télégraphiques sur les courants telluriques gênant le trafic.

Il a été publié :

Étude des courants telluriques par David Stenquist (Mémoires publiés par la Direction Générale des Télégraphes de Suède. Stockholm 1925).

Recherches sur l'électricité des orages. — Dans le projet d'ordre du jour au Congrès de Prague, le Comité exécutif a reconnu l'importance d'obtenir des données additionnelles sur les éclairs.

A cet effet l'Administration des forces hydrauliques en Suède avait institué, depuis 1918, des recherches systématiques du champ électrique terrestre pendant les orages.

Les surtensions dangereuses dans les lignes de transmission et dans les installations électriques en Suède sont presque sans exception causées par les orages. Une étude directe oscillographique de ces surtensions reste comme on le sait assez difficile. Il semble toujours plus facile de commencer par effectuer une étude indirecte. En premier lieu, on a étudié l'intensité du champ dans les orages. Par un réseau de stations à distances variées on a aussi étudié la variation simultanée du champ dans les orages à différents points de la surface terrestre. Une phase secondaire des recherches a comporté une étude oscillographique des éclairs, afin de déterminer la vraie nature des décharges. Les recherches effectuées ont déjà donné des résultats fort intéressants. Par des recherches directes sur l'intensité du champ, on a pu constater des valeurs de l'intensité atteignant 200 kilovolts par mètre, tandis qu'on se limitait souvent à des maxima de 10 à 20 kilovolts par mètre. Les études comparatives de l'intensité simultanée du champ dans trois stations ont donné les résultats qu'une décharge est suivie d'une variation très brusque, généralement transitoire, dans l'intensité du champ, aux mêmes heures dans les trois stations. Pour analyser les impulsions des éclairs, on a construit un oscillographe cathodique. Les premières observations furent effectuées en 1921. Par des observations oculaires, on a pu conclure que les éclairs n'étaient pas oscillants. Cet oscillographe cathodique enregistreur était capable d'enregistrer les variations jusqu'à une période d'un dix-millième de seconde. En résumant, on est arrivé aux conclusions suivantes : que les décharges, dans les limites de 0 à 1/10.000^e de seconde, doivent être considérées comme apériodiques ; que la durée doit varier entre quelques millièmes et quelques dixièmes de seconde.

L'Administration des Forces hydrauliques de l'État a fait paraître, au cours des trois dernières années, de septembre 1924 à septembre 1927, les publications suivantes traitant de ses recherches sur l'électricité des orages.

1° *Revue Technique* 1925, *Électrotechnique* 8, « Recherches expérimentales concernant la forme de décharge de l'éclair », par Harald Norinder, docteur ès-sciences (En langue suédoise).

2° *Revue Technique* 1925, *Électrotechnique* 9, « De l'emploi des valves cathodiques comme oscillographe à haute fréquence spécialement pour les recherches des ondes transitoires (à surtension), par H. Norinder, docteur ès-sciences (En suédois).

3° Conférence Internationale des grands réseaux à très haute tension. Paris 1925. « Recherches sur la nature des décharges électriques des orages », par le Dr H. Norinder, Upsala, Suède.

Les recherches dont les résultats ont été donnés dans les Nos 1 et 3 des publications précitées ont été ensuite continuées et développées à l'aide d'un oscillographe spécialement construit et d'une extrême sensibilité, jusqu' à embrasser l'étude des surtensions d'origine atmosphérique sur les transmetteurs électriques.

V. Carlheim-Gyllensköld.

Stockholm, août 1927.

SUISSE

COMMUNICATION DU COMITÉ NATIONAL SUISSE

Le développement inattendu et très rapide des réseaux électriques, principalement à courants continus intenses, juste au moment où la Suisse s'apprêtait à organiser sur son territoire l'observation régulière des éléments du magnétisme terrestre et à lever aussi une carte de ces éléments, a causé l'abandon effectif de telles préoccupations.

A l'exception de quelques recherches isolées (van Rijckevorsel et van Bemmelen, au Rigi ; Bruekmann : effet de l'altitude ; Mercanton : état magnétique de poteries préhistoriques) tout est — ou plutôt était — encore à faire sur le territoire de la Confédération, que l'existence des hautes Alpes rend pourtant des plus intéressants, surtout depuis que l'effort continu de la Commission géodésique suisse et de ses ingénieurs nous ont dotés d'une carte de la pesanteur fort remarquable.

Cette situation regrettable va prendre fin : Commission géodésique suisse et Commission fédérale de météorologie se sont entendues pour supporter conjointement les frais d'exécution par le Dr Brueckmann, de l'Institut de Zurich, d'une carte magnétique sommaire mais correcte et utilisable comme base de compléments ultérieurs.

Le programme, que M. Brueckmann est en voie d'éxécuter actuellement et qui est déjà très avancé, comporte le levé magnétique de 24 stations suisses dont l'une, à Regensberg (Zurich), est en même temps la station permanente de variations. En outre deux stations, Tullingerhoehe (Baden) et Annemasse (France) raccordent le nouveau réseau suisse aux réseaux allemand et français. Notons que les instruments nécessaires à ce travail de précision ont été obligeamment mis à la disposition du Dr Brueckmann tant par l'Observatoire magnétique de Potsdam que par l'Institut de Physique du Globe de Paris.

Cette réalisation est un vrai soulagement pour le monde scientifique suisse.

Préhistoire magnétique de la Terre. — A Lausanne le professeur Mercanton a poursuivi l'examen de l'état magnétique de roches éruptives, d'âges géologiques connus, et des résultats singulièrement suggestifs sont apparus : des basaltes tertiaires provenant du Groenland (Disco) d'une part, d'Australie (Queensland et Nouvelles Galles du sud) d'autre part, ont manifesté des aimantations de sens nettement opposés à celles qu'ils prendraient aujourd'hui dans le champ terrestre aux mêmes lieux ; l'inclinaison aurait donc été, lors des grandes éruptions du tertiaire, *australe* au Groenland et *boréale* en Australie. Ces résultats dignes d'attention accentuent l'importance du vœu émis à Madrid, à la prière de MM. Palazzo et Mercanton, que l'étude du magnétisme des roches soit poussée activement et généralisée à tout notre globe. L'appui matériel de la Section est pour cela désirable.

Electricité atmosphérique. — La Commission instituée par la Soc. helvétique des Sc. nat. a été privée d'un élément très précieux en la personne de son président, feu le professeur Gockel, dont l'activité a constitué pendant longtemps l'essentiel de l'effort de la Commission. Notons toutefois les belles recherches du R. P. Huber, d'Altdorf (Uri) sur les particularités électriques du foehn alpin ; les études importantes du Dr Staeger (Fribourg et Zurich) sur l'électrisation des poussières aériennes, de la neige, etc. Au cours de l'été 1926, MM. Staeger et Baumann (Bâle) ont fait, pour la Commission, quelques déterminations préliminaires de la variation du potentiel à même les champs de neiges perpétuelles du Col de la Jungfrau. Cette station de 3450 mètres offre en effet des perspectives intéressantes pour l'avenir. Notons que MM. Kohlhoerster et de Salis viennent d'y effectuer, ainsi que sur le Moench, à 4000 mètres dans des conditions relativement aisées, de très belles recherches sur la radiation pénétrante, laquelle paraît bien être d'origine stellaire.

Dans le domaine de la radiotélécommunication, des études prometteuses ont été inaugurées par M. Jean Lugeon, de l'Institut fédéral de météorologie, sur l'origine des parasites et la localisation de leur siège en altitude.

P. L. MERCANTON.
délégué de la Confédération suisse.

Lausanne, septembre 1927.

UNITED KINGDOM (GREAT BRITAIN AND IRELAND)

WORK DONE BEARING ON RESOLUTIONS PASSED AT MADRID

Resolution No. 5 *a.* — The final results of the intercomparison of magnetic standards at British Observatories (Bulletin No. 5, pp. 112-113) are given in *Meteorological Office Geophysical Memoirs,* No. 30, p. 286.

A comparison has recently been made by Dr. D. W. Dye between a new Schuster-Smith coil magnetometer belonging to Abinger Observatory and the original one at the National Physical Laboratory (see *Terrestrial Magnetism,* v. 31, 1926, pp. 177-185).

Resolution No. 7. — A coil instrument involving the principle of electrical resonance has been devised at the National Physical Laboratory by Dr. D. W. Dye, but its suitability as an observatory instrument for measuring the vertical force remains to be tested.

Magnetic-survey work

In 1925 the Survey Department took magnetic observations at seven stations in the Channel Islands, three in Jersey, two in Guernsey, and one each in Alderney and Sark. Most were near stations occupied in the survey by Rücker and Thorpe. In 1926 the Survey observed at thirty stations in the south of England. These with one or two exceptions were identical with stations occupied for the 1915 survey by G. W. Walker. The results of the survey-work of 1925 and 1926 been published by H. M. Stationery Office. Is is intended to complete observations at the rest of Walker's stations before the end of 1930.

Publications

In addition to publications enumerated in connection with observatories the following may be mentioned :

"Encyclopaedia Britannica", 13th edition, articles on Atmospheric Electricity and Magnetism Terrestrial.

British Empire Exhibition "Handbook to the exhibition of pure science" (p. 98) and "Phases of modern science" (p. 100), articles on atmospheric electricity.

The Physical Society of London and the Royal Meteorological Society, "A discussion on the ionization in the atmosphere—held November 28, 1924" (separate publication by Physical Society).

„Discussion on the electrical state of the upper atmosphere, March 4, 1926", *Roy. Soc. Proc. A.*, vol. 111, p. 1.

Sir A. Schuster, F. R. S., "A review of Mr. George W. Walkers magnetic survey", *Roy. Soc. Proc. A.*, vol. 111, p. 68.

G. C. Simpson, F. R. S., "On lightning", *Roy. Soc. Proc. A.*, vol. 111, p. 56.

J. C. McLennan, J. H. McLeod, and W. C. McQuarrie, „An investigation into the nature and occurrence of the auroral green line, "*Roy. Soc. Proc.* A., vol. 114, p. 1., and earlier papers on the same subject by Prof. McLennan in *Roy. Soc. Proc.*

C. Chree, F. R. S. Atmospheric ozone and terrestrial magnetism, "*Roy. Soc. Proc. A*, vol. 110, p. 693.

C. Chree, F. R. S., "Magnetic disturbance and the magnetic characterization of days", *Gerland's Beiträge zur Geophysik*, Bd. XV, Helf I, p. 14.

C. Chree, F. R. S., "Analysis and discussion of magnetograph curves" in *Australian Antarctic Expedition* 1911-14, *Scientific Reports*, Series B, Vol. 1, Part. II.

Work at magnetic observatories

Greenwich (latitude 51°28′ north, longitude 0°00′ ; director, Sir Frank Dyson, F. R. S., Astronomer Royal).—Owing to the increase of artificial disturbance from electric railways, magnetic work at Greenwich came to an end in 1926.

Abinger (latitude 51°11′ north, longitude 0°23′ west ; director, Sir Frank Dyson, F. R. S.). — The transfer of the magnetic observatory from Greenwich to Abinger referred to in the last report was completed in 1925. From February 1, 1925 to February 28, 1926, complete observations both absolute and continuous of the three elements were obtained at both stations, and except for vertical force until May 31, 1926. At this date observations at Greenwich were discontinued. A comparison of the simultaneous results at the two observatories is under discussion. The Schuster-Smith coil magnetometer is in regular use and works very satisfactorily. A paper by Dr. D. W. Dye published in *Terrestrial Magnetism* for December 1926 gives an account of this instrument.

Kew (latitude 51°28′ north, longitude 0°19′ west).—Owing to the increased artificial disturbance electric railways, and the prospective retirement in 1925 of the then superintendent, Dr. C. Chree, magnetic work at this observatory ceased at the end of 1924. The following publications relating to the work done at the Observatory may be mentioned : "Absolute daily range of magnetic declination at Kew Observatory, Richmond, 1901-1910", by J. M. Stagg, M. A., B. Sc., *Meteorological Office Geophysical Memoirs,* No. 29, 1926 ; "Comparison of magnetic standards at British observatories with a discussion of various instrumental questions involved", by C. Chree, F. R. S., *Meteorological Office Geophysical Memoirs,* No. 30, 1926 : "A comparison of the records from British magnetic stations underground and surface", by C. Chree, F. R. S., and R. E. Watson, B. Sc., *Proc. Roy. Soc. A*, vol. 112 (1926), p. 304, and *Meteorological Office Geophysical Memoirs,* No. 35, 1927.

Valencia (Cahirciveen Co. Kerry, Ireland, latitude 51°56′ north, longitude 10°15′ west ; superintendent, C. D. Stewart, B. Sc.).—This Observatory has remained under the control of the Meteorological Office. The work remains as described to the Rome Meeting.

Stonyhurst (latitude 53°51′ north, longitude 2°28′ west ; director, Rev. E. D. O'Connor, S. J., M. A., F. R. A. S.).—The general character of the work and the instrumental equipment are the same as prior to 1924, and the results of observations have appeared as in former years in the annual "Results of Geophysical ans Solar Observations" issued by the Observatory.

The late Father Cortie, S. J., published in 1924 in the *Proceedings of the Royal Society* a paper on the 27-day period (interval) in terrestrial-magnetic disturbances and their relation with long-disturbed areas of sunspot activity. In 1924 the magnetometer and dip circle were compared with the Kew standards. In declination and inclination satisfactory accordance was obtained, but in horizontal force a notable discordance was found, which was greatly reduced by a re-determination of the moment of inertia of the collimator magnet. The outstanding discrepancy is still under investigation.

The next two observatories Eskdalemuir and Lerwick are administered by the Meteorological Office and are under the supervision of the Meteorological Office, Edinburgh, where also a considerable part of the data are prepared for publication (superintendent, A. H. R. Goldie, M. A., F. R. S. E.). Up to and including those for the year 1921 the magnetic and atmospheric-electric results were published in "Hourly Values from Autographic Records". Beginning with the year 1922 a new series "The Observatories Year Book" was started. The latest volume issued is that for 1924.

Eskdalemuir (latitude 55°19′ north, longitude 3°12′ west; officer-in-charge H. W. L. Absalom, B. Sc., A. R. C. S.).—The work continues to be carried on as described to the Rome Meeting. In the latter part of the year 1925 the arrangements for recording the more minute changes in the vertical component of terrestrial-magnetic force by measurement of the current induced in a horizontal coil, were improved in detail; since early in 1926 a very satisfactory and almost continuous record has been maintained.

Lerwick (latitude 60°08′ north, longitude 1°11′ west; officer-in-charge, A. W. Lee, M. Sc.).—Regular work in terrestrial magnetism has continued since its commencement on January 1, 1923. Owing to initial difficulties with the recording instruments it has been deemed advisable to restrict publication for the years 1923, 1924, and 1925 (in the Observatories Year Book) to the monthly means extracted from the records, a summary of the absolute observations, and diurnal inequalities in declination and horizontal force. From about September to April a watch for aurora is maintained each evening; detailed observations are made of any displays observed. Since April 1925 a record of atmospheric-electric potential-gradient has been maintained by means of a Benndorf electrograph.

Results in Terrestrial Magnetism at Lerwick Observatory.—As no magnetic records from the new Observatory at Lerwick had been analyzed at the time of Madrid Meeting, it may be of interest to comment now on the records of the first three years, viz. 1923-1925. For greater detail reference may be made to the "Observatories Year Book".

In 1890 when a system of magnetic quiet days was first introduced in this country, the beliefs generally entertained were apparently those expressed by Rücker and Thorpe in their great work on the magnetic survey of the United Kingdom for the epoch 1891 (*Roy. Soc. Phil. Trans.*, A, 108, 1896). The view was then taken that there were two quite distinct phenomena, viz., a regular diurnal variation and irregular movements. The former was though to be much the same on quiet and disturbed days and also (when expressed in local time) over very considerable areas; the latter was supposed to follow universal time, and to be practically invariable within such an area as the British Isles. As soon as records become available from Eskdalemuir it became obvious that natural magnetic disturbance there, though sensibly simultaneous, was considerably greater than at Kew. That disturbance at Lerwick, again would prove to be larger than at Eskdalemuir was confidently anticipated, but the increase has been so large that it emphasizes certain difficulties much less acutely felt in the average observatory. Irregular movements, for instance, are so much larger at Lerwick than, say, at Kew, that their elimination from diurnal inequalities tends to be rather incomplete, sometimes even in the seasonal or annual means. In comparing the Lerwick diurnal inequalities with those of Eskdalemuir, rather less than 600 km distant, it is found that whilst the differences in the *D*-inequalities are in general small, the differences in the *H*-inequalities for disturbed days are in some months enormous. When individual disturbed days are considered, the two sets of curves sometimes bear little resemblance to one another. In a few cases which have been studied in detail it has appeared that the seat of the disturbance, or at least the location of a vector representing the resultant (electric-current) disturbance, has been at a distance from one observatory or the other of an order equal to or less than their distance apart.

Results in Atmospheric Electricity at Lerwick Observatory.—Referring to paragraph (*a*) of the Report of the Committee on Observational Work in Atmospheric Electricity, Bulletin No. 5, p. 39, it is of interest to report that the atmospheric-electric observational made at Lerwick to date indicate that potential gradient there is higher in summer than in winter. In this matter the association with the seasonal variation of weather conditions appears to be close. At Lerwick in summer the mean wind-speed is reduced as compared with winter to such an extent that—having regard to the relative smallness at any time of the year of convectional turbulence in northerly maritime regions—the total "Austausch" in the surface layers seems to be appreciably less in summer than in winter. Correspondingly it is already well known that in these regions the annual frequency of occurrence of fog has a prominent maximum in early summer.

As to the diurnal inequality of potential gradient, the summer-variation at Lerwick is similar to the typical winter-curve at other observatories. But in this connection it was noted that the diurnal inequality of wind-speed in the summer of 1925 was also somewhat unusual in that there was a secondary maximum shortly after midnight. There is a tendency for this meteorological peculiarity to appear at Aberdeen Observatory, but there only in winter, whilst at Eskdalemuir Observatory it can be found in the winter-variation if days of electrical character "O" are considered by themselves.

Other observational work not at magnetic observatories

Prof. C. T. R. Wilson, F. R. S., has continued his investigations of thunderstorm-phenomena at Cambridge, and Lord

Rayleigh has made further observations on the occurrence of the green auroral line.

C. CHREE.

Kew Observatory, Richmond, Surrey, March 6, 1927.

UNITED STATES

REPORT ON WORK OF SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY OF THE AMERICAN GEOPHYSICAL UNION, 1925-27.

Since the Madrid Assembly, the Section of Terrestrial Magnetism and Electricity of the American Geophysical Union has held three annual meetings for the presentation of reports and scientific papers and to hear symposia on selected subjects of current interest. The proceedings at these meetings are published in the transactions of the American Geophysical Union for the sixth annual meeting April 30 and May 1, 1925, for the seventh annual meeting April 29 and 30, 1926, and for the eighth annual meeting April 28 and 29, 1927, in bulletins Nos. 53 (July 1925), 56 (November 1926), and 61 (July 1927), respectively, of the National Research Council. One of the object of the Section has been to solicit the cooperation of the workers of the corresponding sections of Canada and Mexico in the coordination of the researches especially as regards the continent of North America and to coordinate also those researches which depend upon international cooperation.

The scope of the activities at these annual meetings of the Section at Washington, D. C., may be inferred from the following list of papers presented which are published in the transactions above referred to :

Meeting of April 30, 1925. — The electric condition of the lower atmosphere, by S. J. Mauchly ; Present status of radio atmospheric disturbances, by L. W. Austin ; Application of radio transmission phenoma to the problems of atmospheric electricity, by J. H. Dellinger ; on the supposed conducting layer in the atmosphere and the effect of the Earth's magnetic field in radiotelegraphy, by G. Breit ; Theoretical changes of the magnetic elements with altitude, by Louis A. Bauer ; Methods and means for the magnetic exploration of the upper atmosphere, by J. P. Ault ; Altitude changes of the magnetic elements as deduced from observations on mountain tops, by Daniel L. Hazard.

Meeting of April 29, 1926. — Results of recent experiments on cosmic rays, by R. A. Millikan ; Improvements in magnetic recording instruments to fit them for special investigations, by N. H. Heck ; Improvements in magnetographs and variometers for observatory and field use, by J. A. Fleming ; Improved equipment for measuring earth-current potentials and earth-resistivity, by O. H. Gish.

Meeting of April 28, 1927. — This meeting was devoted to a symposium on correlations of various radio phenomena solar and terrestrial magnetic and electric activities, and included the following papers : Purpose of symposium, by N. H. Heck ; Sunspots and solar radiation, by C. G. Abbot ; Sunspots and magnetic and electric disturbances, by Louis A. Bauer ; Magnetic observations at the Mount Wilson Observatory, by Seth B. Nicholson ; The correlation of radio reception with solar activity and terrestrial magnetism—II, by Greenleaf W. Pickard ; Radio atmospheric disturbances and solar activity, by L. W. Austin ; A suggestion of a connection between radio fading and small fluctuations in the Earth's magnetic field, by G. Breit ; Correlation of static with the atmosphere, by E. H. Kincaid ; Possible relations between earth-currents, earth-resistivity, and some radio phenomena, by O. H. Gish ; Apparatus for recording radio phenomena, by T. Parkinson ; Summary of symposium, by J. H. Dellinger. In connection with this meeting, an exhibit of geophysical instruments, researches, and applications was held in the exhibit-rooms of the National Academy of Sciences and National Research Council of Washington, D. C., each of the six sections of the Union taking part. The exhibits displayed by the Section of Terrestrial Magnetism and Electricity included : (*a*) Shaw fading recorder for taking graphic records of radio-signal fluctuations ; (*b*) temperature-compensated variometer with diagrams showing increased efficiency through such compensation in magnetic-observatory work and compilations ; (*c*) scaling device for reading photographic records directly in absolute units ; (*d*) transparencies from photographs in the Arctic Sea off the north coast of Siberia, 1918 to 1925, showing types of aurora ; (*e*) transparencies of correlations between solar activity and (1) the magnetic and electric activities of the Earth, (2) radio reception ; (*f*) earth inductor and galvanometer for detailed study of anomalies and geological formations ; (*g*) apparatus for observing radio signal-intensities at magnetic and electric observatories.

Relations with the International Section of Terrestrial Magnetism and Electricity were maintained by correspondence and conferences through the Secretary and Director of the Central Bureau of that Section. The Executive Committee of the American Section also did everything possible to forward in the United States the accomplishment of the various resolutions passed by the international assemblies at Madrid and Prague and correlated various suggestions from the American Geophysical Union to be considered in the preparation of the agenda for the Prague Assembly. The results of some of the activities of the Section are given in the reports submitted for the Prague Assembly by the United States Coast and Geodetic Survey, the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, the Sloane Laboratory of Yale University, and the Department of Geophysics of the Colorado School of Mines.

It seems fitting to make mention here of the quarterly publication "Terrestrial Magnetism and Atmospheric Electricity" which for 32 years has been ably conducted by Dr. Louis A. Bauer, assisted by a board of eminent investigators and published under the auspices of the Johns Hopkins Press, Baltimore, Maryland. It continues to serve as medium for the publication of original articles, reviews, abstracts, current notes, and bibliographies, relating to the special fields of the Section, and, being the only truly international journal devoted to the diffusion of reliable information on these subjects, has been an important agent in the promotion of the interests of the Section, not in this country alone but over the whole Earth.

(Signed) J. A. FLEMING, *Secretary.*

Washington, D. C., August, 1927.

PROGRESS OF WORK IN TERRESTRIAL MAGNETISM OF THE UNITED STATES COAST AND GEODETIC SURVEY, JANUARY 1, 1925, TO JUNE 30, 1927 (1).

(REPORT OF THE SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY OF THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION, INTERNATIONAL RESEARCH COUNCIL)

There has been little change in the condition of the magnetic survey of the United States during the period covered in this statement. The survey has covered the area of the United States proper, with observations in Alaska and the various insular groups under the jurisdiction of the United States. In certain regions, especially in the western mountain regions of the United States and in Alaska off the main lines of travel, additional observations are needed. The main object at present is to occupy the selected repeat stations every five years, to outline the extent of disturbed areas, and to occupy such new stations as are found practicable. Owing to the use of magnetic methods by land surveyors in many parts of the United States, there is strong demand in many places for the maintenance of magnetic stations to test magnetic instruments so used, and such stations, in so far as practicable, are replaced when defective or missing.

United states proper

The work since 1924 has been chiefly the occupation of repeat stations. However, a number of new stations have been occu-

(1) Special Publication No. 133, Dept. Comm., U. S. Coast Geod. Surv., Washington, D. C., 1927, 7 pp. 23 cm.

pied in regions not hitherto reached, especially in Texas, Montana, Utah, and Nevada. A large number of stations have been replaced for the benefit of local surveyors, with the consequent obtaining of magnetic information, but these requests have been met only in part. A magnetic survey of the State of North Carolina in cooperation with the State authorities has been completed.

Information in regard to the magnetic stations is furnished in a publication issued every 10 years (1915-1925, etc.), giving the values of the magnetic elements at all stations, but without descriptions of stations, and containing maps giving the isogonic, isoclinic, and lines of equal horizontal intensity for the epoch of the publication. A five-yearly publication (1920-1925, etc.) gives tables for secular change covering the period from the earliest observations to January 1 of the year for which the publication is issued. This publication contains an isogonic map of the United States for the same date. The most recent one, that for January 1, 1925, contains tables of secular change on a new plan. Instead of designating the approximate area concerned, as heretofore, values are given for every two degrees of latitude and longitude. This makes interpolation easy.

In addition to the publications covering the country as a whole, a demand for information on a larger scale has been met by publications covering individual States or groups of States. These publications contain values of the declination at all stations, descriptions of the stations, a large-scale map, and secular-change tables at frequent intervals, so that little or no interpolation is needed. Up to the present time those for Arkansas, Missouri, Florida, and North Carolina habe been issued, and several others are in course of preparation.

In connection with the use of magnetic stations by local surveyors the condition of more than half of 3,700 marked stations in the United States have been voluntarily reported. This indicates the interest in the subject, which is indicative of future progress in the work.

A special effort has been made to secure rather intensive observations along the coast, and the surveying vessels make many more observations of declination than is possible for the country as a whole. The Coast and Geodetic Survey does not possess a nonmagnetic vessel, and, while use is made of the results of occasional cruises along our shores of the *Carnegie*, of the Carnegie Institution of Washington, magnetic information for mariners' charts is chiefly obtained from shore observations. The results with a nonmagnetic ship are so much superior that observations at sea by the vessels of the Coast and Geodetic Survey have ceased, except in areas of local magnetic disturbance where exact values are not important.

Alaska and Island possessions

Alaska covers a large area, much of which is inaccessible by road, railroad, or water transportation. Accordingly, most of the magnetic observations are confined to regions readily reached, except in the case of the boundary where many observations were made at the time of its demarcation. The present effort is to occupy repeat stations every 10 years. During the past three years observations have been made at new stations in the Aleutians and at various points along the shores of southeastern and southwestern Alaska.

During the period covered by this report repeat observations were made in the Hawaiian Islands and in the Philippine group. Observations were made in the island group between Luzon and the Japanese Islands to the north, and in Palawan and various small islands in the Sulu Sea.

Special observations were made during the total solar eclipse of January 24, 1925, at Ithaca, N. Y., in cooperation with Cornell University. Atmospheric electric observations were also made potential gradient) in cooperation with the department of terrestrial magnetism, Carnegie Institution of Washington.

All field instruments used in the above surveys, were standardized at the observatory at Cheltenham, Md.

Especial attention is called to the relations with Canada. That country makes field observations over a large portion of its area, even in relatively inaccessible regions. Results in the vicinity of the border are exchanged between the two countries in advance of publication when necessary, so that each has the benefit of the other country's results in preparing the isomagnetic maps.

Observatory results

The observatories at Cheltenham, Md., Sitka, Alaska, and Honolulu, Hawaii, each completed 25 years of continuous observation without change of site during 1926. The Tucson observatory completed 17 years. The Porto Rico observatory on Vieques Island was discontinued at the close of 1924, after 21 1/2 years' observations, because of difficulties with the site. A new site was obtained on the Island of Porto Rico at which most of the difficulties with the previous station have been eliminated. Operation began January 1, 1926, and it is hoped the new series will cover a long period. Difficult climatic conditions, especially extreme moisture, make special precautions necessary.

At Cheltenham a small experimental building without temperature control has been in practically constant use. Problems of temperature compensation of variometers and improvements in variometer design have been worked out here. The Carnegie Institution of Washington has also made of this building in similar work. The working relations with the latter organization are excellent.

Efforts have been directed toward modernizing the observatory equipement and keeping it up to modern standards. Improvements have been especially directed toward meeting the requirements of direct scaling of magnetograms, which will be described in a separate report. This program has included remodeling of the observatory magnetometers, which has also made possible intercomparisons of instruments. The program has included the placing of a spare magnetometer, compared at Cheltenham, at each observatory, while the magnetometer of the observatory is being remodeled. Each observatory magnetometer is compared with the spare and then at Cheltenham before and after remodeling. It is then compared with the spare, which goes on to the next observatory. In this way the spare is, in effect, being constantly compared with Cheltenham and, on its return to Washington, will again be compared at Cheltenham. In accordance with a resolution at the Rome meeting of the International Geodetic and Geophysical Union, asking each country to designate a special observatory for comparison of instruments, Cheltenham was selected along with the standardizing observatory of the Carnegie Institution of Washington.

The improvements of these instruments will enhance the value of intercomparison in the future. In case of a cruise of the *Carnegie*, for example, it might become desirable to compare at Honolulu, for instance, and Kakioka, Japan, which would be quite advantageous.

At Sitka systematic observations were made of the aurora and a study made between radio disturbances and magnetic storms and aurora. Sitka is not an ideal place for aurora observation, both because of considerable distance from the belt of maximum frequency and because it is in the coastal belt of high humidity, with much rain and cloudy weather. Fairbanks, Alaska, is a more logical site, but at present there appears no prospect of activity there.

The records of Cheltenham have been regularly furnished during the past two years to various investigators of radio disturbance and magnetic conditions, and Dr. Greenleaf W. Pickard has found definite correlations between them. Magnetic-observatory results have been used by various investigators searching for oil and minerals by magnetic methods. Several universities have installed courses in geophysics and have received assistance from the division of terrestrial magnetism and seismology of the Coast and Geodetic Survey. This indicates that the interest in magnetic-observatory results from the practical viewpoint is probably greater at present than at any time. Personnel shortage has prevented the publication of observatory results after 1922. However, because of the development of direct scaling, there is not the accumulation of unfinished results that might be expected, and much of the work now received from the observatories is ready for publication, except for final revision. It is hoped that this will be true of all results in the not distant future. Lack of sufficient personnel has also prevented adequate attention being given to the important matter of discussion of observatory results. It is hoped to accomplish more of this in the future.

There is very little overlapping of the work of the Carnegie Institution of Washington and that of the Coast and Geodetic Survey. Considerable mutual benefit accrues from the fact that the head-quarters of both organizations are in close proximity, making possible a constant interchange of ideas and mutual assistance in the development of instruments, training of observers, and other ways, with resulting important contributions to the progress of the study of terrestrial magnetism.

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Computation of magnetic-observatory results

In the report made to the Madrid meeting of the International Geodetic and Geophysical Union an outline was given of the methods used by the United States Coast and Geodetic Survey in the computation and preparation for publication of the results from its five magnetic observatories. Various devices for facilitating the computations were explained, and attention was called to the adoption of the method of photographic reproduction for the publication of the tables of hourly values and the consequent great saving in the cost of publication, and elimination of typographical errors and labor of proof reading.

Even with these improvements in methods there is still a very large amount of tedious computing to be done in deriving absolute hourly values of declination, horizontal intensity, and vertical intensity from the magnetograms. With the addition of seismological investigations to the functions of the division of terrestrial magnetism and the increasing demands of other phrases of the work of the division, it has not been possible to keep the computation of the observatory results up to date. With no immediate prospect of increase of personnel, it has become of the utmost importance to devise ways and means for further curtailing the labor involved in this branch of the work in order to prevent it from getting too greatly in arrears. Two recent developments of great value promise to revolutionize the reduction of magnetic-observatory work in this bureau—first, the temperature compensation of horizontal-intensity variometers, and second, the direct scaling of absolute hourly values from the magnetograms. It is recognized that this is not merely a problem of the Coast and Geodetic Survey, but that magnetic stations throughout the world are being kept from complete publication of their results because of the amount of labor required and the corresponding cost of the work.

Dr. Adolf Schmidt many years ago worked out a method of compensating horizontal-intensity variometers for temperature and applied it to the instruments at the Seddin observatory. It was not, however, until the theory of the variometer had been worked out by George Hartnell, observer in charge of the Cheltenham magnetic observatory, and a simpler system of temperature control had been devised by him that it became feasible for this bureau to undertake the remodeling of its variometers to secure this much-desired result. The H variometers at San Juan, P. R., and at Cheltenham, Md., have already been provided with temperature compensation, and those at the other observatories will be similarly remodeled as soon as circumstances permit. With the H variometers provided with temperature compensation and the Z variometers modified so as to secure greater stability and permit a closer adjustment of the temperature compensation, one step in the reduction of the observations—application of correction for temperature—will be eliminated.

Until recently it was the practice of the Coast and Geodetic Survey to have the hourly ordinates scaled in millimeters at the observatories, leaving the conversion of these scalings from millimeters to gammas, the application of temperature correction, and the addition of the base-line value to be done in the office. It was recognized at the outset that scales could be made which would make it possible to read the ordinates in absolute measure instead of in millimeters, but, because of the difficulty and cost of securing the larger number of scales which would have been required to fit the varying H and Z scale values, this possibility was not given serious consideration. With the development of a method for the cheap and speedy production of scales and the increase in the stability of the variometers, and a corresponding decrease in the number of scales required, the possibility has become a reality.

The making of a scale involves first a drawing three times the size of the required scale, so that unavoidable errors in drawing will be reduced in the finished product. A photographic negative on glass is then made of drawing, reduced to the required size. From this negative prints are made on thin aluminium plates. It is then a simple matter to cut out the scales, trim, and varnish them.

For declination and vertical intensity the graduations are equally spaced on the drawings. Because of the inherent instability of the vertical-intensity variometer there is frequently a considerable range of scale value, even when no changes of adjustment are made and enough scales must be made to cover that range. To save photographic work it has been found convenient to draw side by side a series of scales differing by 1 per cent, as many as can be photographed on a single negative. By varying the amount of photographic reduction this drawing can be used for a wide range of scale values.

In a horizontal-intensity variometer of the Eschenhagen type the scale value is in general not constant, but may be represented very closely by a formula of the form $S=a+bh$, in which h is the ordinate in millimeters and a is the scale value for a zero ordinate. A scale with the spacing of the graduations varying in accordance with such a formula may be used for all ordinates, so long as the values of a and b remain unchanged. The horizontal-intensity variometers of the Coast and Geodetic Survey have shown such stability in recent years that adjustments changing these quantities are rare. Accordingly, a scale has been made for each observatory corresponding to the established values of a and b. On each scale the point corresponding to the value of $S=a$ is marked, and this point must always be set at the base line on the magnetogram when readings are made. To make a drawing for such a scale it is necessary to compute the proper spacing of the graduations. However, the scale value changes so slowly that it is sufficient to carry out the computation for only a few points, the intervening graduations being spaced equally.

These scales give at once the distance between curve and base line in minutes in the case of declination and in gammas in the case of horizontal and vertical intensity, and do away with the tedious operation of multiplying each ordinate scaled in millimeters by the scale value. A simple device makes possible the addition of the base-line value at the same time, so that for declination or an intensity variometer compensated for temperature the absolute hourly values are read at once from the magnetogram, and in the case of an uncompensated variometer there remains only the process of correcting the hourly values for temperature effects.

The scales are not numbered, but the observer is furnished with the base-line values to be used. He fastens to the scale a strip of paper of such width as not to cover the graduation marks and writes the base-line value opposite the point on the scale which is to be set at the base-line of the curve to be read. At the proper points on the paper lines are drawn in continuation of the scale divisions and numbered to indicate the values of the quantity which differ by 100 gammas (or 10′ in the case of declination).

To facilitate the use of these scales the observer is provided with a reading board, a set of three T squares (one for the scale of each element), and a piece of squared plate glass, suitably etched. The reading board has spring clamps for holding the magnetogram in position. At its upper edge is a straightedge which may be adjusted in position by means of a slow-motion screw at either end. The scale is clamped to the arm of its T square with the graduation along the right edge when the head of the T square rests on the straightedge of the reading board. The piece of plate glass is of such thickness that its upper surface is even with the upper surface of the scale in position on its T square. On its under surface are etched a set of five vertical lines 2 centimeters apart (corresponding to the spaces between hour marks on the Eschenhagen magnetograms) and a single horizontal line. On the upper surface, directly over each end of this line, at the edge of the glass, is etched a short line a few millimeters long.

The magnetogram is placed on the reading board in such a position that the base line of the scale will coincide with the base line of the curve to be read, throughout its length, as the head of the T square to which the scale is attached is slid along the straightedge. The magnetogram is placed approximately in the proper position and then clamped. The accurate setting is made by the adjusting screws of the straightedge. The T square is then moved along the straightedge until the first hour interval of the curve to be read is inclosed by two vertical lines of the reading glass. The glass is then moved up or down along the edge of the scale until the space between the horizontal line and the curve is as much below the line as above. The scale is then read at the point indicated by the short line at the left edge of the upper surface of the glass.

This method is now in use at the observatories of the Coast and Geodetic Survey. At Cheltenham and Honolulu, where the change of temperature in the variation room in the course of the day is seldom more than two-tenths of a degree, the temperature correction is applied to the base-line value, and the final hourly values are read directly from the magnetograms. For the other observatories, until the variometers are compensated for temperature, the correction for temperature will be applied in the office at the same time that the printer's copy of the tables is prepared.

The scalings can be made with the same accuracy and with nearly the same rapidity as when the readings were in millimeters, and the cost of making the scales is comparatively small, so that there is a saving of practically all the labor formerly expended on conversion from millimeters to gammas and application of base-line values. Some small changes will, no doubt, be required in the provisionally adopted base-line values, but, as the base-line for values a month are not fixed until the observed values for two succeeding months are available, the corrections will be small and can readily be applied in connection with the preparation of the printer's copy. At least half, and probably more, of the work of computing the observatory results will be eliminated in this way.

In future publications of observatory results the diurnal variation tables, as well as the tables of hourly values, will be reproduced photographically, which will result in a further saving in cost of printing and labor of proof reading.

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Division of Terrestrial Magnetism and Seismology.

Washington, June 30, 1927.

REPORT BY THE DEPARTMENT OF TERRESTRIAL MAGNETISM, CARNEGIE INSTITUTION OF WASHINGTON

Investigational and experimental work

The work done by the Department since the Madrid Assembly has emphasized the advantage of combination of facilities for observation, expeiiment, and investigation.

Good progress has been made during the past three years by the Department in the elucidation and interpretation of magnetic and electric phenomena of interest, not alone to students of the Earth's magnetism and electricity, but also to the physicist, the geologist, the astronomer, and the increasing circle of those interested in radiotelegraphy and telegraphic transmission.

The chief subjects of investigation relating to solar activity and the Earth's magnetic and electric activity have included (*a*) measures of solar activity with respect to their use in geophysical investigations, (*b*) measures of the Earth's magnetic activity, (*c*) critical studies of measures of solar activity and the Earth's magnetic and electric activity, (*d*) concomitant solar and magnetic observations, (*e*) investigations of possible 27-day periods in earth-current and polar lights, and (*f*) compilation of magnetic disturbances and correlation coefficients for sunspot numbers. The application of the results of these investigations in the observational work will be found indicated in the various following sub-sections of this report.

Comprehensive studies have been made of the secular variation of the Earth's magnetism in various regions of the globe in order to reduce as accurately as possible the accumulated magnetic data to a common epoch. In this connection, data for polar regions have been collected and charted in order that the complete analysis of the Earth's magnetic field may be proceeded with.

In connection with the observational programs of the Department, that for the investigation of many questions by laboratory methods has been materially increased since the report made at the Madrid Assembly. In particular, the existence of an upper conducting layer in the atmosphere and the nature of magnetism have been investigated.

The Department undertook to obtain a direct test of the presence of the ionized region. This was done by a special radio method with the help of signals which were kindly sent by the Naval Research Laboratory and several other institutions. The conducting layer was definitely shown to be real by the existence of reflections of radio waves. The signal arriving along the ground and the echo of it arriving *via* reflecting layer have been photographed and the retardation of the indirect signal as compared with the direct one was measured. Numbers for the effective height of the layer have been obtained. This work has been later confirmed and extended by Heising of the Bell Telephone Laboratories. Further developments of the method are in progress at the Department.

The magnetic permeability of iron has been claimed by some investigators to depend critically on the frequency of alternations of the magnetic field to which it is subjected. If this be so, important additions should be made to current views on the nature of magnetism. The permeability of iron and magnetite has been investigated at the Department in the supposedly critical region and its vicinity. No critical variation of permeability has been found at the claimed frequency of one million. Sources of error which have not been considered by other workers have been demonstrated experimentally to exist and ways of eliminating them lave been found.

The magnetic properties of matter are at present considered to be associated with an ability of atoms to orient themselves in a magnetic field in several definite ways. With the cooperation of Dr. Ellett, then a National Research Fellow, it has been found how long a mercury atom must be subjected to a magnetic field in order to be oriented.

An experimental study was made of the various sources of error involved in potential-gradient observations. This includes, for instance, the effect of wires attached to the collector system, the orientation of the collector face, and the effect of leakage in the insulators. As a result of this investigation, slight changes should be made in the customary calculation of the reduction-factor. Ways of making the collector system follow the potential gradient without lag have been devised.

Work is in progress on the production of artificial and very penetrating radiation. Convenient laboratory sources for the production of high electrical potentials have been developed. Cosmic radiation corresponds to thirty million volts. When this report was prepared, potentials reaching 4,700,000 volts had been obtained despite certain unfavorable laboratory conditions; it is hoped that potentials of the order of ten million will be obtained here.

The effect of pressure on the critical temperature of magnetization has been investigated experimentally in a cooperative investigation with the Geophysical Laboratory of the Institution. The experiments on nickel, meteoric iron and other kinds of iron, and magnetite, indicate a slight decrease in the critical temperature of magnetization with increase of pressure; accordingly, the argument cannot be successfully combated that at a depth of ten or twelve miles below the Earth's surface the temperature of magnetizable materials is such as to exclude the possibility that any portion of the Earth's magnetism can arise from materials at that depth. Instead of the accompanying increase of pressure as the Earth is penetrated causing an elevation of the critical temperature at which magnetization is annulled, the increased pressure would seemingly, according to these experiments, cause a lowering of the critical temperature. The final publication of these results is being delayed pending some theoretical investigations regarding a possible volume change under the pressures used (the highest pressures for the different materials range from 2,000 to 3,600 atmospheres).

World magnetic survey. Land work

The field work of the Department of Terrestrial Magnetism during recent years has been confined mainly to repeating observations at stations occupied during the years when the primary survey of the whole Earth was in progress. The policy adopted in the beginning and followed throughout the first survey, of confining operations mainly to those land areas for which no other agency was able to provide magnetic data, has been followed in the resurvey.

These land areas may be grouped into large divisions as follows : Australia, New Zealand, and the East Indies ; the islands of the South Pacific ; China and contiguous portions of southeast Asia ; the continent of Africa and adjacent parts of southwest Asia ; Mexico, Central America, and the West Indies, the continent of South America. It has always been the practice to make repeat observations wherever the itineraries of observers crossed those of earlier expeditions, and in this manner scattered data for secular variation have been obtained, but the systematic resurvey may be said to have begun in 1921 with the work of our observer in the South Pacific and Australasia. This work was finished in 1923, and a full discussion of the results is now well under way.

The resurvey of the West Indies, Mexico, and Central America was begun in 1922 and was completed in 1926. Magnetic observations have been made in some portion of South America every year since the first two expeditions were sent out to Guiana and Colombia, respectively, in 1908, and this exceptional effort has been rewarded by the presentation of some problems of unique interest. The systematic resurvey was undertaken in connection with that of the adjoining regions to the north in 1922 and was completed in 1926. While this work was still in progress, a preliminary discussion of the results was made on the occasion of the Third Pan-American Scientific

Congress in Lima in 1924. This discussion (see *Terr. Mag.*, vol. 29, pp. 139-148, Dec. 1924) revealed areas of peculiar interest with regard to the fluctuations of the rate of annual change in each of the elements, each of these areas being favorably situated for continued study by future observers. In western South America, more particularly in southern Peru and northern Chile, a region was found where the daily range of inclination was unusually large, amounting in some instances to more than ten minutes, and in at least one case on the day of observations approximating twenty minutes. This has been the subject of a special discussion (see *Terr. Mag.*, vol. 31, pp. 165-176, Dec. 1926).

The systematic resurvey of Africa is now in progress. In 1920 to 1922 reoccupations were made of some of the stations established in the eastern colonies by Dr. J. C. Beattie (now Sir Carruthers Beattie) in cooperation with this Department as well as by J. C. Morrison in 1909, and subsequently by other observers between 1914 and 1927. The systematic covering of the whole continent of Africa with a network of repeat stations was begun in 1925 and at this time (June 1927) has been completed over the western portion from Morocco to Angola. It is expected that the southern colonies will be covered during the coming year, after which the eastern colonies and Madagascar and southwestern parts of Asia will be included.

In 1922, on the occasion of the return of an observer from Canton, China, to Washington, a few stations were reoccupied in eastern China, but aside from these no opportunity has presented itself for making a resurvey of that extensive region. Plans for cooperating with members of teaching staffs of Chinese universities have been held in abeyance until conditions become more favorable.

By means of a satisfactory coordination of the work of other organizations with that of the Carnegie Institution of Washington, particularly through a better control of standards and instrument corrections and a more nearly uniform procedure in making observations and reductions, there should be less uncertainty in utilizing data from a variety of sources and a consequent reduction in the time required to assemble homogeneous data for the discussion of secular variation over the entire Earth.

Ocean work

Since the Madrid meeting, the Department has devoted its efforts to the completion and publication of the final magnetic and electric data obtained over the oceans during the cruises of the *Carnegie*. Volume V of the Department's "Researches", bearing the general title "Ocean magnetic and electric observations, 1915-1921", presents in detail these results and the descriptions of the instruments and methods used. The portion of the volume devoted to magnetic observations contains discussions of these data, particularly annual changes of the elements as determined from the *Galilee* and *Carnegie* results during 1905 to 1921, the magnetic chart-differences for world charts as shown by *Carnegie* results from 1915 to 1921 for the latest editions of the isomagnetic charts issued by the British Admiralty and the United States Hydrographic Office, status of the general magnetic survey of the oceans, and requirements for future ocean work.

The electric data presented in the second part of the volume are discussed in two special reports. The first of these is on the correlation between sunspot and annual variations of atmospheric electricity. The general conclusion from the investigation based on land and ocean results is to indicate with a high degree of probability that during the cycle of 1913-1922 the atmospheric potential-gradient increased with increasing sunspottedness by at least 20 per cent of its mean value for the cycle between the years of minimum and maximum sunspottedness. The same statement applies with regard to measures of the diurnal variation and of the annual variation of the potential gradient. At an undisturbed locality, where the value of the potential gradient approximates to the average ocean value of about 130 volts per meter, the effect of sunspottedness may be found greater than the amount stated. In general, the atmospheric potential-gradient over the oceans is, on the average, greater during the period October to March than during the period April to September, when the Earth is farthest away from the Sun.

The second special report based on these electric data concerns itself with discussions of the diurnal variation, distribution, and annual change of potential gradient over the oceans, variations and distribution of ionic content, conductivity, and air-earth current-density over the oceans, the radioactive content of sea air, penetrating radiation, and some considerations on the atmospheric-electric work of the *Carnegie*. First in importance in these results is the conclusion that the 24-hour wave of the diurnal variation of atmospheric potential-gradient progresses approximately according to universal rather than local time. This conclusion was admirably confirmed by the observations obtained during the three winters of the *Maud* Expedition from 1922 to 1925 on the Arctic Ocean off Siberia and on the Siberian Arctic Coast (the data of the *Maud* Expedition and comparison with results of the *Carnegie* are discussed and illustrated in detail by H. U. Sverdrup in Volume VI of the "Researches").

As a result of the discussion and publication of the data obtained over the oceans by the *Carnegie* through 1921, the need of securing additional information regarding the secular variation of the magnetic elements was emphasized. Accordingly, plans were made for the resumption of the *Carnegie's* cruises. The Trustees of the Carnegie Institution of Washington have arranged that the *Carnegie* be overhauled and repaired in the summer of 1927 preparatory to recommissioning of the vessel and the taking up of a three-years' cruise (No. VII) beginning in May 1928. Plans for this cruise are to follow as closely as possible the tracks of former cruises instead of placing dependence largely upon frequent track-intersections for secular variation data. Thus the fullest possible information as to secular changes will be obtained.

While more information on the distribution and the secular variation in the Earth's magnetism is required for practical purposes, yet future magnetic and electric work at sea is far more necessary for the advancement of theoretical studies. In addition, the program is to include observations in physical and biological oceanography and in marine meteorology.

Observatory work

The Department has continued, since the report made in October 1924 at the Madrid meeting, to operate its two magnetic and electric observatories at Watheroo, Western Australia, and at Huancayo, Peru. At both of these there is now being carried out the full program of observational and investigational work in terrestrial magnetism, atmospheric electricity, earth-currents, meteorology, and radiotelegraphy as regards terrestrial and cosmical correlations. The Department has also continued to cooperate with the New Zealand Government in the maintenance of the Apia Observatory. In the Arctic the Department cooperated extensively with Amundsen's *Maud* Expedition of 1918 to 1925, the results of which have been prepared for publication in Volume VI of the "Researches" of the Department now in press.

The Watheroo Magnetic Observatory in Western Australia, about 12 miles west of Watheroo and 125 miles north of Perth at an elevation of 800 feet, is in latitude 30°19′.1 south and longitude 115°52′.6 east of Greenwich. The approximate values of the magnetic elements during 1924 to 1926 were as follows :

Year	Declination west	Inclination south	Intensity		Observer-in-charge
			Horizontal	Vertical	
	° ′	° ′	γ	γ	
1924	4 18.3	64 05.2	.24750	.50941	G. R. Wait to April, H. F. Johnston from May.
1925	4 17.6	64 07.9	.24719	.50976	H. F. Johnston.
1926	4 17.2	64 10.7	.24681	.51007	H. F. Johnston.

The Huancayo Magnetic Observatory in Peru, about 9 miles west of Huancayo and 120 miles east of Lima at an elevation of 11,000 feet, is in latitude 12°02′.7 south and longitude 75°20′.4 west of Greenwich. The preliminary means of absolute magnetic values determined weekly during 1924 to 1926 were as follows :

Year	Declination east	Inclination north	Intensity		Observer-in-charge
			Horizontal	Vertical	
	° ′	° ′	γ	γ	
1924	8 01.7	0 54.6	.29762	.00473	W. C. Parkinson.
1925	7 59.1	1 01.5	.29750	.00531	W. C. Parkinson to July 17, R. T. Booth from July 18.
1926	7 55.5	1 09 8	.29725	.00604	R. T. Booth to March, R. H. Goddard from April.

The observatory instruments continue to be as indicated in the report to the Madrid meeting. The magnetic elements registered are declination, horizontal intensity, and vertical intensity, and the atmospheric-electric elements registered are positive and negative conductivity and potential gradient.

The special C. I. W. observatory standard type of electrometer and registration apparatus for the atmospheric potential-gradient was completed and installed at both observatories during 1927. These have replaced the recording bifilar string electrometers constructed by Günther and Tegetmeyer. The chief improvements of the new recorder are a modified Dolezalek electrometer capable of registering potentials up to 1,000 volts of either sign (see *Annual Report of Department* for 1925-1926, p. 228) and an arrangement for giving automatically a record indicating the reliability of the essential insulators of the collecting system (see *Annual report of Department* for 1924, p. 182-183, and *Phys. Rev.*, vol. 23, pp. 302-303).

The registration of earth-current potentials has continued at Watheroo without important interruptions since October 1923. An extraneous component of the diurnal variation was detected in one of the three independent registrations of the northward component and the cause located and removed. This was possible with the design of system used there (*Terr. Mag.*, vol. 28, pp. 89-108, 1923, and *Bull. Nat. Research Council* No. 58, pp. 87-88, 1926) and illustrates one of its advantages. The accuracy in the diurnal variation of the northward component as now determined at Watheroo compares favorably with that in the other geophysical elements recorded there. The recorded diurnal-variation in the eastward component must, however, be regarded with less confidence on account of certain inconsistencies which persist between the several independent records of this component. On this account, together with the fact that the diurnal range in this component is apparently only about one-fifth that in the northward component, an extension of line was made so as to record on an additional electrode located about 10 kilometers due east of the point of common reference. The general characteristic of the diurnal variation as indicated by the records during 1925 and 1926, most of which have been reduced, are the same as reported for the year 1924 (see *Annual Report of Department* for 1925, p. 215).

The installation of a system for recording earth-current potentials (see *Annual Report of Department* for 1925-1926, p. 224) was completed at the Huancayo Magnetic Observatory in 1926, and the regular recording which began November 15 of that year has continued without interruption to date. A recording potentiometer similar to that used at Watheroo is installed. Two independent, four-point cross-systems are installed, one, together with the observatory, is located on a gently undulating shelf of land, the other on a fairly flat lower shelf which is separated from the former by a 60-meter escarpment. Aerial connecting lines are used throughout. The diurnal-variation characteristics indicated by the records from November 15, 1926, to February 28, 1927, are briefly as follows : Both components show very small departures during the night ; the northward component has a single maximum at about 9^h to 10^h, a minimum at 14^h to 16^h, and a range of 3.7 mv/km ; the eastward component shows a maximum at about 14^h, a minimum at 9^h to 10^h, and a range of 5.4 mv/km. The departure in both components is zero at midday. Disturbances which closely parallel those in the magnetic elements at this Observatory are both very frequent and intense, and the ratio of the amplitude of the earth-current disturbance to that in the magnetic elements is much larger than is found at Watheroo. In short, the characteristics of the earth-current thus far observed at this station seem anomalous.

At Washington the registrations of atmospheric potential-gradient and of negative conductivity have been continued in the experimental observatory located on the roof of the main laboratory of the Department. The values of these elements as determined from the records were reduced only for class "O" days. Unfortunately real-estate development has been quite active in recent years in the neighborhood of the Department's site and, therefore, the records have been much more disturbed by artificial causes then in previous years.

In order to supplement the earth-current potential measurements, a method of measuring the average resistivity of large masses of earth *in situ* has been developed (*Terr. Mag.*, vol. 30, pp. 161-188, 1925, and *Bull. Nat. Research Council* No. 58, pp. 89-91, 1926). Data thus obtained in the vicinity where earth-current potentials are known, make possible a more reliable estimate of the earth-current density in the region. Measurements and tests made near Washington in 1923, 1924, and 1925 showed the feasibility of the method and indicated that considerable knowledge of the variation of resistivity with depth, at least if not exceeding a few hundred meters, could be obtained from surface measurements thus made. Measurements, constituting an extensive survey in the vicinity of the earth-current measuring system at Watheroo, were then made in 1925 and 1926 (*Terr. Mag.*, vol. 32, pp. 49-63, 1927). The resistivity at the surface (average to a depth of 2.5 meters) varied exceedingly from place to place, the extremes being 2 megohms-cm and 100 ohm-cm for dry sand and wet clay, respectively. According to the interpretation of the measurements, the highly conducting clay underlies a bed of surface sand whose greatest depth in the region of the survey is 10 meters, and the clay extends to a depth of about 60 meters, while beyond this depth material of higher resistivity than that of the clay abounds. The mean of all measurements embracing a body of earth extending to a depth of 600 meters indicates that to this depth the average resistivity is 5,000 ohm-cm.

A less extensive survey was made in the vicinity of the Ebro Observatory, Tortosa, Spain, during November 1926. The electrodes of the earth-current measuring system there are all located practically in the fertile valley of the Ebro River. The resistivity of the loam near the surface is about 2,000 ohm-cm. The average resistivity increases as the depth of the body of earth involved increases and reaches a value of about 12,000 ohm-cm when that depth is 300 meters, the maximum. The surface resistivity on the adjoining hillsides is greater than that of the surface soil in the valley, but, whatever the initial character of variation, as the depth approaches 300 meters the average resistivity of the body earth to that depth approaches 12,000 ohm-cm. A consideration of the resistivity and earth-current potential data for Watheroo and Tortosa leads to the conclusion that, even though the diurnal range in earth-current potentials is of a higher order of magnitude at Tortosa than at Watheroo, the predominant earth-current density is of the same order of magnitude at the two places.

The work of general improvement at the two observatories has been concentrated on improvements which will not only facilitate but will eventually greatly curtail the routine work in the preparation of results for publication. Among these improvements (see *Bull. Nat. Research Council* No. 56, pp. 81-86, Nov. 1926) which have been made or under way are :

(*a*) Better time-control by elimination of parallax of the reflected beam-systems in the registrations and by the marking automatically across each photographic record of a time-line placed accurately at each hour and at the same instant for all automatic records in the observatories. To accomplish this electric clocks and program machines have been installed at each observatory. These clocks are controlled by radio time-signals and are kept within a limit of one or two seconds of zonal mean time. Thus, since records at the two observatories are changed at the hour nearest that of 0^h for the Greenwich mean date, the time-markings for all the records obtained are simultaneous at the two observatories.

(*b*) It has been found that the magnetic method of determining constants for the magnetic instruments subjects those instruments unavoidably to shocks which are quite likely to affect both scale-value and base-line constancy. Therefore, a system of automatic determinations once every four hours for the scale-values of the three variometers has been provided by centering the variometers in Helmoltz-Gaugain coils of suitable dimensions. In addition to furnishing the scale-value determinations for different values of ordinates of the photographic records, this method also afforts, through the automatic feature operating by the central electric clock, an excellent check on any possible parallax of the record and the time-markings which may be associated with or result from other causes.

(*c*) The temperature-coefficients of the intensity variometers at the observatories have been large and, while the diurnal variation in temperature is almost negligible, the seasonal variation may be considerable. Temperature-compensation arrangements, therefore, have been installed on the intensity variometers so that the temperature-coefficients may be made entirely negligible. This, in connection with the time-marks will greatly facilitate the mean scalings of the magnetograms and their reduction to absolute values.

The meteorological observations as for a first-class meteorological station are regularly made at each observatory for particular use in investigations of possible correlation between phenomena of terrestrial magnetism, terrestrial electricity, and meteorology. Some progress has been made in the study of such correlations. Particular attention has been given during the past year to the development of a program for dust-count observations regularly at the observatories, as results of preliminary investigations indicate what appears to be a pertinent correlation between the dust-count of the atmosphere and its electrical phenomena (see *Terr. Mag.*, vol. 32, 31-35, March 1927).

At the Apia Observatory, cooperation was continued by the Institution in the observations of atmospheric electricity and allied meteorological phenomena, the electrical observations being confined to those for potential gradient. The observations at the land station habe been maintained fairly continuously despite the severe humidity conditions prevailing at Apia which produce such serious difficulties in maintaining the insulation necessary for successful recording. Unfortunately it has not been possible to maintain satisfactorily continuous registration at the lagoon-house station, especially in the stormy weather of the wet season when the spray penetrates the house and the high waves set up in the lagoon make it difficult for observers to reach the house for necessary repairs and examination of the apparatus. The records during the dry season, however, from May to October, show that the potential gradient went through practically the same daily fluctuations as at the station on the Observatory grounds. Thus the results at the lagoon house apparently do not confirm the *Carnegie* observations in the open ocean of a single daily maximum notwithstanding the maritime exposure of the lagoon station (see *Terr. Mag.*, vol. 31, pp. 113-120, Sept. 1926). Continuous tidal records have been obtained from the lagoon station, and harmonic analysis of these data for the year June 1, 1924, to May 31, 1925, was completed by the United States Coast and Geodetic Survey. Some attention has been given during the past two years to the records of the high-power wireless station at Apia to obtain the annual and diurnal variation of the intensity and character of static disturbance ; apparently the intensity of static is practically constant throughout the day, but the disturbance is more nearly continuous during the night from 18^h to 4^h than during the day.

Since the report made to the Madrid meeting, the Department has reduced and compiled the magnetic, atmospheric-electric, and auroral observations obtained in cooperation with the *Maud* Expedition during 1918 to 1925 (except for the absolute observations 1918 to 1921, which had been previously received and reported on pp. 35-56, *Terr. Mag.*, vol. 27, 1922). These results were obtained chiefly at temporary observatories erected at winter-quarters and on the ice during the drift of the *Maud* in the winters of 1918 to 1925. Despite unusually difficult conditions, the data obtained, their discussion, and the resulting conclusions form valuable contributions to Arctic scientific investigations in the fields of terrestrial magnetism and electricity, meteorology, and geophysics.

Other polar work, the results of which have come into the hands of the Department since the report to Madrid, is the series of magnetic and atmospheric-electric records obtained in cooperation with the MacMillan North Greenland Expedition, October 1923 to June 1924, at the Refuge Harbor station in latitude 78°32′.5 north and longitude 72°22′.8 west. The absolute magnetic results at this station are being published in Volume VI of the "Researches" of the Department. The reductions of the magnetic and electric records are now under way, and the results promise to be of great interest particularly when taken in conjunction with observations made by the *Maud* Expedition. It may be mentioned that the records apparently show a direct correlation between the normal high values of potential gradient and fresh wind laden with fine snow blowing past the collector.

Reduction of observatory records

The reduction of observatory records has now been systematized and considerable attention has been given to plans by which the publication of such records may hereafter be made promptly and at the minimum cost. The magnetic results for the Watheroo Observatory during the eight years 1919 to 1926 are completed. It is proposed to reproduce the typed tabulations directly, thus eliminating not only the grat expense of printer's composition but also the great amount of time required in proof-reading and the danger even then of not having the final printed copy correct. Specimen pages for the month of June 1924 of such tabulations are attached to this report and will serve to indicate the character of the proposed form. While it is realized that reproduction of typed matter is sometimes not always satisfactory, it is thought that the advantages in economical publication and the saving of time will much more than offset any minor disadvantages in such reproductions. It is also felt that the size of the proposed for the publication eliminates almost entirely the most serious objection raised to this form of reproduction, namely, too great reduction. The data published for the Department observatories will be based on magnetogram data (1) for all days, (2) for 10 least-disturbed days, and (3) for five selected international

JUNE 1924

HORIZONTAL INTENSITY

24000 PLUS TABULAR QUANTITIES, EXPRESSED IN GAMMAS

(THE TABULAR VALUES ARE AVERAGE VALUES FOR SUCCESSIVE PERIODS OF ONE HOUR AS INDICATED 120TH MERIDIAN MEAN TIME)

JUNE 1924

DAY	✻	†	‡	0–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24	MEAN	CHARACTER	MAXIMUM H M	MAXIMUM	MINIMUM H M	MINIMUM	RANGE
1	✓			749	751	753	754	754	756	758	761	768	770	766	756	748	744	745	748	753	756	756	756	753	750	749	752	754	0	9 15	771	13 04	744	27
2				753	753	754	753	754	753	752	758	761	763	761	755	749	746	748	746	751	757	756	755	752	748	749	749	753	0	9 58	764	13 18	743	21
3	✓	✓		749	751	753	755	756	756	757	761	767	767	763	759	752	750	746	742	748	756	757	755	752	752	751	750	754	0	9 07	768	15 32	742	26
4				751	751	751	752	754	755	756	761	767	769	763	757	752	752	753	753	757	761	762	757	749	741	737	740	754	0	9 01	770	22 37	735	35
5	✓			744	746	749	751	752	752	754	759	762	764	757	746	737	732	731	739	750	758	758	758	758	755	752	753	751	0	9 00	764	14 04	730	34
6	✓	✓		751	750	752	753	754	754	755	760	765	767	765	754	744	738	737	741	749	758	760	759	759	757	756	756	754	0	9 23	767	14 44	736	31
7	✓	✓		756	756	756	759	760	762	764	768	768	765	761	756	755	752	746	747	752	758	759	759	758	758	757	758	758	0	8 05	769	14 39	745	24
8	✓	✓		758	760	760	761	762	764	764	767	769	768	764	758	754	751	748	751	759	764	764	764	762	761	759	758	760	0	9 04	770	14 24	747	23
9				759	761	761	762	763	764	763	764	765	766	769	761	751	743	740	748	756	762	764	763	761	759	763	761	760	1	10 32	770	14 14	739	31
10			✓	759	758	759	761	769	769	775	780	773	776	773	765	764	755	745	720	712	730	706	689	659	657	634	635	734	2	7 03	781	22 24	616	165
11			✓	636	644	650	666	697	699	698	687	692	678	678	673	672	671	667	669	678	682	685	690	694	708	706	707	680	2	24 00	716	0 27	629	87
12				712	716	718	728	739	754	774	734	736	742	739	734	725	718	711	714	727	731	729	730	729	728	728	728	730	1	6 44	788	0 42	707	81
13				728	731	732	733	734	735	731	738	741	732	741	739	737	734	730	723	727	732	735	734	733	732	731	729	733	1	8 40	745	15 40	722	23
14	✓	✓		731	734	734	733	734	736	737	742	745	744	742	734	730	725	720	723	729	736	739	739	737	733	732	732	734	0	8 57	745	14 00	719	26
15				733	734	735	737	738	739	741	746	751	754	751	744	737	731	732	735	743	746	747	744	741	743	744	743	741	1	9 59	754	13 35	729	25
16				741	748	747	748	748	749	750	750	755	759	754	748	736	727	730	731	737	747	747	736	723	735	741	742	743	1	9 43	760	20 17	710	50
17				741	742	743	746	748	751	752	755	758	761	758	752	750	748	750	746	750	751	749	748	745	741	742	742	749	1	9 34	762	23 55	739	23
18			✓	740	741	742	742	745	747	750	750	754	760	753	751	748	744	736	743	739	735	724	726	726	735	739	738	742	2	9 20	761	19 02	716	45
19			✓	737	739	740	741	736	749	745	751	761	765	767	758	748	739	734	736	741	739	732	735	730	727	721	715	741	2	10 31	772	23 17	713	59
20			✓	717	727	755	749	758	763	743	719	726	728	708	682	699	718	721	719	722	725	720	726	727	727	726	730	726	1	4 53	778	11 31	676	102
21				727	727	729	730	732	732	733	734	737	742	742	737	730	721	713	717	728	737	738	740	740	734	729	728	732	1	9 54	744	14 40	712	32
22				726	724	732	732	735	740	730	749	753	752	745	730	724	727	728	724	730	731	727	728	729	732	741	736	734	1	7 55	758	1 25	721	37
23				734	732	734	737	742	740	740	743	747	737	745	741	734	724	718	722	738	740	731	735	741	740	737	741	736	1	8 35	749	15 04	709	40
24				737	737	739	739	742	743	745	747	746	747	752	748	739	735	731	727	734	738	740	738	741	742	741	740	740	1	10 47	753	15 09	725	28
25	✓			738	738	739	738	738	739	740	742	747	752	750	747	744	736	733	738	744	747	747	747	746	746	746	744	743	0	9 35	753	14 16	731	22
26				745	745	747	748	746	747	749	749	744	759	759	753	749	750	751	751	751	755	756	757	754	755	753	753	751	1	10 03	761	0 00	744	17
27	✓			751	751	752	752	752	751	751	755	762	762	759	754	745	739	738	739	744	748	751	750	749	744	740	743	749	0	8 27	762	14 43	736	26
28	✓			742	742	741	743	744	744	747	748	753	754	747	741	734	731	733	733	737	744	742	737	739	739	742	740	742	0	9 17	756	13 26	731	25
29				741	742	743	746	748	748	747	751	758	762	760	756	750	746	739	739	741	744	737	736	744	744	742	741	746	1	9 37	763	19 00	730	33
30				738	737	738	741	744	747	752	756	761	758	750	750	744	739	738	742	748	747	730	726	732	731	729	733	742	1	9 02	761	18 55	723	38
31																																		
MEANS ALL DAYS				738	739	741	743	746	748	748	750	753	754	751	745	739	736	733	734	739	744	742	741	739	738	737	737	742						41
MEANS TEN DAYS ✻				747	748	749	750	751	751	753	756	761	761	757	750	744	740	738	740	746	752	753	752	751	750	748	749	750						26
MEANS FIVE DAYS † (G. M. T.)				751	752	753	754	755	757	758	760 761	763 764	762	759	752	747	743	739	741	747	754	756	755	754	752	751	751	753						
MEANS FIVE DAYS ‡ (G. M. T.)				706	711	718	723	732	729	739	725	741	741	736	726	726	725	721	717	718	722	713	713	707	711	705	705	721						

DESIGNATIONS AND REMARKS

✻ = TEN LEAST DISTURBED DAYS
† = FIVE INTERNATIONAL QUIET DAYS
‡ = FIVE INTERNATIONAL DISTURBED DAYS
[] = APPROXIMATE, MAGNETIC STORM
( ) = INTERPOLATED
[ ] = ESTIMATED
▽ = LAMP OUT
△ = RECORD OFF SHEET
□ = CLOCK STOPPED
⧖ = NO RECORD

VERTICAL INTENSITY

50000 PLUS TABULAR QUANTITIES, EXPRESSED IN GAMMAS

(THE TABULAR VALUES ARE AVERAGE VALUES FOR SUCCESSIVE PERIODS OF ONE HOUR AS INDICATED 120TH MERIDIAN MEAN TIME)

JUNE 1924

DAY	✲	†	‡	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	MEAN	CHAR-ACTER	MAXIMUM h m	MAXIMUM	MINIMUM h m	MINIMUM	RANGE
1	✓			941	938	939	939	941	941	942	940	942	944	942	937	934	932	931	934	938	941	943	944	944	944	942	939	940	0	21 07	947	14 13	930	17
2				936	936	936	936	937	939	939	936	939	942	942	939	934	929	926	928	938	941	940	940	941	942	939	937	937	0	9 37	943	14 13	925	18
3	✓	✓		936	934	934	934	935	937	937	936	942	946	942	933	928	925	924	929	936	939	939	941	942	942	942	940	936	0	9 16	946	14 09	922	24
4				938	935	935	934	934	935	935	934	939	940	937	933	930	929	927	930	934	938	938	940	944	946	948	943	936	0	22 23	951	14 54	927	24
5	✓			938	936	936	935	935	936	936	935	939	944	944	937	932	926	920	926	935	939	939	941	942	943	942	941	937	0	9 46	946	14 23	919	27
6	✓	✓		939	937	935	935	935	936	935	936	943	948	946	940	938	933	927	926	932	938	938	939	941	941	941	940	937	0	10 08	949	15 10	924	25
7	✓	✓		938	937	935	934	934	934	934	934	938	944	944	938	933	926	924	929	935	936	937	937	939	939	938	938	936	0	9 48	945	14 18	924	21
8	✓	✓		936	935	933	933	933	934	934	933	937	939	939	935	935	933	928	928	933	936	937	937	938	938	938	938	935	0	9 37	940	14 43	926	14
9				938	936	936	935	934	934	934	933	936	939	937	925	925	928	928	929	933	936	936	936	938	938	938	936	934	1	22 36	941	11 44	922	19
10			✓	934	934	933	928	931	932	931	928	931	932	938	932	920	918	917	928	948	951	962	966	973	985	993	996	943	2	22 37	⊢	14 27	912	102
11			✓	992	977	955	948	943	927	920	928	927	935	939	942	946	948	945	949	952	959	957	957	959	955	957	951	949	2	0 28	⊨	6 30	915	90
12				943	945	946	939	936	932	926	938	942	943	942	941	940	939	939	940	943	944	944	944	944	944	942	941	941	1	0 43	952	6 53	913	39
13				941	959	940	941	941	942	939	937	943	946	950	947	939	929	928	931	941	946	946	946	946	944	943	942	942	0	10 38	951	14 55	926	25
14	✓	✓		940	940	941	941	941	942	940	938	939	944	941	934	929	928	930	936	954	961	956	954	953	951	949	946	943	0	17 41	962	13 37	926	36
15				944	944	944	945	947	947	947	946	950	952	947	934	928	933	938	942	947	950	950	952	952	950	947	946	945	1	21 23	954	12 22	926	28
16				945	940	940	942	944	947	947	946	947	945	939	933	930	933	939	944	949	950	950	955	976	947	941	937	944	1	20 41	996	12 44	930	66
17				937	936	934	935	937	940	941	938	938	940	938	930	923	924	926	932	937	940	945	947	950	950	949	946	938	1	20 50	951	12 24	921	30
18			✓	943	941	938	938	938	939	939	937	940	946	942	931	924	919	924	924	935	938	947	946	945	947	936	932	937	2	21 37	949	13 13	915	34
19			✓	932	923	927	930	919	922	928	919	926	935	934	931	928	927	924	924	929	936	938	940	942	948	940	942	931	2	22 11	952	1 55	893	59
20			✓	939	939	915	925	907	916	918	911	914	936	943	936	940	936	933	933	935	938	946	943	940	942	942	937	932	1	18 35	955	4 51	897	58
21				938	935	934	933	934	934	935	935	938	941	942	941	936	935	932	931	935	938	938	938	939	941	944	943	937	1	22 49	948	15 36	930	18
22				942	938	928	930	929	927	923	929	936	939	941	938	939	938	935	937	940	938	940	942	940	939	939	936	936	1	22 12	945	6 08	916	29
23				938	936	935	932	931	932	932	932	933	939	939	941	935	935	935	938	936	938	939	943	937	938	939	938	936	1	19 13	951	7 19	926	25
24				939	935	935	933	927	935	932	932	935	933	932	932	932	928	924	924	929	934	935	936	934	935	933	934	932	1	0 26	939	4 16	919	20
25	✓			935	935	934	935	935	934	934	929	929	932	935	935	932	929	926	929	933	935	935	935	935	934	934	934	933	0	10 44	937	14 57	925	12
26				934	934	933	933	934	934	935	930	930	934	934	932	924	920	923	930	934	934	934	934	934	934	933	932	932	0	11 07	936	13 43	918	18
27	✓			933	933	934	933	934	934	933	926	923	930	933	927	922	921	922	925	929	933	935	935	935	936	937	935	931	0	21 18	939	13 29	919	20
28	✓			933	933	933	933	934	933	933	933	934	933	930	926	920	917	921	925	931	936	937	938	939	937	935	934	932	0	19 47	940	13 34	917	23
29				933	931	932	931	933	935	935	932	934	938	938	930	924	920	919	921	930	936	937	940	938	937	936	935	932	0	19 11	942	14 23	918	24
30				935	934	933	931	933	932	931	930	932	936	937	936	930	923	921	924	930	936	939	941	943	943	939	935	934	1	20 32	946	14 30	921	25
31																																		
MEANS ALL DAYS				940	938	936	935	934	935	934	933	936	940	940	935	931	929	928	931	937	940	942	943	944	944	943	941	937						32
MEANS TEN DAYS ✲				937	936	935	935	936	936	936	934	937	940	940	934	930	927	925	929	936	939	940	940	941	940	940	938	936						22
MEANS FIVE DAYS † (G. M. T.)				939	937	937	936	936	937	937	935 936	940 940	944	942	936	933	929	927	930	938	942	941	942	943	942	942	940	938						
MEANS FIVE DAYS ‡ (G. M. T.)				950	944	937	935	928	926	925	926	928	937	939	934	932	930	929	932	940	944	950	950	952	955	955	952	939						

DESIGNATIONS AND REMARKS

✲ = TEN LEAST DISTURBED DAYS
† = FIVE INTERNATIONAL QUIET DAYS
‡ = FIVE INTERNATIONAL DISTURBED DAYS
[ ] = APPROXIMATE, MAGNETIC STORM
( ) = INTERPOLATED
⌈ ⌉ = ESTIMATED
▽ = LAMP OUT
⊢ = 1014
△ = RECORD OFF SHEET
□ = CLOCK STOPPED
⊼ = NO RECORD
⊨ = 1005

JUNE 1924

DECLINATION

4° WEST PLUS TABULAR QUANTITIES, EXPRESSED IN TENTHS OF MINUTES

(THE TABULAR VALUES ARE AVERAGE VALUES FOR SUCCESSIVE PERIODS OF ONE HOUR AS INDICATED 120TH MERIDIAN MEAN TIME)

JUNE 1924

DAY	*	†	‡	0–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24	MEAN	CHAR-ACTER	MAXIMUM H M	MAXIMUM	MINIMUM H M	MINIMUM	RANGE
1	✓			180	178	178	177	177	177	178	177	179	186	189	190	185	177	175	171	171	177	178	179	181	183	182	180	179	0	11 02	193	15 55	168	25
2				179	178	178	178	177	177	178	174	177	186	189	189	187	176	168	170	173	179	181	182	183	183	182	181	179	0	10 54	190	15 04	16[illegible]	24
3	✓	✓		179	178	177	177	177	178	177	175	182	198	202	197	185	175	174	172	171	177	180	180	181	182	184	184	181	0	10 06	204	16 08	167	37
4				182	180	179	178	179	180	179	176	179	187	188	185	176	171	169	170	174	178	179	179	181	184	188	186	179	0	22 24	193	14 34	168	25
5	✓			183	181	181	179	180	180	179	175	179	190	195	189	179	166	154	153	165	176	177	182	182	184	183	182	178	0	10 53	196	15 07	151	45
6	✓	✓		181	179	176	177	178	178	176	178	187	201	206	202	195	179	168	159	166	177	180	181	184	184	183	182	182	0	10 10	207	15 42	157	50
7	✓	✓		179	178	178	176	177	177	176	175	181	190	195	191	183	174	167	166	169	178	181	182	183	182	181	179	179	0	10 29	197	15 06	164	33
8	✓	✓		177	176	176	176	176	177	178	178	184	188	186	185	181	180	174	168	171	180	184	183	182	181	180	179	179	0	9 47	192	15 28	167	25
9				177	177	176	175	177	177	178	176	177	187	186	180	173	167	164	164	166	175	179	181	183	183	187	183	177	1	22 35	196	15 00	162	34
10			✓	177	175	171	163	169	174	174	173	174	178	196	188	168	158	136	129	154	182	197	198	198	226	231	248	181	2	22 38	259	15 45	108	151
11			✓	258	248	240	221	240	211	185	181	172	173	170	170	175	171	161	160	159	170	174	181	188	196	202	194	192	1	0 29	278	16 17	153	125
12				196	188	190	183	178	177	176	177	184	192	195	194	188	184	176	176	177	179	182	185	187	188	187	186	184	1	0 43	199	6 52	15[illegible]	49
13				183	176	177	177	176	177	172	169	180	178	196	199	193	186	179	164	167	176	182	184	186	187	187	186	181	1	11 44	206	15 37	15[illegible]	47
14	✓			184	182	180	178	177	177	177	176	185	196	201	197	183	170	159	158	167	178	180	184	186	187	188	186	181	0	10 44	203	15 01	15[illegible]	47
15				183	180	178	178	178	178	178	177	184	190	191	186	182	180	176	171	174	179	183	182	186	187	187	186	181	1	21 22	196	15 26	[illegible]	28
16				187	178	178	177	177	178	177	175	179	191	187	178	175	172	172	171	175	179	184	181	220	186	187	186	181	1	20 42	257	13 48	166	9[illegible]
17				183	180	174	175	175	175	176	175	176	184	182	176	173	175	171	165	167	168	174	178	184	185	186	187	177	1	23 55	190	15 58	16[illegible]	24
18			✓	186	185	183	182	181	180	179	175	176	185	191	187	179	176	170	160	175	177	186	185	188	202	139	186	182	2	21 38	211	15 12	14[illegible]	66
19			✓	188	178	180	196	167	168	175	157	167	185	194	198	194	188	179	175	180	186	187	189	189	207	210	199	185	2	22 12	219	1 54	11[illegible]	103
20			✓	198	202	178	197	164	185	172	138	123	170	181	164	180	178	175	172	177	183	195	192	188	190	193	188	178	1	1 46	236	8 01	99	137
21				188	182	180	181	183	182	180	178	176	185	194	195	193	187	177	163	173	183	186	187	188	189	194	196	184	1	23 10	205	15 45	167	38
22				194	189	176	179	176	169	148	168	177	183	188	175	168	176	174	175	181	183	188	193	190	191	196	188	180	1	22 13	205	6 18	137	68
23				187	182	179	177	176	178	179	177	180	183	181	187	178	169	169	173	174	179	183	193	187	187	187	188	181	1	19 12	202	14 44	157	45
24				186	179	177	172	158	177	176	178	181	184	189	192	187	180	175	172	172	180	186	188	187	188	185	185	181	1	19 58	197	4 16	145	52
25	✓			183	177	178	178	178	179	179	175	176	181	187	188	182	178	169	168	172	179	182	184	185	185	183	182	180	0	11 22	189	15 12	166	23
26				180	178	177	177	177	179	183	178	177	183	189	193	188	179	175	170	173	178	180	181	183	183	184	183	180	0	11 11	197	15 41	168	29
27	✓			183	182	181	181	182	185	185	177	175	186	189	191	185	175	167	162	164	171	178	179	184	187	190	189	180	0	11 27	193	16 00	159	34
28	✓			188	186	182	179	182	180	181	185	189	203	204	196	187	181	176	169	169	176	178	181	186	187	188	186	184	0	9 57	207	15 50	168	39
29				183	180	178	177	176	178	177	173	177	188	198	198	191	179	170	164	165	173	171	178	183	187	187	188	180	0	11 13	200	15 52	161	39
30				189	187	185	178	179	177	177	175	178	189	198	201	191	178	172	167	170	176	178	179	192	196	190	188	183	1	11 29	206	15 05	166	40
31																																		
MEANS ALL DAYS				187	183	181	180	178	179	177	174	177	187	191	189	183	176	170	166	170	178	182	184	187	189	189	188	181						52
MEANS TEN DAYS *				182	180	179	178	178	179	179	177	182	192	195	193	184	176	168	165	168	177	180	182	183	184	184	183	180						36
MEANS FIVE DAYS † (G. M. T.)				180	178	177	177	177	178	178	176 176	184 181	195	198	194	185	176	168	165	169	178	181	182	183	183	183	182	180						
MEANS FIVE DAYS ‡ (G. M. T.)				206	200	194	196	186	185	178	166	162	178	186	181	179	174	164	159	169	180	188	189	190	204	205	203	184						

DESIGNATIONS AND REMARKS

* = TEN LEAST DISTURBED DAYS
† = FIVE INTERNATIONAL QUIET DAYS
‡ = FIVE INTERNATIONAL DISTURBED DAYS
[ ] = APPROXIMATE MAGNETIC STORM
( ) = INTERPOLATED
⌈ ⌉ = ESTIMATED
▽ = LAMP OUT
△ = RECORD OFF SHEET
□ = CLOCK STOPPED
⧖ = NO RECORD

days. For harmonic analyses of the thus far made, it has not seemed worth while to apply any correction for non-cyclic change for reasons set forth elsewhere in comments on the Agenda for the Prague Assembly.

Magnetic standards and comparisons

In view of the curtailment in field work necessitated by the more intensive experimental and laboratory investigations of the Department during 1924 to 1927, the comparisons of magnetic standards have not been so numerous as in previous years. Intercomparisons have, however, been effected as follows : Huancayo, Peru, October 29 to November 6, 1924 ; San Miguel, Azores, May 31 to June 10, 1925 ; Vassouras, Brazil, November 9 to 16, 1925 ; Pilar, Argentina, January 15 to 21, 1926, and La Quiaca, Argentina, January 26 to 28, 1926. The Department has, in addition, determined the constants and has standardized magnetometer-inductors of the C. I. W. design manufactured by the Precise Instrument Company of Brooklyn, New York, for the following governmental bureaus : Naval Institute and Observatory of San Fernando, Spain ; National Observatory of Mexico ; Meteorological Office of Argentina (two instruments), and Hydrographic Office of Sweden. Some of these instruments are to be used in observatory and field work in the countries named. It is thought that these intercomparisons of standards will have been an effective means towards accomplishing the desired purpose of international coordination of magnetic-survey and observatory work.

The Department has continued at Washington its careful comparison of field instruments both before and after land-survey work, and in so doing has maintained the long series of data for continuity of discussion of the constancy and behavior of its standard instruments. The discussion of these data, not only for the standard instruments of the Department but also for the various magnetometers used including those of its design above referred to, confirm the deductions drawn in earlier reports to the Rome and Madrid meetings and in the detailed reports on comparisons of instruments published in volumes II and IV of the "Researches" of the Department as regards maintenance and precision of standards. These investigations have, above all things, indicated the necessity of exercising every control on the moment of inertia of the suspended magnet for magnetometers of any design. With the application of such control, it has been found that for types of instruments used by the Department the factors involving distribution coefficients may be considered as constant within all necessary precision for long periods. Thus for magnetometer No. 3, the standard of the Department for intensity by the magnetic method, the value of the distribution coefficient P' resulting from all observations made with that instrument since 1907 gives a mean value of 13.38, the extreme range over the twenty years of operation being 0.5 corresponding to a total difference in the value of horizontal intensity as computed on the basis of the mean value of P' of $0.0004H$. The results have also confirmed in every way the earlier conclusions drawn as regards the universally satisfactory character of the earth inductor as an instrument with negligible correction for all values of inclination.

Memoranda of work done on resolutions adopted at the Madrid Assembly

Since the Madrid meeting, the Department has, so far as possible in the execution of its program of work, borne in mind the various resolutions adopted by the International Section at the Madrid meeting October 7, 1924. The relations established or the work done may be briefly summarized as follows, the numbers referred to being of the resolutions as published in Bulletin 5 of the International Section, pages 27 to 29 :

1. Relations have been maintained with all countries interested in our fields of work to the end that collaboration and cooperation of active investigators in all countries might be obtained.

2a. The Department has continued to extend its facilities for comparisons of magnetic instruments both in Washington and in the field as opportunity permitted.

2d. The efforts of the Department have been directed during the last year to the development of a rotating inductor suitable for the determination of intensity on board ship and at land stations. The early resumption of the *Carnegie's* work has made it necessary to concentrate on such application with the viewpoint of determining intensity of sufficient precision to answer the requirements of sea work, but the experimental work being done has as its ultimate object the perfection of a rotating-coil equipment which may be used with high precision at observatories for the accurate recording of sudden commencements of magnetic storms and of magnetic pulsations.

4. The Department has extended to the Central Bureau of the International Section the facilities of its laboratory and personnel to some extent in the preparation of manuscripts for the publication of Bulletins, 4, 5, and 6 issued since the Madrid meeting.

5*b*. Because of the lack of a regularly functioning atmospheric-electric observatory within the limits of the United States, the Department has maintained its atmospheric-electric station on the roof of its laboratory at Washington not only as an experimental station for the development of apparatus but also as a fully recording station in the regristration of atmospheric potential-gradient and negative conductivity. Preliminary steps have been taken which it is hoped will result in the cooperation of a number of organizations within the United States including, among others, the United States Coast and Geodetic Survey, the University of Arizona, and the Carnegie Institution of Washington in the installation of first-class equipment for registrations in terrestrial electricity at the Magnetic Observatory near Tucson, Arizona. It is hoped that this plan may be realized in the near future with the construction of a special electric observatory in which to install continuously recording apparatus for the determination of potential gradient and negative and positive conductivity of the atmosphere and eventually of earth-currents following methods now used by the Department at its Watheroo and Huancayo observatories.

6. The curve measurements pertaining to terrestrial magnetism and electricity at the observatories of the Department have been made according to zonal mean time, thus making it possible to refer readily any element or compilation of data to Greenwich mean days if it is desirable in the study of universal features of any of the phenomena. In order that the reproduction of records might be more readily made and compared with those of other organizations, the procedure at the two main observatories of the Department has been so altered that individual traces begin at 0^h Greenwich mean time.

7. As stated above, the Departement has been conducting experimental work for some time with the object of applying a rotating coil to the accurate determination of magnetic vertical intensity in absolute measure by electric methods.

12. The Department has extended its cooperation to the San Fernando Observatory in the determination of the constants and corrections on the Department's provisional International Magnetic Standards of the new magnetometer-inductor purchased by that Observatory.

13. Cooperation has been continued with the Apia Observatory through a yearly grant in order to insure the continuance of the atmospheric-electric program there, and assistance has been extended in numerous other directions to maintain the work of the Observatory in its full activity.

14. Partly as the result of this resolution, the Department has procured authorization from the Institution by which an additional three-years' cruise of the *Carnegie* may be undertaken beginning early in 1928 to determine the terrestrial magnetic and

electric elements over all oceans. It is planned that, in addition to the program in magnetism and electricity, extensive data may also be obtained in marine meteorology and in physical and biological oceanography, the latter more particularly as pertaining to geophysics.

15. Every advantage has been taken of opportunities offered fo cooperation with polar expeditions. Thus the Department since 1924 has cooperated in observations by the *Maud* Expedition. It has cooperated also with the United States Coast and Geodetic Survey in Dr. Mac Millan's Arctic Expedition of 1924-1925 and in G. R. Putnam's Baffin Island Expedition of 1927.

16. While it has not been possible to carry out upper-air observations in terrestrial magnetism and electricity, the Department has continued work in these subjects at the Huancayo Observatory at an altitude of 11,000 feet and, in addition, one of the members of its staff has begun a series of investigations showing the relation between observed potential-gradient on high isolated points near the Huancayo Observatory as compared with the results obtained at that Observatory. Some progress has also been made at the Huancayo Observatory in the photographing of lightning flashes, a matter of interest particularly because of the great altitude of that Observatory above sea-level.

17. As elsewhere reported, the equipment in terrestrial electricity, that is to say, atmospheric electricity and earth-currents, was completed at the Huancayo Observatory ; thus both the Watheroo and Huancayo observatories of the Department have now complete installations functioning for both terrestrial magnetism and terrestrial electricity. As above stated, tentative plans have been drawn by which it is hoped a corresponding condition will be brought about at the Tucson Magnetic Observatory of the United States Coast and Geodetic Survey. It is thought that investigations in the field of earth-currents has been materially advanced by the work on earth-resistivity done by the Department since the Madrid meeting at Watheroo and at Ebro.

18. Frequent control-observations for determinations of the reduction-factors for atmospheric potential-gradient registrations have been maintained at the three observatories of the Department.

19. Beginning November 1924 in cooperation with the Geophysical Laboratory, the Department has continued an investigation on the effect of pressure on the critical temperature of magnetization which may be considered as a laboratory contribution in the research on magnetic properties and conditions of materials in the crust of the Earth. Samples of nickel, steel, magnetite, hematite, and meteoric iron have been tested.

20. Cooperation has been extended in the magnetic survey

of the Baltic Sea through the loan of a sea dip-circle modified and improved by the Department.

21. In view of the expressed sense of importance of observations of atmospheric potential-gradient on Jungfraujock, it is hoped that the special work done at and near the Huancayo Observatory, Peru, may prove of interest.

Publications

The publications of the Department since the report made at the Madrid meeting include : (*a*) Annual or progress reports for the years ending with June 39 of 1924, 1925, and 1926 appearing in Yearbooks Nos. 23 to 25 of the Carnegie Institution of Washington ; (*b*) some 200 articles on investigations and on special matters contributed to scientific journals by members of the staff ; and (*c*) Volume V of "Researches" containing the ocean magnetic and electric observations obtained by the Department of Terrestrial Magnetism during 1915 to 1921 and special reports. The Department, through its Library, maintains also a bibliography of recent publications on terrestrial and cosmical magnetism, terrestrial and cosmical electricity, and miscellaneous subjects relating to these. Compilations of the latest annual values of the magnetic elements as determined at the world's observatories are prepared and published each year.

The statements regarding annual progress were reprinted from the Yearbooks of the Institution and distributed each year to interested organizations and investigators, thus keeping them fully informed of the Department's operations. There port covering the year July 1, 1926, to June 30, 1927, is now in preparation and will appear in the Institution's Yearbook No. 26. These reports summarize the general activities of the Department's investigational and experimental work, field work and reductions, and miscellaneous activities, including concise abstracts not only of publications during the year but also of investigations by members of the staff. Thus information regarding the progress and development of the Department's program in laboratory, investigational, and field work is communicated promptly to all interested, making it possible for any one to make inquiry for immediate details if desired.

The communications by members of the staff presented from time to time in scientific journals have kept current the results of (1) theoretical discussions preliminary to experimental and field work, (2) laboratory investigations, (3) compilations and reductions of field data, and (4) information regarding characteristics of magnetic and electric storms at the Huancayo and Watheroo observatories. The following list of a few of such communications presented since the Madrid meeting will serve to indicate the scope of these reports :

AULT, J. P. — Oceanographic investigations on the next cruise of the *Carnegie*. *Bull. Nat. Research Council*, No. 61, 198-204 (July 1927).

BARNETT, S. J., and L. J. H. BARNETT. — New researches on the magnetization of ferro-magnetic substances by rotation and the nature of the elementary magnet. *Amer. Acad. Arts and Sci.*, vol. 60, 127-216 (1925).

BAUER, Louis A. — Correlations between solar activity and atmospheric electricity. *Terr. Mag.*, vol. 29, 23-32 and 161-186 (March and Dec. 1924).

BAUER. — Regarding atmospheric electricity and its relation with solar activity. *Terr. Mag.*, vol. 30, 17-23 (March 1925).

BAUER. — Theoretical changes of the magnetic elements with altitude. *Bull. National Research Council*, vol. 10, 64-65 (July 1925).

BAUER. — Cosmic aspects of atmospheric electricity. *Science*, vol. 65, 314-316 (Apr. 1, 1927).

BAUER. — Need of magnetic and electric data in Polar Regions. *Petermanns Mitt., Ergänzungsheft*, No. 191, 47-51 (1927).

BAUER. — Sunspots and magnetic and electric disturbances. *Bull. National Research Council.*, No. 61, 129-132 (July 1927).

BAUER, and C. R. DUVALL. — Studies concerning the relation between the activity of the Sun and the Earth's magnetism. *Terr. Mag.*, vol. 30, 191-213 (Dec. 1925) ; vol. 31, 37-47 and 97-101 (March and Sept. 1926).

BAUER, and W. J. PETERS. — Regarding abrutply beginning magnetic disturbances. *Terr. Mag.*, vol. 30, 45-68 (June 1925).

BREIT, G. — The dependence of radio fading on modulation. *Phys. Rev.*, vol. 25, 589 (Apr. 1925).

BREIT. — On the supposed conducting layer in the atmosphere and the effect of the Earth's magnetic field in radiotelegraphy. *Bull. National Research Council*, vol. 10, 62-64 (July 1925).

BREIT. — Glaser's experiments and the orientation of molecules in a magnetic field. *J. Wash. Acad. Sci.*, vol. 15, 429-434 (Nov. 1, 1925).

BREIT. — Depolarizing influence of alternating magnetic fields on resonance radiation. *J. Optical Soc. Amer.*, vol. 11, 465-471 (Nov. 1925).

BREIT. — Polarization of radiation scattered by an electronic system in a magnetic field. *J. Optical Soc. Amer.*, vol. 12, 195-205 (March 1926).

BREIT. — A suggestion of a connection between radio fading and small fluctuations in the Earth's magnetic field. *Bull. National Research Council*, No. 61, 150-158 (July 1927).

BREIT, and A. ELLETT. — The depolarizing influence of a rapidly changing magnetic field on the resonance radiation. *Phys. Rev.*, vol. 25, 888-889)June 1925).

BREIT, and M. A. TUVE. — A radio method of estimating the height of the conducting layer. *Nature*, vol. 116, 357 (Sept. 5, 1925).

BREIT, G., A. E. RUARK, and F. G. BRICKWEDDE. — Frequency changes of light and quantum theory. *Phil. Mag.*, vol. 3, 1306-1314 (June 1927).

DUVALL, C. R. — Memorandum on the uncertainty in the amplitudes and phase-angles of Fourier terms. *Terr. Mag.*, vol. 32, 65-68 (June 1927).

DUVALL, and C. C. ENNIS. — Note on a graphical method of computing diurnal variations by differential formula. *Terr. Mag.*, vol. 29, 121-123 (Sept. 1924).

ENNIS, C. C. — Note on a device to facilitate compilation of data in investigational work. *Terr. Mag.*, vol. 31, 9-10 (March 1926).

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).

FISK, and C. R. DUVALL. — A differential method for deriving magnetometer deflection-constants. *Terr. Mag.*, vol. 30, 1-10 (March 1925).

FLEMING, J. A. — The magnetic and electric survey of the Earth : Its physical and cosmical bearings and development. *J. Wash. Acad. Sci.*, vol. 16, 109-132 (March 4, 1926).

FLEMING. — Improvements in magnetographs and variometers for observatory and field use. *Bull. National Research Council*, vol. 11, 81-86 (Nov. 1926).
GISH, O. H. — Preliminary results of earth-current measurements at Watheroo, Western Australia. *J. Wash. Acad. Sci.*, vol. 15, 15-16 (Jan. 4, 1925).
GISH. — Improved equipment for measuring earth-current potentials and earth-resistivity. *Bull. National Research Council*, vol 11, 86-91 (Nov. 1926).
GISH. — Possible relations between earth-currents, earth-resistivity, and some radio phenomena. *Bull. National Research Council*, No. 61, 179-183 (July 1927).
GISH, and W. J. ROONEY. — Measurement of resistivity of large masses of undisturbed earth. *Terr. Mag.*, vol. 30, 161-188 (Dec. 1925).
JOHNSTON, H. F. — Determination of the atmospheric potential-gratient reduction-factor at the Watheroo Magnetic Observatory, Western Australia. *Terr. Mag.*, vol. 31, 145-152 (Dec. 1926).
MAUCHLY, S. J. — The radium-emanation content of sea air from observations aboard the *Carnegie*, 1915-1921. *Terr. Mag.*, vol. 29, 187-194 (Dec. 1924) ; *Phys. Rev.*, vol. 25, 254 (Feb. 1925).
MAUCHLY. — The electricity of the air. *Sci. Mon.*, vol. 21, 641-645 (Dec. 1925).
PETERS, W. J. — On the use of stereographic projections in the study of progression of magnetic disturbances. *Terr. Mag.*, vol. 30, 67-68 (June 1925).
ROONEY, W. J., and O. H. GISH. — Results of earth-resistivity surveys near Watheroo, Western Australia, and at Ebro, Spain. *Terr. Mag.*, vol. 32, 49-63 (June 1927).
SVERDRUP, H. U. — Scientific work of the *Maud* Expedition, 1922, 1925. *Sci. Mon.*, vol. 22, 400-410 (May 1926).
THOMSON . A. — Preliminary report on the atmospheric potential-gradient recorded at the Apia Observatory, Western Samoa, *Terr. Mag.*, vol. 29, 97-100 (Sept. 1924).
THOMSON. — Preliminary comparison of atmospheric potential at sea with that under closely similar insular conditions at Apia, Western Samoa. *Terr. Mag.*, vol. 31, 113-120 (Sept. 1926).
TUVE, M. A. , and G. BREIT. — Note on a radio method of estimating the height of the conducting layer. *Terr. Mag.*, vol. 30, 15-16 (March 1925).
WAIT, G. R. — Magnetic permeability of iron and magnetite in high-frequency alternating fields. *Phys. Rev.*, vol. 29, 566-578 (Apr. 1927) ; abstract, *ibidem*, vol. 28, 848-849 (Oct. 1926).
WAIT. — Preliminary note on the effect of dust, smoke, and relative humidity upon the potential gradient and the positive and negative conductivities of the atmosphere. *Terr. Mag.*, vol. 32, 31-35 (March. 1927).
WAIT, and H. U. SVERDRUP. — Preliminary note on electromotive forces possibly produced by the Earth's rotating magnetic field and on observed diurnal-variation of the atmospheric potential-gradient. *Terr. Mag.*, vol. 32, 73-83 (June 1927).
FISK, H. W. — Some preliminary results of diurnal variation of magnetic inclination at field stations in South America. *Terr. Mag.*, vol. 31, 165-176 (Dec. 1926).

The character of the contents of Volume V of our "Researches" containing 430 + vii pages with 15 plates and 31 figures is sufficiently indicated by the following subtitles : "Magnetic results obtained aboard the CARNEGIE, 1915-1921", by J. P. Ault; "Atmospheric-electric results obtained aboard the CARNEGIE, 1915-1921", by S. J. Mauchly and J. P. Ault ; "The Hudson Bay Expedition, 1914", by W. J. Peters ; "Navigation of aircraft by astronomical methods" by J. P. Ault ; "The compass-variometer", by Louis A. Bauer, W. J. Peters, and J. A. Fleming ; "Sunspot and annual variations of atmospheric electricity with special reference to the CARNEGIE observations, 1915-1921", by Louis A. Bauer ; "Studies in atmospheric electricity based on observations made on the CARNEGIE, 1915-1921", by S. J. Mauchly.

Volume VI of the "Researches" is now in press for publication about September 1927 by the Carnegie Institution of Washington and has the general title "Land magnetic and electric observations, 1918-1926". This volume of approximately 400 pages with 13 plates and 41 figures is devoted to (1) Magnetic results, 1921-1926, by H. W. Fisk, and (2) Magnetic, atmospheric-electric, and auroral results, MAUD Expedition, 1918-1925, by H. U. Sverdrup. The first portion of this volume, besides giving the results obtained by the Department at land stations during 1921 to 1926, contains a summary of the land work during 1905 to 1926 showing total station-occupations by Department observers in that period of 5,685 (see special report to the Prague Assembly by J. A. Fleming and H. W. Fisk entitled "Summary of magnetic-survey work of the Carnegie Institution of Washington, 1905-1926"). The second portion of the volume relating to the MAUD Expedition is divided into six parts which include, respectively : The absolute magnetic observations, 1918 to 1921 (this section being in co-authorship with C. R. Duvall) ; absolute magnetic observations, 1922-1925 ; results of photographic records of declination at Cape Chelyuskin and at Four Pillar Island ; observations of the atmospheric potential-gradient, 1922-1925 ; observations of the aurora, 1918-1925 ; and narrative of the Expedition, 1918-1925.

Volume VII of the "Researches" will present the magnetic results obtained at the Watheroo Magnetic Observatory, Western Australia, during the years 1919 to 1926. The manuscript for the extensive tabulations of data to form the major part of this volume is completed and, together with the manuscript for the text, will be submitted for publication by the Carnegie Institution of Washington during the latter part of 1927 (see also section of this report relating to observatory work).

Summary of Work Done by the Department of Terrestrial Magnetism, Carnegie Institution of Washington, Since the Madrid Assembly, 1924

a) Investigations concerning terrestrial magnetism and electricity and their cosmical relations.

b) Experiments to determine the existence and height of the conducting layer of the atmosphere.

c) Experiments on the effect of presure on the critical temperature of magnetization, and on the nature of magnetism.

d) Continuation of the world magnetic survey, especially as regards determination of the secular changes in Australia, New Zealand, the East Indies, islands of the South Pacific, China and contiguous portions of southeast Asia, Africa and adjacent parts of Southwest Asia, Mexico, Central America, the West Indies, and the continent of South America. Authorization was received in December 1926 to make required the repairs of the *Carnegie* in 1927 for a 3 years' cruise to begin in 1928 to embrace investigations in terrestrial magnetism and electricity, oceanography, and meteorology.

e) The two observatories at Watheroo, Western Australia, and Huancayo, Peru, have been in continuous operation, the observational programs including terrestrial magnetism, atmospheric electricity, earth currents, meteorology, and radiotelegraphy as regards terrestrial and cosmical correlations. The Department has also continued to cooperate with the New Zealand Government in the maintenance of the atmospheric-electric work at the Apia Observatory. In the Arctic the Department has cooperated with Amundsen's *Maud* Expedition, 1918-1925, and other expeditions.

f) Improvements have been introduced at Watheroo and Huancayo for obtaining better time-control on all photographic and other registrations and for the determination of scale values.

g) Special electric resistivity surveys were made in 1926 at the Watheroo Observatory and at the Ebro Observatory to determine with the aid of the usual earth-current potentials the actual current-density. It was found that the latter quantity was of about the same order of magnitude, though the potential gradients at the two places were considerably different.

h) Comparisons of magnetic standards have been continued in Washington and elsewhere, as opportunity afforded.

i) Investigations have been made relating to the various sources of error involved in observations of the atmospheric potential-gradient, and as regards the effect of atmospheric pollution and humidity on the potential gradient and the conductivity.

j) Besides the usual annual reports and Vols. V and VI (now in press) of the Researches of the Department, about 200 articles habe been contributed to scientific journals by members of the staff. Vol. V appeared in 1926 and was entitled " Ocean Magnetic and Electric Observations, 1915-1921" and was accompanied by 5 Special Reports. The title of Vol. VI will be " Land Magnetic and Electric Observations, 1918-1926 " ; it will contain the magnetic results at the Department's land stations, 1921-1926, by H. W. Fisk, and the magnetic, atmospheric-electric and auroral results of the Maud Expedition, 1918-1925, by Dr. H. U. Sverdrup.

Résumé des travaux du Department of Terrestrial Magnetism, Carnegie Institution of Washington, effectués depuis le Congrès de Madrid, 1924

a) Recherches relatives au magnétisme et à l'électricité terrestres et à leurs rapports cosmiques.

b) Études expérimentales pour constater l'existence de la couche conductrice de la haute atmosphère et en déterminer la hauteur

c) Études sur l'effet de la pression sur la température critique du magnétisme, et sur la nature du magnétisme.

d) Continuation du levé magnétique mondial surtout en vue de déterminer la variation séculaire dans les régions suivantes : l'Australie, la Nouvelle-Zélande, les Indes Orientales, les îles du Pacifique du Sud, la Chine et les parties limitrophes de l'Asie sud-orientale, l'Afrique et les pays du sud-ouest de l'Asie avoisinants, le Mexique, l'Amérique Centrale, les Antilles et le continent de l'Amérique du Sud. En décembre 1926, on a reçu l'autorisation de faire au « Carnegie » les réparations nécessaires en vue d'une croisière de trois ans à partir de 1928, dont le but principal sera l'étude du magnétisme et de l'électricité terrestres, de l'océanographie et de la météorologie.

e) Les deux observatoires situés l'un à Watheroo, Australie Occidentale, l'autre à Huancayo, Pérou, ont fonctionné sans interruption ; leur programme d'observations comprend le magnétisme terrestre, l'électricité atmosphérique, les courants telluriques et la radiotélégraphie dans ses rapports terrestres et cosmiques. Le Département n'a pas cessé de coopérer avec le Gouvernement de la Nouvelle-Zélande au maintien des études d'électricité atmosphérique à l'observatoire d'Apia. Dans les régions arctiques, le Département a également collaboré avec l'Expédition « Maud » d'Amundsen en 1918-1925, et avec d'autres expéditions.

f) A Watheroo et à Huancayo des perfectionnements ont été apportés aux enregistrements photographiques, etc., pour mieux contrôler l'heure et pour déterminer la valeur de l'échelle.

g) Des levés spéciaux de la résistivité électrique ont été exécutés en 1926 à l'Observatoire de Watheroo et à l'Observatoire de l'Èbre afin de déterminer, à l'aide des potentiels usuels des courants telluriques, la réelle densité du courant. On a trouvé que cette dernière quantité était à peu près du même ordre de grandeur, bien que les gradients de potentiel (du courant tellurique) aux deux endroits accusassent des différences considérables.

h) Les comparaisons des étalons magnétiques ont été continuées à Washington et ailleurs suivant que se présentait l'occasion.

i) On a fait des études relatives aux diverses causes d'erreurs se produisant dans les observations du gradient de potentiel de l'atmosphère et à l'effet de la pollution atmosphérique et de l'humidité sur le gradient de potentiel et la conductibilité.

j) En outre des rapports annuels réguliers et des volumes V et VI (actuellement sous presse) des Recherches du Département, le personnel du Département a donné aux journaux savants 200 articles environ. Le volume V, paru en 926, avait pour titre « Ocean Magnetic and Electric Observations, 1915-1921 » t contenait en outre cinq rapports spéciaux. Le volume VI portera le titre « Land Magnetic and Electric Observations, 1918-1926 » ; on y trouvera les données magnétiques provenant des statons terrestres du Département 1921-1926, par M. H. W. Fisk, et les résultats des observations du magnétisme, d'Électricité atmosphérique et d'aurores polaires, obtenus par l'Expédition « Maud » 1918-1925, par le Dr. H. U. Sverdrup.

Louis A. BAUER, *Director* ;
John A. FLEMING, *Assistant Director.*

Washington, June 30, 1927.

Published articles and transactions distributed at the Prague meeting containing reports of interest to the section of terrestrial magnetism and electricity

Published articles in the form of reprints and published transactions containing matter bearing on work in terrestrial magnetism and electricity were distributed at the Prague meeting or were attached to the national reports as follows :

DENMARK. — *Det Danske Meteorologiske Institut. Communications magnétiques*, Nos. 1, 2, 3, 4, et 5, Copenhague, 1927.

FRANCE. — *Deuxième rapport préliminaire sur la foudre*, E MATHIAS, Toulouse, 1927, 31 pp.

Perturbations magnétiques et aurores boréales. Loi de répartition des régions actives du Soleil. Importance du rayonnement corpusculaire, H. DESLANDRES.

Aurore boréale et perturbation magnétique du 9 *mars* 1926 *à l'Observatoire de Meudon*, Paris, *C.-R. Acad. sci*, .t. **182**, 11 mars 1926, pp. 669-672, H. DESLANDRES.

Perturbation magnétique du 5 *mars* 1926 *et perturbations des premiers mois de l'année*. Paris, *C.-R. Acad. sci.*, t. **182**, 22 mars 1926, pp. 733-735, H. DESLANDRES.

Distribution dans le temps des perturbations magnétiques terrestres et répartition correspondante dans le Soleil des régions qui émettent un rayonnement corpusculaire. Paris, *C.-R. Acad., sci.*, t. **182**, 31 mai 1926, pp. 1301-1305, H. DESLANDRES.

Loi de distribution des orages magnétiques terrestres, et loi correspondante de répartition des régions actives du Soleil. Paris, *C.-R. Acad. sci.*, t. **183**, 19 juillet 1926, pp. 165-169, H. DESLANDRES.

Remarques sur la loi de distribution dans le temps des orages magnétiques. Paris, *C.-R. Acad. sci.*, t. **183**, 13 septembre 1926, pp. 494-497, H. DESLANDRES.

Loi de distribution des orages magnétiques et de leurs éléments. Conséquences à en tirer sur la constitution du Soleil. Paris, *C.-R. Acad. sci.*, t. **183**, 27 décembre 1927, pp. 1313-1317 ; t. **185**, 4 juillet 1927, pp. 10-14, H. DESLANDRES.

Annales de l'Institut de Physique du Globe et du Bureau Central de magnétisme terrestre, publiées par les soins de Ch. MAURAIN, Paris, tomes III, IV, V, 1925-1926-1927, contenant des mémoires de Ch. MAURAIN, C. E. BRAZIER, L. EBLÉ, E. SALLES, E. TABESSE, G. GIBAULT relatifs au magnétisme terrestre et à l'Electricité atmosphérique.

ITALY. — *Bollettino N.* 13 *de Comitto nazionale italiano geodetico-geofisico* (30 *giugno* 1927). *Consiglio Internazionale di Richerche, Unione Internazionale Geodetica-Geofisica*, Venezia, 1927, 28 pp. [*Sezione di Magnetismo ed Elettricità terrestre*, pp. 19-20].

Risultati di una esplorazione magnetica nei territori del Giuba e dell' Uebi Scelbeli, L. PALAZZO. Roma, *Rend. Accad. Lincei*, Vol. 5, 1927 (933-940).

Variazioni magnetische secolari a Massaua col contributo di recenti misure, L. PALAZZO. Roma, *Atti Pont. Accad. Nuovi Lincei*, anno 80, 1927 (165 con 3 curve).

L'opera scientifica di Ciro Chistoni, Napoli, 1927, 57 pp. [*L'opera svolta da C. Chistoni per lo studio del magnetismo terrestre*, L. PALAZZO, pp. 3-8 ; *Ciro Chistoni e l'elettricità atmosferica*, D. PACINI, pp. 19-20].

JAPAN. — *Central Meteorological Observatory*, Tokyo. *Observations of sudden commencements of magnetic storms in* 1926. *Reprinted from the Annual Report of the Kakioka Observatory*, 1926, Tokyo, 1927, 4 pp.

A note on the magnetic characterization of days. S. Ono. Reprinted from the Annual Report of the Kakioka Observatory, 1926, Tokyo, 1927, 8 pp.

POLAND. — *Travaux de l'Observatoire Magnétique à Swider No.* 3. *Carte des déclinations magnétiques en Pologne pour l'année* 1927. S. KALINOWSKI, Warszawa, 1927, 7 pp. avec carte.

SIAM. — *Report of progress on the geodetic and magnetic operations carried out by the Royal Survey Department of Siam period 1st January*, 1924 — 31st December 1926. 1927. 7 pp. with index map showing magnetic stations and indicating those occupied during 1924-26.

SPAIN. — *Mapa magnético de España para la época de* 1924. *o. construido por la Direccion General del Instituto Geográfico y Catastral de España.* Madrid, 1927, 8 pp. con tres mapas de curvas isomagnéticas, a saber, de isógonas, isoclinas e isodinámicas.

UNITED-STATES. — *U. S. Coast and Geodetic Survey. Progress of work in terrestrial magnetism of the U. S. Coast and Geodetic Survey, January*, 1, 1925, to June 30, 1927, N. H. HECK and D. L. HAZARD, Washington, D. C., 1927, 7 pp. [Special publication No. 133.]

Bulletin of the National Research Council, No 61. *Transactions of the American Geophysical Union, Eighth Annual Meeting*, April 28 and 29, 1927, Washington, D. C. Washington, 1927, 296 pp. [Section of Terrestrial Magnetism and Electricity, pp. 127-197.]

PART IV

COMMENTS ON AGENDA

COMMENTS ON THE AGENDA FOR THE PRAGUE MEETING OF THE SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

AUSTRALIA

CENTRAL WEATHER BUREAU, MELBOURNE

C. — *Observatory Work*

C 5.—The term "normal" value of the magnetic element on January 1 does not appear to be a very desirable one. A normal value may mean many other things. Would not some such term as "epochal" value be more satisfactory ?

Edward KIDSON.

Melbourne, June 12, 1927.

CHINE

OBSERVATOIRE DE LU-KIA-PANG

A. — *Appareils et Constantes*

A 1. — Contrôle utile, mais qui semble de fait à peu près irréalisable.

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A 2. — Il serait fâcheux de rendre les voyages magnétiques si onéreux qu'on ne puisse les entreprendre qu'en caravanes.

A 3. — Ma lettre de l'autre jour montre que je considère les méthodes magnétiques comme importantes en la matière. Avant de construire un appareil neuf, qui sera coûteux, d'un emploi onéreux et qu'en fait peu se procureront, je suggérais qu'on utilise d'abord sérieusement ce qui existe. Après le congrès de Madrid, il a aussi été question d'un appareil nouveau ; la circulaire du Dr Tanakadate a-t-elle eu une demi-douzaine de réponses ? La proposition A 3 est exposée à un fiasco, je le crains.

B. — *Réseaux Magnétiques et Électriques*

B 1. — Un État qui se sent à même de faire un réseau, le rapportera sûrement à la date qui est la plus avantageuse à son propre réseau. L'exemple récent de l'Inde montre qu'on ne choisit pas la date qu'on voudrait. La proposition B 1, ne devant pas être prise de fait en considération, il est prudent de l'omettre.

B 2. — Très bien, mais en laissant la dernière ligne, pour la même raison que ci-dessus.

C. — *Travaux des Observatoires*

C 1. — *(a)* Oui.

C 1. — *(b)* Non. Plus d'un organisme a un besoin réel d'une certaine liberté.

C 2. — Oui.

C 3. — Passe, mais en remplaçant le mot *doit* par un autre qui ne sonne pas un ton autoritaire.

C 4. — Il ne faut pas oublier que ce qui est moins coûteux ici l'est plus ailleurs. Au surplus, comme il ne s'agit que de *considérations*, il n'y a rien à dire contre le mot *faut*. Parce qu'un observatoire, par exemple, Stonyhurst, publie peu, il ne faudrait pas pour autant nier la valeur d'une série de premier ordre.

C 5. — Définition très légitime.

C 6. — Il y aurait un adjectif à ajouter. Les instituts qui depuis 50 ans considèrent comme annuelle la différence entre les 1er juillet, qu'ils changent leur méthode ou non, vont avoir deux espèces de variation séculaire, qui seront trop faciles à confondre.

D. — *Propositions générales*

D 3. — Je ne connais pas la technique de ce qui est visé ici et qui est peut-être à la portée d'organismes médiocrement outillés. Peut-être coopérerons-nous si nous pouvons.

Zi-ka-wei, Chine, le 27 mai 1927. J. DE MOIDREY, S. J.

CHINA

LUKIAPANG OBSERVATORY

A. — *Instruments and Constants*

A 1.—A useful control, but which seems, in fact, hardly feasible.

A 2.—It would be unfortunate to make magnetic expeditions so onerous that they could only be undertaken by caravan.

A 3.—My letter of the other day shows that I consider magnetic methods important in this regard. Before constructing a new apparatus, which would be expensive, of arduous employment and which indeed few would procure, I would suggest that first serious use be made of existing instruments. After the Congress of Madrid, there was also the question of a new instrument. Did the circular of Dr. Tanakadate receive a half dozen replies ? The item A 3 is susceptible of a fiasco, I fear.

B. — *Magnetic and Electric Surveys*

B 1.—A state which feels able to make a survey, will surely reduce it to the date which is most advantageous to its own survey. The recent case of India shows that one does not always select the date that one would prefer. The proposal B 1, since it ought not really to be taken under consideration, it would be more prudent to omit it.

B 2.—Very well, but omitting the last line for the same reason as above.

C. — *Observatory Work*

C 1.—(*a*) Yes.

C 1.—(*b*) No. More than one organization has a real need of a certain liberty.

C 2.—Yes.

C 3.—Let it pass ; but by substituting the word *doit* by another wich would not sound so arbitrary.

C 4.—One should not forget that what is less expensive here is more so elsewhere. Moreover, since it is only a question of *considerations*, there is no objection to the word *faut*. Because an observatory, Stonyhurst, for example, publishes little, one ought not for that reason to deny the value of a first-class series.

C 5.—Very legitimate definition.

C 6.—An adjective should be added. The institutions which have considered, for 50 years, as annual the difference between July 1 and July 1, whether they change their method or not, are going to have two kinds of secular variation, which it will be too easy to confuse.

D. — *General Proposals*

D 3.—I am not familiar with the technique of what is here aimed at and which is perhaps within the reach of organizations of mediocre equipment. Perhaps we will cooperate, if we are able.

J. DE MOIDREY, S. J.

Zikawei, May 27, 1927.

CZECHOSLOVAKIA

INSTITUT DU RADIUM

J'aurais quelques propositions à faire à l'égard des recherches dans les régions polaires et j'espère que j'aurai l'occasion de les présenter au Congrès.

En ce qui concerne l'ordre du jour, je me permets d'observer qu'il serait peut-être bien d'attirer particulièrement l'attention des assistants sur le problème des mesures de la radioactivité de l'atmosphère. Ce point doit être inclus dans le point 1° de l'article D, mais je crois qu'il serait bien d'insister sur la nécessité d'une méthode générale de mesure qui serait régulièrement employée pour des observations continuelles dans les différents postes.

Je crois qu'il persiste beaucoup plus d'incertitude à ce sujet que pour les autres facteurs d'électricité atmosphérique vu la différence des méthodes adoptées par plusieurs observateurs, leur insuffisance, l'impossibilité de raccorder les différentes observations, le manque absolu d'une série continue d'observations, etc. J'en ai signalé quelques-unes dans un mémoire (1), intitulé « Recherches sur l'électricité et la radioactivité de l'atmosphère au Spitzberg » dont je me permets d'ajouter le sommaire.

SOMMAIRE. — On a fait, pendant l'expédition polaire d'Amundsen-Ellsworth-Nobile, des observations continuelles à Kingsbay (Siptzberg) de l'ionisation et de la radioactivité atmosphériques. On a trouvé, pour la quantité d'ions légers et la conductiblité de l'atmosphère, des valeurs qui, en moyenne, ne diffèrent pas de celles qu'on trouve sur les continents ; cependant, la mobilité

(1) Paris, *J. de Physique et Le Radium*, v. 8, 1927 (161-181).

des ions présentait des valeurs assez variables et pour la plupart inférieures à 1 cm : pour 1 v : cm. On a fait également une série d'observations de la charge totale de l'atmosphère déterminée par la méthode d'Obolensky, conduisant au résultat que le nombre des gros ions (les ions de Langevin) est du même ordre de grandeur que sur les continents. On a trouvé des valeurs élevées pour le gradient du potentiel ; cependant, l'intensité du courant vertical d'électricité atmosphérique, tout en étant en moyenne égale à celle qu'on trouve sous les climats tempérés, présentait souvent des valeurs dépassant plusieurs fois la valeur moyenne. Les recherches sur la radioactivité de l'atmosphère ont eu, dans les limites de la sensibilité d'un appareil spécial construit dans ce but, un résultat négatif. Ce résultat confirme l'explication de la radioactivité des couches basses de l'atmosphère comme dû à des exhalations continuelles de radon par le sol. Une discussion théorique de la méthode employée (la méthode du dépôt actif) est donnée, de même qu'une discussion des résultats obtenus pour les caractéristiques de l'électricité atmosphérique, en connexion avec le rayonnement ultra-pénétrant (rayonnement de Hess-Millikan) de l'atmosphère. On décrit également un essai fait pour déterminer l'afflux électronique nécessaire au maintien de la charge négative terrestre. Le résultat négatif de cet essai et d'expériences analogues faites par Swann et Schweidler est expliqué théoriquement par l'hypothèse des électrons très rapides de Swann, dont l'effet sur les appareils employés serait de l'ordre des erreurs d'observation.

François Běhounek, *Assistant.*

Prague, le 27 *juin* 1927.

CZECHOSLOVAKIA

INSTITUT DU RADIUM

I have some proposals respecting investigations in polar regions which I hope to present at the Meeting.

In connection with the Agenda, permit me to suggest that it might perhaps be well to bring to the attention of the meeting the problem of observing the radioactivity of the atmosphere. This matter should come under No. 1 of Article D, but I think it would be well to emphasize the need of a common method of measurements to be employed regularly at the various stations for continuous observations.

I think that there is much more uncertainty in this matter than exists for the other atmospheric-electric factors, for example, the different methods adopted by several observers, the impossility of recording the different observations, the absolute lack of a continuous series of observations, etc., some of which I have pointed out in the enclosed paper (1) entitled "Investigations of the electricity and radioactivity of the atmosphere at Spitzbergen" summaried below.

(1) Recherches sur l'électricité et la radioactivité de l'atmosphère au Spitzberg. Paris, *J. de Physique et Le Radium*, v. 8, 1927 (161-181).

Abstract. — Düring the Amundsen-Ellsworth-Nobile polar expedition, continuous observations of the ionization and radioactivity of the atmosphere were made at Kings Bay (Spitzbergen). There were found for the number of light ions and the conductivity of the atmosphere, values which, on the average, do not differ from those found on the continents. However, the mobility of the ions showed rather variable values and for the most part lower than 1 cm : s for 1 v : cm. There was also made a series of observations of the total charge of the atmosphere determined by the method of Obolensky which yielded as a result that the number of large ions (Langevin ions) is of the same order of magnitude as on the continents. High values were found for the potential gradient. However, the intensity of the vertical current of atmospheric electricity while being, on the average, equal to that which is found in temperate climates often gave values many times greater than the mean value. Investigations of the radioactivity of the amosphere gave, within the limits of the sensitivity of a special apparatus constructed for this purpose, a negative result. This result confirm the explanation of the radioactivity of the lower layers of the atmosphere as being due to the continual radium emanation by the soil. A theoretical discussion of the method used (active-deposit method) is given, as well as a discussion of the results obtained for the characteristics of atmospheric electricity in connection with the ultra-penetrating radiation (Hess-Millikan radiation) of the atmosphere. A description is given of an attempt to determine the electronic afflux required to maintain the Earth's negative charge. The negative result of this experiment and of similar ones made by Swann and Schweidler, is explained theroretically by Swann's hypothesis of very fast electrons, the effect of which on the instruments used would be of the order of errors of observation.

François BĚHOUNEK, *Assistant.*

Prague, June 27, 1927.

FRANCE

INSTITUT DE PHYSIQUE DU GLOBE

A. — *Appareils et Constantes*

A 1. — La comparaison des appareils étalons est extrêmement utile. Elle ne peut pas, cependant, établir une différence constante entre les valeurs publiées par les divers Observatoires. Une certaine partie des différences provient en effet de l'incertitude des valeurs de base (lignes de repère), et est ainsi un peu variable, particulièrement pour la Composante Verticale et l'Inclinaison.

Relativement à la manière de procéder, il semble qu'on puisse envisager : 1° Des comparaisons faites par un même personnel dans les principales Stations de la Terre, avec des appareils de comparaison semblables ; 2° des comparaisons plus fréquentes entre des Stations de pays voisins.

A 2. — Très utile.

B. — *Réseaux Magnétiques et Electriques*

B 1. — Très utile.

B 2. — Il y aurait lieu de définir un appareil simple pour les mesures du champ électrique, de manière que les mesures fussent comparables. Par exemple, deux prises de potentiel à l'ionium, placées l'une à 1 mètre au-dessus d'un sol plat gazonné, l'autre à 2 mètres au-dessus de la première et sur la même verticale. — Il serait utile qu'un tel système portatif fût comparé aux appareils enregistreurs en service dans les divers Observatoires.

C. — *Travaux des Observatoires*

C 1. — Oui, il est désirable que le vœu de Madrid relatif au magnétisme terrestre soit étendu à l'électricité atmosphérique. Il est important que l'heure adoptée, Greenwich ou zonale, soit toujours indiquée en tête des tableaux.

C 2. — La correction non cyclique a toujours été faite au Val-Joyeux aussi longtemps qu'on a publié des développements en série de Fourier.

C 3. — Toutes les valeurs horaires des 3 éléments D, H, Z ou X, Y, Z. Il paraît impossible d'imposer la publication de X et Y dans les Observatoires où on enregistre D et H, le calcul serait trop long. — On pourrait envisager l'emploi de deux bifilaires enregistrant X et Y ; mais dans la pratique on a plus souvent besoin des valeurs de D, et il est commode de les lire directement.

C 4. — Au Val-Joyeux et à Nantes on peut envoyer à l'impression au milieu de chaque année les observations de l'année précédente. Les publications doivent comprendre au minimum les valeurs horaires des 3 éléments, leurs moyennes mensuelles et annuelles.

C 5. — Semble devoir être adopté.

C 6. — Semble devoir être adopté.

C 7. — Faire les deux choses pendant quelques années, et charger quelqu'un de présenter un rapport sur ce sujet d'après les résultats de ces deux manières de procéder.

D. — *Propositions Générales*

D 6. — Très utile.

Ch. Maurain, *Directeur*

Paris, le 21 *juin* 1927.

FRANCE

INSTITUT DE PHYSIQUE DU GLOBE

A. — *Instruments and Constants*

A 1.—The comparison of standard instruments is most useful. It cannot, however, furnish a constant difference between the values published by the various observatories. Some portion of these differences is due, in fact, to the uncertainty of the values of the base line (lines of reference) and is therefore somewhat variable, particularly for the vertical component and the inclination.

Regarding the plans, it seems as though the following should be considered : *a*). Comparisons made by same personnel at the principal observatories of the world with similar instruments of comparison ; *b*). More frequent comparisons between observatories of neighboring countries.

A 2.—Very useful.

B. — *Magnetic and Electric Surveys*

B 1.—Very useful.

B 2.—The specifications of some simple apparatus for measuring the electric field should be adopted, so that the observations would be comparable. For example, two ionium collectors installed, one at one meter above a flat lawn, the other at 2 meters vertically above the first. It would be very useful to have such a portable installation compared with the recording apparatus in use at the different observatories.

C. — *Observatory Work*

C 1.—Yes, it is desirable that the Madrid resolution specifying time for terrestrial magnetism should be extended to apply to atmospheric electricity. It is important that the hour adopted, Greenwich or zonal, should always be stated at the head of the tables.

C 2.—The non-cyclic correction has always been applied at Val-Joyeux ever since the results of Fourier analysis have been published.

C 3.—All the hourly values of the three elements, D, H, Z, or X, Y, Z. It appears to be impossible to prescribe the publication of X and Y by observatories where D and H are recorded, the computations would be too long. The use of 2 bifilars recording X and Y might be considered, but in actual practice the the values of D are more often required and it is more convenient to read them directly.

C 4.—At Val-Joyeux and Nantes the observations of the preceding year can be sent to press in the middle of the year. The published data should comprise, at least, the hourly values of the three elements, their monthly and their annual means.

C 5.—Apparently should be adopted.

C 6.—Apparently should be adopted.

C 7.—Try both for several years and appoint some one to present a report on the subject in accordance with the results obtained by the two methods.

D. — *General Proposals*

D 6. — Very useful.

CH. MAURAIN, *Director*.

Paris June, 21, 1927.

NEW ZEALAND

APIA OBSERVATORY, WESTERN SAMOA

It is suggested by Assistant Director C. J. Westland that when the diurnal variation of a magnetic element shows two maxima and minima daily, this report should be drafted in such a manner that this fact is readily ascertainable. It is not proposed that the practice of giving absolute ranges be discarded but that the presence of the other maximum and minimum be shown clearly at any rate in the monthly means of the hourly values.

The values of the atmospheric-electric potential occuring when a negative charge is attracted to the Earth are usually too great to be registered on an electrograph recording the daily variation of the potential. It is fairly easy, however, to measure the duration of ,, negative electricity'' and it is suggested that in reports of observatories the length of time be stated.

Andrew THOMSON, *Director*.

Apia, March 1, 1927.

NORWAY

NATIONAL COMMITTEE

D. — *General Proposals*

D 2.—The National Committee of Norway has already considered this matter.

We are prepared to submit a scheme for visual observations of polar lights with photographic illustrations of the forms of polar lights which are to be obtained.

My proposal is that a committee of 6 members representing Sweden, Denmark, Finland, Great Britain, Norway, and the United States and Canada, which are the countries in which polar lights are very frequently seen, should be appointed to receive the scheme from the Norwegian National Committee and to bring it into operation in such a manner and extent as it might be found possible as soon as convenient. Also that this Committee should entertain correspondence with representatives in other countries where observations could be made.

The personnel for such a Committee is suggested as follows : Sweden, Carlheim-Gyllensköld ; Denmark, La Cour ; Finland, Melander ; Great Britain, Chapman ; Norway, Störmer ; United States and Canada, Heck. The Committee should be supplied with funds by the Section to cover expenses connected with operation of the scheme.

When the scheme is ready it should be printed by arrangement between the Secretary and the above Committee.

C. Störmer.

Bygdö, Oslo, September 1927.

UNITED STATES

UNITED STATES COAST AND GEODETIC SURVEY

A. — *Instruments and Constants*

A 1.—It is hoped that the Department of Terrestrial Magnetism of the Carnegie Institution of Washington may find it possible, in connection with its world-wide observations for determining the secular change of the magnetic elements, to carry out a program of comparison of its instruments with adopted standard instruments in a few countries so distributed in the different continents that it would not be a serious task for any other country to arrange for comparison of its standards with those of one of these selected countries.

It might be advisable to have a special committee to consider the best methods for securing constancy in standard instruments, in view of the probability that general intercomparisons of standards will be made only infrequently. A further study of the apparent variability of the distribution factors of a magnetometer might be helpful in this connection.

A 3.—Collection of information regarding what has already been done along these lines, the instruments and methods used, would be of great value.

C. — *Observatory Work*

C 1.—The ordinary form of tabulation of hourly values of magnetic observatory results is designed especially to facilitate a study of the solar-diurnal variation of the earth's magnetic field. At the same time it presents the results in detail so that the magnetician may combine them in any way that may be required for the solution of any particular problem.

The solar-diurnal variation is primarily a local phenomenon, closely associated with the position of the sun above the horizon. During the night hours the departures from the daily mean are relatively small and not systematic. It is, no doubt, affected by magnetic disturbances, which are primarily cosmical in character and which occur nearly simultaneously all over the earth.

For a study of the solar-diurnal variation the results should (strictly) be tabulated according to local apparent time, but the difference between mean and apparent time is not great enough to require consideration. For the investigation of the variations of the earth's magnetism for the whole earth it is important to have results based on simultaneous observations. With the use of zonal time, the tabulated hourly values at different observatories fulfill this requirement, and at the same time they are suitably arranged for the study of phenoma which are primarily a function of local mean time.

For magnetic observatories differing in longitude from Greenwich by less than six hours there appears to be no serious objection to the use of Greenwich time, as Greenwich midnight falls within the local night hours. As the longitude interval increases above six hours, the beginning of the Greenwich day extends farther and farther into the portion of the local day in wich the principal part of the solar-diurnal variation occurs. For observatories so situated, the use of Greenwich time would result in combining the end portion of one day's activity with the beginning of the next day's activity, with the night hours of comparative inactivity between. The use of Greenwich time at the Honolulu observatory, for example, would begin the day at about the time of minimum declination, maximum horizontal intensity and minimum vertical intensity, the time of day when the greatest differences from one day to the next are to be expected.

While there is now a great mass of reliable data available for the study of the solar-diurnal variation, it is not certain that the time has come to make the accumulation of further data for that study a matter of secondary importance. It seems better to continue to tabulate the results in a form convenient for that study and make such other combinations of the results as may be needed for other investigations.

C 2.—If a recommendation favoring the application of a correction for non-cyclic change is adopted, it should specify the manner in which the correction is to be applied.

C 4.—A discussion or exchange of views as to the accuracy to be sought at various stages—scale values, base-line values, reading of hourly ordinates—would have an important bearing on the question of methods of reduction to be adopted.

R. L. FARIS, *Acting Director.*

Washington, D. C., June 27, 1927.

UNITED STATES

UNITED STATES COAST AND GEODETIC SURVEY

A. — *Appareils et Constantes*

A 1. — On espère que le département de magnétisme terrestre de l'institution Carnegie de Washinghton trouvera possible, en connexion avec ses observations dans toutes parties du monde pour la détermination du changement séculaire des éléments magnétiques, d'exécuter un programme de comparaison de ses instruments avec ceux qui servent d'étalons dans plusieurs pays distribués dans les différents continents, de telle manière qu'il ne serait pas difficile pour un pays quelconque d'organiser la comparaison de ses étalons avec ceux d'un des pays choisis.

Il serait bon qu'un comité spécial étudiât les meilleures méthodes pour obtenir une bonne constance des instruments qui servent d'étalon, puisqu'il est probable que les intercomparaisons ne seront pas très fréquentes. Une étude approfondie de la variabilité apparente des facteurs de distribution d'un magnetomètre pourrait être utile à ce point de vue.

A 3. — Une collection de renseignements sur ce qui a été déjà fait, et sur les instruments et les méthodes employés, serait très précieuse.

C. — *Travaux des Observatoires*

C 1. — La forme ordinaire de la tabulation des valeurs de chaque heure des résultats des observatoires magnétiques est destinée particulièrement à faciliter l'étude de la variation solaire du champ magnétique terrestre. En même temps cela présente les résultats en détail, de sorte qu'on peut les combiner suivant le mode convenant à chaque problème.

La variation solaire-diurne est en principe un phénomène local, associé intimement à la position du soleil au-dessus de l'horizon. Pendant la nuit, les écarts diurnes sont relativement faibles et non systématiques. Sans doute, cette variation est affectée par les perturbations magnétiques, dont l'origine a un caractère cosmique et qui se produisent à peu près en même temps sur toute la terre.

Pour une étude de la variation solaire-diurne il convient que les résultats soient rangés en tables selon le temps vrai local, mais la différence entre le temps moyen et le temps vrai n'est pas assez grande pour entrer en considération. Pour les recherches portant sur des variations du magnétisme sur toute la terre, il faut posséder des résultats fondés sur des observations simultanées. Si le temps zonal est employé, les valeurs rangées en tables pour chaque heure remplissent cette condition et, en même temps, elles se présentent de manière convenable pour l'étude des phénomènes dont la cause est liée au temps moyen local.

Pour les observatoires qui diffèrent en longitude avec Greenwich de moins de six heures, il n'y a pas d'objection sérieuse à employer le temps de Greenwich, le minuit de Greenwich, ayant lieu pendant les heures de la nuit. Quand l'intervalle en longitude devient supérieur à six heures, le commencement du jour à Greenwich entre de plus en plus dans la partie du jour local pendant laquelle se produit la partie principale de la variation diurne magnétique. Pour de tels observatoires, l'emploi du temps de Greenwich combinerait la partie finale de l'activité d'un jour avec le commencement de l'activité du jour suivant, les heures de la nuit, comparativement inactives, restant entre les deux parties. Par exemple, l'emploi du temps de Greenwich à Honolulu ferait correspondre au commencement du jour le temps du minimum de la déclinaison, du maximum de l'intensité horizontale et du maximum de l'intensité verticale, le moment du jour pour lequel on peut attendre les plus grandes différences avec le jour suivant.

Quoiqu'il y ait maintenant une grande accumulation de données sur lesquelles on peut compter pour l'étude dela variation solaire-diurne, il n'est pas sûr que le temps soit arrivé de considérer comme d'importance secondaire l'accroissement de ces données. Il paraît préférable de continuer de ranger les résultats en tables sous une forme convenable pour cette étude, et de faire telles autres combinaisons des résultats qu seraient nécessaires pour les autres investigations.

C 2. — Si une recommandation est adoptée pour l'application d'une correction pour le changement non-cyclique, il faut qu'elle spécifie la manière d'appliquer la correction.

C 4. — Une discussion ou un échange de vues sur l'exactitude requise pour diverses quantités (valeurs des échelles, valeurs des lignes de repère, lecture des ordonnées horaires) serait important pour éclairer sur les méthodes de réduction qu'il convient d'employer.

R. L. Faris, *Acting Director.*

Washington, D. C., le 27 juin 1927.

DEPARTMENT OF TERRESTRIAL MAGNETISM, CARNEGIE INSTITUTION OF WASHINGTON

A. — *Apparatus and Constants*

1—The large number of land stations scattered over the Earth provides the basis for numerous determinations of secular variation. It is important that every reoccupation should furnish results comparable with previous and subsequent ones. This, of course, depends on the identity of station, and on the standards and constants in use by the organizations making the observations. The attempt to use observations from a variety of sources of the past has been disappointing in many cases. The errors in declination standards are generally small and of little significance. The same may be said of inclination errors whenever the earth inductor has replaced the less reliable dip-circle. The intensity standards offer the chief difficulty, the main source of error in the intensity, when measured by the usual form of mamagnetometer, being the uncertainty in the moment of inertia.

The other source of error, the distribution coefficients, may be determined with sufficient accuracy by refinements of observation and measurements of the deflection-distances. Special emphasis should be placed on the subject of securing high-quality intercomparisons. The importance of interchange of instruments and stations cannot be over emphasized.

2—The distribution of magnetic observatories is so unequal that large areas of the Earth are too remote from any observatory to allow even approximate reduction to mean of day for field observations or for the study of local and regional conditions and of space-variation. There seems to be evidence that certain limited regions have daily changes in one or more of the elements. peculiar to themselves ; the inclination daily changes found by field methods in southern Peru and northern Chile are examples of this. Obviously the existence of such regions can only be disclosed by special diurnal-variation observations at stations distributed over the areas destitute of observatories. Daily variations of the magnetic and electric elements can be obtained by field instruments but cannot be carried out continuously for more than ten or twelve hours at a time because of the limitation of an observer's endurance, and such as are made are often of diminished value by reason of abnormal conditions prevailing on the day of days selected for the work. Self-recording instruments capable of giving reliable data within a few days, therefore, are much needed.

3.—The number of geological formations or materials wich a change in permeablilty of the crust sufficient to affect the magnetic field as measured by a magnetometer is not great. On the other hand, it is not uncommon to find great irregularity in the isomagnetic lines over any considerable area when sufficient data permit their delineation. Whatever is the cause of these irregularities, it must lie in certain physical properties of the geological formation. Spurious results, however, may be obtaiend by observations affected by the content of the surface soils as illustrated by work done in Bermuda, where iron salts have been left in the soil composed of disintegrating coral rock sufficient to produce very strong local disturbances, while the more general anomaly has its seat at a great depth. It ought to be practicable to separate these sources of disturbance by making observations in a vertical plane at different heights. The earth inductor, double compass, and field variometers of various types seem well-suited for reconnaissance work, however, recording devices of required precision for observations in various levels still remain to be devised.

Regarding the use of electric methods for investigating underground geological formations, the method of earth-resistivity measurement used by the Department has shown the possibility of its adaptation to such investigations. Discontinuities indicated at depths of 100 meters have been verified ; similar indications for great depths have not as yet been verified on account of lack of borings in the region of the measurements.

B. — *Magnetic and Electric Surveys*

1.—The limitations of personnel and equipment make it difficult to secure data from which to construct charts of different regions, referred to a common date, without resort to extrapolation. Over some large regions where the annual rates of change progress uniformly such extrapolation is comparatively safe but for other regions, in the vicinity of foci of rapid change, the accelerations are great and changeable, so that either interpolation or extrapolation is subject to a large uncertainty for data at widely separated dates. In general, a reduction to an intermediate date is safest and this fact limits the epochal dates chosen for the charts within the periods included by the available observations. For regions within which some observations are continuously being carried on, this limit is not a serious handicap, but for other very large areas desirable dates must necessarily differ widely.

2.—The prosecution of magnetic and electric surveys in polar regions needs special emphasis and it is important that polar expeditions be urged to secure additional data (see Resolution 15, Madrid meeting). However, it should be pointed out that, in general, specially-trained observers must be included in an expedition's personnel to insure reliable results.

Except for certain regions which must be individually considered, future magnetic surveys may be mainly concerned in many instances in studying secular variations. Attention should be directed toward the foci of large annual changes to discover how the lines of equal annual change move, whether the closed ovals expand or contract and whether the centers undergo a motion of translation. There are several such centers in the western hemisphere and in southern Africa, in regions remote from observatories, where reliance must be placed on field observations. The rates of change in the vicinity of these foci fluctuate so rapidly that repeat observations should be made at comparatively short intervals of time, say every two or three years, at well-established stations selected for the purpose.

Reduction to epoch implies methods of deriving satisfactorily both diurnal and secular variations. The question as to how large an area may be covered by empirical interpolation formulae of some form is important, and depends upon the character of the region investigated.

C. — *Observatory Work*

1*a*.—Zonal time to the nearest standard hour is prefered as this would emphasize rather than obscure changes due to local time. Disturbances that are world-wide may still be studied with ease. But there are too many local conditions depending on uncertain factors to make advisable at the present time any change from zonal time. Needless to say the kind of time used should appear conspicuously in all tabulations of results. The period to which values given apply should be definitely stated; hourly means on the half hour are preferred.

1*b*.—In the event of agreement being reached it is desirable that a date several years in advance be set from which the change is to be effective.

1*c*.—Zonal or Greenwich time being adopted, it should hold for atmospheric electricity and earth-currents, and all work of similar character; otherwise, there would be the incongruity of having possibly in the same publication the tabulations of data of two or more allied investigations according to different times, thus rendering immediate comparability difficult. There are many factors entering into the diurnal variations and sudden changes that may be due largely to geographical position, to elevation, to geological causes, and to varying air conditions, that it is wise to study them as nearly as possible at local time, as well as at universal time. Thus for convenience of reduction, compilation and investigation, local zonal time is preferable.

2.—It would seem desirable at first to make a careful study of all the questions involved before non-cyclic corrections, according to an assumed law, are applied in the analysis of the variations of the Earth's magnetism and electricity.

3 and 4.—The study of features on given days offers a fruitful source of research and some means of notting such features would be helpful to the individual investigator who must use the observatory data as published. Neither mean hourly values nor momentary hourly values satisfy all purposes and the reproductions of selected days are necessarily limited in number. The preferred form of tabulating daily results is indicated in the tabulations attached to the Report from the Dept. Terrestrial Magnetism.

Consideration of some uniform system regarding the limit of accuracy in observatory computations and reductions is desirable; for example the unavoidable uncertainties in the phenomena themselves do not warrant giving computed amplitudes and phase-angles by harmonic analyses to more than the nearest $0'.1$, 0.1γ, and $0^{\circ}.1$ for the 24-hour and 12-hours terms nor to more than the nearest minute, gamma, and degree for other terms. The more general and judicious application of graphical methods in reductions and the preparation of manuscript results in shape for immediate reproduction or publication will go far in reducing the costs of observatory publications.

5 and 6.—The practice in general has been to regard, as the normal value of the year, the mean of the twelve monthly means

of the calendar year and hence as applying to the middle of the calendar year. In view of the great amount of published work, already done under this assumption and available at the present moment, it would seem more advantageous to continue to follow this method rather than one which would practically destroy the continuity of the published material and which would necessitate considerable recomputation to obtain uniform data at the various observatories during the period of their existence.

The secular change in one year in any case should be the difference of the yearly means as obtained by the method adopted.

7.—In view of the great effects of local meteorological conditions upon recorded electric field of the atmosphere it appears best to accept monthly mean values for the data as based upon meteorologically-undisturbed days, giving however all data available so far as possible with appropriate notes of conditions. Because of the large annual variation of the potential gradient, it is preferred, in general, to derive the annual mean value from the monthly means without weighting the latter according to the number of days used per month.

7b.—It is suggested that the time of duration of "negative electricity" be given in tabulations since the values of the atmospheric-electric potential occuring when a negative charge is attracted to the Earth are usually too great to be registered on an electrograph recording the daily variation of the potential.

8.—Any discussion involving the Indian magnetic observatories should give careful consideration to the present most unsatisfactory distribution of observatories for the entire globe, especially in the Tropics and Southern Hemisphere.

D. — *General Proposals*

2.—That valuable investigations may be based upon systematic of auroral displays at a single station is indicated by the important conclusions drawn from the *Maud* Expedition observations of this class during 1918-1925. It appears desirable therefore that careful consideration be given to any promising scheme of publication of a summary of auroral observations.

3.—Lightning offers an opportunity to study the results of nature's experiments on a large scale—one of the few means for securing data on upper-air electric phenomena. The contradictory results of several recent studies of the total net current to the Earth in the form of lightning flashes, together with the bearing of the conclusions on the maintenance of the Earth's charge, emphasize the importance of gathering more and better-distributed data regarding this as well as other electrical discharges which occur when the electrical intensity in the atmosphere approaches that associated wich thunderstorms.

4.—Systematic measurements of the effects of atmospheric pollution are of great importance in programs of work at atmospheric-electric observatories.

5.—That some kind of intimate relation exists between several earth-current and terrestrial-magnetic phenomena is well recognized even though the precise nature be not known as yet. Suitable sites for magnetic observatories are likely also to be suitable sites of earth-current measurements at least as regards freedom from electrical disturbances of cultural origin. In view of the entirely inadequate number of earth-current installations, it seems desirable that serious consideration be given to the possibility of installing equipment for earth-current measurement at those more favorably situated. The following locations seem particularly desirable : (1) for high latitudes, Spitzbergen, Sitka, Ekaterinburg, Matochkin Shar, Orcadas ; (2) for distinctly continental conditions, Central Asia (Irkutsk) and Central North America (Tucson) ; (3) for distinctly oceanic conditions, Hawaiian Islands (Honolulu) ; (4) for low latitudes, Batavia-Buitenzorg, Apia, Alibag, Porto Rico ; (5) for intermediate latitudes and general distribution, New Zealand (Christchurch), United States (Cheltenham), South America (Pilar), and at as many other observatories as possible. The experience at Watheroo emphasizes the advantage of having such an arrangement for measuring earth-currents that two or more independent records may be obtained for each composent ; valuable criteria of the reliability of the recorded data are thus obtained.

When the potential-measuring system at an observatory is found satisfactory, a resistivity-survey in the region should be made in order to evaluate the earth-current density and to satisfactorily compare records from various observatories. This might be done at all observatories with one set of earth-resestivity equipment and by the same trained observer. Such a project is suggested for support by the Section. For Terminology in earth-resistivity the folloving units are suggested : ohm-centimeter (or mho-centimeter) or ohm-meter (or mho-meter).

6.—While various bodies already have committees which are concerned to a certain extent in such matters there is great need for gathering additional data and for investigations from the viewpoints of terrestrial magnetism and electricity. The problem might perhaps be best approached from a study of upper-air relations with the conducting layer, is variations, etc. The development of a common scheme or program of observations and decision as regards suitable instruments are important.

Louis A. BAUER, *Director* ;

J. A. FLEMING, *Assistant Director*.

Washington, D. C., June 30, 1927.

DEPARTMENT OF TERRESTRIAL MAGNETISM, CARNEGIE INSTITUTION OF WASHINGTON

A. — *Appareils et Constantes*

1. — Le grand nombre de stations terrestres éparses sur la surface de la Terre fournit la base de nombreuses déterminations de la variation séculaire. Il importe que les résultats de toute réoccupation soient comparables aux résultats des occupations qui la précèdent et qui la suivent. Ceci dépend, bien entendu, de l'identité de la station, et des étalons et des constantes employés par l'organisation faisant les observations. Les tentatives faites pour utiliser des observations de diverses provenances ont souvent échoué. En général les erreurs des étalons de la déclinaison sont petites et de minime importance. Il en est de même des erreurs d'inclinaison dans le cas où l'inclinomètre à induction a remplacé la boussole d'inclinaison, moins sûre. Les étalons d'intensité présentent la difficulté capitale, la source d'erreur principale de l'intensité, observée au magnétomètre ordinaire, provenant de l'incertitude du moment d'inertie. L'autre source d'erreur, les coefficients de distribution, peut être déterminée, avec une précision suffisante, par des observations très soignées, et des mesures des distances déterminant les déviations. On devrait souligner la necessité d'obtenir des intercomparaisons de premier ordre. On ne saurait trop insister sur l'importance de l'échange des instruments et des stations.

2. — La répartition des observatoires est tellement inégale qu'il existe d'immenses étendues de la Terre trop éloignées d'un observatoire pour qu'il soit possible de faire une réduction, même approximative, à la moyenne du jour, pour les observations de campagne ou pour l'étude des conditions locales ou régionales et de la variation avec la situation géographique. Il paraît que dans certaines régions de petite étendue il existe des variations diurnes d'un ou plusieurs éléments qui leur sont propres ; les variations diurnes de l'inclinaison mises en évidence par les méthodes de campagne dans le sud du Pérou et le nord du Chili en sont des exemples. Évidemment, l'existence de telles régions ne peut être découverte que par des observations spéciales de la variation diurne faites dans des stations réparties sur les étendues dépourvues d'observatoires. On peut déterminer les variations diurnes des éléments magnétiques et électriques à l'aide des appareils de voyage, mais l'observation ne pourrait dépasser 10 ou 12 heures de suite, les forces de l'observateur ayant une limite ; et la valeur de telles observations est souvent diminuée par les conditions anormales des jours choisis pour les mesures. Donc,

on a grand besoin d'appareils enregistreurs capables de fournir des données précises pendant quelques jours.

3. — Il n'y a qu'un petit nombre de formations ou matières géologiques qui produisent dans la croûte terrestre un changement de perméabilité suffisant pour influer sur le champ magnétique mesuré par le magnomètre. D'un autre côté, on ne constate que rarement de grandes irrégularités des isomagnétiques sur une étendue considérable lorsqu'on en possède suffisamment de données pour permettre de les dessiner. Quelle que soit la cause de ces irrégularités, il faut la chercher dans les propriétés physiques de la formation géologique. Des observations exposées à l'influence des matières qui existent dans les couches supérieures du sol, peuvent donner de faux résultats, ainsi que le démontrent les travaux exécutés aux Bermudes, où des sels ferrugineux provenant de la désagrégation de masses de corail suffisent à amener de fortes perturbations, alors que l'anomalie générale a son siège à une grande profondeur. En faisant des observations à des hauteurs différentes dans le plan vertical, il doit être possible de séparer les centres de perturbation. L'inclinomètre à induction, la boussole double, et les divers modèles de variomètres portatifs paraissent bien s'adapter aux opérations de reconnaissance; cependant il reste à établir des dispositifs enregistreurs précis pour les observations à différentes altitudes. En ce qui concerne l'emploi des méthodes électriques pour l'étude des formations géologiques souterraines, l'adaptation à ces recherches de la méthode dont se sert le Département pour mesurer la résistivité terrestre, s'est montrée possible. On a vérifié des discontinuités géologiques qui ont été indiquées par des méthodes électriques jusqu'à des profondeurs de 100 mètres ; de semblables indications pour des profondeurs plus grandes n'ont pas encore été vérifiées, par suite de l'absence de forages dans les régions où ont été faites les mesures.

B. — *Réseaux Magnétiques et Électriques*

1. — Le manque de personnel et d'équipement a rendu difficile de recueillir des données qui permettraient la construction, sans interpolation, des cartes de différentes régions, rapportées à une même époque. Pour certaines vastes régions où la variation séculaire se répartit d'une manière uniforme, on peut se permettre de telles interpolations, mais pour d'autres régions, au voisinage des variations les plus rapides dans la répartition de la variation séculaire, les changements sont si grands et si variables que l'application de l'interpolation ou de l'extrapolation aux données se rapportant à des dates très éloignées, est exposée à des incertitudes considérables. En général il vaut mieux ramener les données à une date intermédiaire, ce qui limite les dates choisies aux périodes comprises entre les observations disponibles. A

l'égard des régions où l'on fait des observations d'une manière continue, cette restriction ne présente pas d'inconvénient sérieux mais, en ce qui concerne d'autres vastes régions, les dates désirables doivent nécessairement différer beaucoup.

2. — Il y a intérêt à insister pour la continuation des levés magnétiques et électriques commencés dans les régions polaires et à attirer sur la necessité de données additionnelles l'attention des expéditions polaires (voir le vœu 15, Congrès de Madrid). Il convient de faire remarquer la nécessité qu'il y a, en général, d'adjoindre au personnel d'une expédition des observateurs qui ont été spécialement formés afin d'obtenir de bons résultats.

Les levés magnétiques futurs pourront être consacrés de préférence à l'étude des variations séculaires sauf dans certaines régions qui devront être l'objet d'une étude particulière. On devrait porter l'attention vers les centres de grande variation séculaire afin de constater comment se déplacent les lignes de variations annuelles égales, c'est-à-dire de déterminer si les ovales s'étendent ou se resserrent, et si les centres sont soumis à un mouvement de translation. Il existe plusieurs de ces centres dans l'hémisphère occidental et dans l'Afrique méridionale loin des observatoires, où il faut compter sur des observations de campagne. Les variations au voisinage de ces centres sont si rapides qu'il importe que des observations soient répétées à de courts intervalles, c'est-à-dire tous les deux ou trois ans, dans des stations établies à cet effet.

Pour rapporter les données à une date quelconque, il faut qu'on dispose des moyens de connaître, d'une manière satisfaisante, les variations diurne et séculaire. L'étendue la plus grande à laquelle peuvent être appliquées des formules empiriques d'interpolation constitue une question d'espèce qui dépend du caractère de la région étudiée.

C. — *Travaux des Observatoires*

1*a*. — Le temps zonal, compté à l'heure légale la plus proche, est à préférer puisqu'il met en relief les changements dus au temps local, plutôt que de les masquer. On peut toutefois étudier à l'aise des perturbations d'une étendue mondiale, mais il y a trop de circonstances locales qui dépendent de facteurs incertains pour que l'adoption d'un autre temps au lieu du temps zonal puisse se justifier au moment actuel. Il va sans dire qu'on doit indiquer d'une manière apparente sur tous les tableaux de résultats le temps employé. La période à laquelle s'appliquent les valeurs données doit être clairement énoncée ; les moyennes horaires centrées à la demi-heure sont préférables.

1*b*. — Si on arrive à une convention sur ce point, il est désirable qu'une date soit fixée plusieurs années à l'avance.

1c. — Le temps zonal ou de Greenwich une fois adopté, il doit être employé pour l'électricité terrestre, les courants telluriques et toute étude de ce genre ; autrement on aurait, peut-être dans la même publication, l'inconvénient de tableaux contenant les résultats de deux ou plusieurs recherches de caractère analogue rapportés à des temps différents, ce qui rendrait difficile une comparaison immédiate. Il y a tant de facteurs qui participent aux variations diurnes et aux changements brusques qui peuvent provenir en grande partie de la situation géographique, de l'altitude, des causes géologiques et des conditions changeantes de l'air, qu'il est prudent de les étudier, dans la mesure du possible, d'après le temps local aussi bien que d'après le temps universel. Ainsi pour en faciliter la réduction, la compilation et l'étude, le temps zonal est préférable.

2. — Il paraît désirable d'abord d'étudier de manière approfondie toutes les questions connexes avant d'appliquer, selon une loi hypothétique, les corrections non-cycliques à l'analyse des variations du magnétisme et de l'électricité de la Terre.

3 et 4. — L'étude des traits caractéristiques de certains jours présente une source féconde de recherches, et un moyen d'indiquer ces traits serait utile au chercheur qui doit se servir des données d'observatoires telles qu'on les publie. Ni les valeurs horaires moyennes ni les valeurs horaires instantanées ne peuvent satisfaire à tous les besoins et le nombre de jours choisis qu'on est à même de reproduire est forcément limité. La table spécimen jointe au Rapport du Département de Magnétisme Terrestre indique la manière préférée de disposer en forme de table les résultats diurnes. Il est désirable de prendre en considération l'établissement d'un système uniforme relativement à la limite de précision des calculs et des réductions en usage dans les observatoires, par exemple, les incertitudes inévitables des phénomènes même ne permettent pas d'exprimer les résultats obtenus à l'aide des séries harmoniques avec une approximation plus grande, pour les amplitudes et les phases, que 0,1′ ,0,1γ et 0°,1 pour les termes de 24^{h} et de 12^{h}, et que la minute, le γ et le degré pour les autres termes.

L'application plus générale et plus judicieuse des méthodes graphiques aux réductions, aussi bien que la préparation des résultats manuscrits en vue de la reproduction ou de la publication immédiates, contribuera beaucoup à réduire les frais de publication des observatoires.

5 et 6. — La pratique générale a été de regarder, comme valeur normale de l'année, la moyenne des douze moyennes mensuelles de l'année civile, appliquée au milieu de l'année civile. En raison du travail considérable déjà exécuté d'après cette pratique, dont les résultats sont disponibles actuellement, il semble qu'il y ait intérêt à continuer à suivre cette méthode plutôt que d'en adopter une autre qui romprait la continuité des données

publiées et entraînerait de nouveaux calculs, afin d'obtenir des résultats uniformes pour les divers observatoires pendant la période de leur existence. Il s'entend bien que la variation séculaire d'une année donnée devrait se définir comme la différence des moyennes annuelles obtenues par la méthode choisie.

7. — En raison des effets exercés par les circonstances météorologiques locales sur l'enregistrement du champ électrique de l'atmosphère, le mieux paraît d'accepter pour les valeurs mensuelles moyennes les mesures faites pendant des jours météorologiquement calmes, accompagnées, autant que possible, de toutes les données disponibles, avec des remarques relatives aux conditions dans lesquelles ont été obtenus les résultats. Par suite de la forte variation annuelle du gradient de potentiel, il est préférable, en général, de faire dériver la valeur moyenne annuelle des moyennes mensuelles sans faire subir à ces dernières une correction dérivée du nombre de jours utilisés par mois.

7*b*. — On propose d'insérer dans les tables le temps pendant lequel le gradient electrique est négatif, car les valeurs du potentiel électrique de l'atmosphère qui dominent lorsque le gradient est négatif, sont ordinairement trop fortes pour qu'elles soient indiquées sur un électrographe qui enregistre les variations diurnes du potentiel.

8. — La répartition actuelle des observatoires sur la surface du Globe, surtout en ce qui concerne les régions tropicales et l'hémisphère sud, laisse beaucoup à désirer, de sorte qu'une discussion touchant l'avenir des observatoires magnétiques indiens devrait se porter spécialement sur ce défaut.

D. — *Propositions générales*

2. — Le fait que de précieuses recherches peuvent s'appuyer sur des notes concernant des aurores polaires, prises à une seule station, a été bien démontré par les conclusions importantes qu'on a tirées de semblables observations faites par l'Expédition de la « Maud » 1918-1925. Il paraît donc désirable d'examiner attentivement tout projet de publication relatif à un résumé utile des observations des aurores polaires.

3. — Une excellente occasion d'étudier, en grand, les résultats des expériences de la Nature est présentée par la foudre — un des rares moyens de recueillir des données sur les phénomènes de la haute atmosphère. Les résultats divergents de plusieurs études récentes sur le courant arrivant à la terre sous forme de foudre et la relation entre les conclusions à en tirer et le maintien de la charge de la Terre, soulignent l'importance qu'il y a à recueillir des données additionnelles mieux réparties sur la foudre aussi bien que sur les autres décharges qui ont lieu lorsque l'inten-

sité électrique de l'atmosphère s'élève au voisinage de celle des orages accompagnés de tonnerre.

4. — Il est très important que des mesures des effets de la pollution atmosphérique figurent sur les programmes de travail des observatoires s'occupant de l'électricité atmosphérique.

5. — Tout le monde admet qu'il existe un lien intime entre les divers phénomènes des courants telluriques et du magnétisme terrestre bien qu'on en ignore encore la nature précise. Il est probable que les emplacements qui conviennent aux observations magnétiques conviendront également aux mesures des courants telluriques au moins en ce qui concerne l'absence des perturbations provenant de courants artificiels. En raison du nombre tout à fait insuffisant d'installations pour mesurer les courants telluriques, il paraît désirable de prendre en considération la possibilité d'équiper en vue de telles mesures les observatoires existants les mieux placés. Les situations suivantes paraissent particulièrement désirables : (1) Pour les latitudes élevées : Spitzberg, Sitka, Sverdlovsk (Ekaterinbourg), Matochkin Shar, Orcades Méridionales ; (2) Pour les conditions nettement continentales : Asie Centrale (Irkoutsk), et Amérique du Nord centrale (Tucson) ; (3) Pour les conditions nettement océaniques : Iles Hawaï (Honolulu) ; (4) Pour les basses latitudes : Batavia-Buitenzorg, Apia, Alibag, Porto Rico ; (5) Pour les latitudes moyennes et la répartition générale : Nouvelle-Zélande (Christchurch), États-Unis (Cheltenham), Amérique du Sud (Pilar). Il est désirable que des mesures des courants telluriques soient instituées dans les autres observatoires. Les expériences faites à Watheroo mettent en évidence l'avantage de posséder un appareil permettant d'obtenir indépendamment pour chaque composante deux ou plusieurs enregistrements. On est ainsi en mesure d'estimer avec précision la qualité des résultats obtenus.

Lorsque dans un observatoire les appareils destinés à mesurer le potentiel fonctionnent d'une manière satisfaisante, il importe qu'on fasse un levé de la résistivité de la région afin de pouvoir ainsi évaluer la densité du courant tellurique et de faire une bonne comparaison des enregistrements obtenus aux divers observatoires. Cela pourrait être fait à tous les observatoires par un même observateur se servant d'un même appareil. On recommande à la Section d'appuyer ce projet. Quant à la terminologie de la résistivité terrestre, on suggère les unités suivantes : Ohm-centimètre (ou mho-centimètre) ou ohm-mètre (ou mho-mètre).

6. — Bien qu'il existe divers corps internationaux ayant des comités qui s'occupent, jusqu'à un certain point, de pareilles questions, on a besoin de données additionnelles et de recherches sur le magnétisme et l'électricité terrestres. Ce problème pourrait être abordé par l'étude de la haute atmosphère par rapport à la couche conductrice et de ses variations, etc. L'élaboration d'un

plan ou programme commun d'observation et une décision au sujet des instruments convenables sont de grande importance.

Louis A. BAUER, *Directeur* ;

J. A. FLEMING, *Sous-Directeur.*

Washington, D. C., le 30 *juin* 1927.

BLUE HILL OBSERVATORY OF HARVARD UNIVERSITY

D. — *General Proposals*

D 3.—Desirability of securing additional statistics of lightning flashes ; we should include *invisible* discharges as well as the visible incandescent streaks ordinarily called lightning flashes. Theze unseen discharges are detected by the electrometer, and by radio. I have particularly in mind electrometer records showing the equalization of potential, evidenced by the quick return of the spot of light on the ground glass scale to zero.

These are not apparently luminous nor followed by thunder or any sound wave, so far as we know. Possibly they are discharges from one part of a cloud to another part, for thunderclouds, cumulo-nimbus and possibly other types can be bipolar. As Professor C. T. R. Wilson recently pointed out a discharge might occur from the top portion of a cloud into the upper air. In wich case probably there would be no flash or path of incandescent air ; and no thunder. Nevertheless it would be essentially a discharge destroying for the time being, the electric field ; and of interest to those studying atmospheric electricity.

The apparatus needed would be a dark chamber, a self-registering electrometer, a lightning recorder, and some means of recording visible flashes as distinguished from the invisible.

Alexander MCADIE, *Director.*

Readville, Massachusetts, May 10, 1927.

RADIO LABORATORY, NEWTON CENTRE

D. — *General Proposals*

The comparison of six months' measurements of reception here of station WBBM at Chicago in 1927 with forty-three rather scattered readings of the same station taken near Washington by the Bureau of Standards indicate these readings to be unmistakably related, but individual nights show well marked differences. Of course, the path from Chicago to Newton Centre is in a somewhat different direction from that joining Chicago and Washington. One of these transmissions, namely that joining Chicago and Newton, runs nearly east and west, and therefore, approximately at right-angles to the earth's magnetic field, whereas, the path between Chicago and Washington is nearly northwest-southeast and therefore, has a considerable component parallel with the earth's field. This is an important point for investigation and will require systematic observations of a suitable network of stations and is one which might advantage be suggested for study at the approaching conference.

I still find the ratio of moving 7-day averages to 27-day averages useful, although in dealing with the relations within the period of the solar rotation, the method of periodic averages gives excellent results. This is particularly true in the case of the 1927 Washington measurements of WBBM which are so scattered that they would be difficult by the method of moving averages.

Systematic night-reception measurements in the frequency band 750-1500 kilocycles (400-200 meters) should be made in Europe, and I should be very glad to have this urged at the Prague meeting. These frequencies have so far shown the most marked relations with solar and magnetic elements, and in Europe, as in this country, they fall in the broadcasting band, thus insuring an abundance of night transmission for measurement. Reception-measurements made at such widely-separated points as this country and Europe might well eliminate the effect of local controls, as for example meteorological elements.

As to the time-basis upon which magnetic elements should be made, I should strongly urge the use of G. M. T. In my work so far this matter has been rather secondary in importance, the shortest time-interval I have used is the day, and the difference between my local time (75th meridian) and G. M. T. is only five hours.

Greenleaf W. PICKARD,
Research Associate,
Carnegie Institution of Washington.

Newton Centre, August 4, 6, 1927.

PART V

COMMUNICATIONS

SUMMARY OF MAGNETIC-SURVEY WORK BY THE CARNEGIE INSTITUTION OF WASHINGTON, (1905-1926)

By J. A. FLEMING and H. W. FISK

The general magnetic survey of the globe, to the accomplishment of which the Carnegie Institution of Washington, trough its Department of Terrestrial Magnetism, devoted its energies for manys years, has been completed for the major part of the Earth. While this task has been accomplished largely through the labors of the Department, these were directed chiefly to the ocean areas and to those countries or regions for which magnetic data would not otherwise be obtained promptly. In some regions, required magnetic surveys were accomplished by cooperation with existing organizations or with interested investigators. Valuable data in polar regions have been obtained by successful cooperation with the Peary Arctic Expedition, the Mawson Antarctic Expedition, the Amundsen Arctic expeditions, and the Baffin Land and North Greenland expeditions of Dr. Donald B. MacMillan.

During the last decade the observers of the Department have for the most part been concerned with securing secular-variation data by means of the reoccupation of magnetic stations established by previous observers. It has been found practicable also to visit a few regions not hitherto reached in a course of earlier surveys, for example, certain portions of the interior of

Brazil, the island of Madagascar, the Bahama Islands, and regions covered by arctic expeditions. Thus, at the end of 1926, repeat stations fairly well distributed for purposes of secular-variation discussion had been occupied in the general region of the South Pacific, in Australia and New Zealand, ower all of Central America and South America, throughout the West Indies, and in parts of Africa including Morocco, West Africa from the mouth of the Niger to Lake Tchad, and portions of East Africa

A general idea of the extent of the operations of the Department and an indication approximately of the density of distribution of the places at which observations have been made in the several regions are given in Table 1.

TABLE 1.—*Summary of Land Operations of the Carnegie Institution of Washington Through its Department of Terrestrial Magnetism,* 1905 *to* 1926.

Geographical divisions	Station enumerated Volume				Totals 1905 to 1926	
	I 1905-1910	II 1911-1913	IV 1914-1920	VI 1921-1926	Stations	Expeditions (*a*)
Africa	389	191	481	113	1,174	22
Asia (*b*)	323	82	(*c*) 405	(*d*) 353	1,163	23
Australasia	11	284	336	117	748	23
Europe	42	36	32	24	134	5
North America	368	50	139	202	759	43
South America	115	248	369	240	972	27
Islands :						
Atlantic	77	16	20	203	316	12
Indian	1	14	33	71	119	3
Mediterranean	2	2	—	4	8	3
Pacific	64	16	106	75	261	12
Antarctic Regions	—	31	—	—	31	1
Totals	1,392	970	1,921	1,402	5,685	174

a) Including expeditions engaged in minor operations and special work.
b) Including stations occupied by the MAUD in the Arctic Sea off the coast of Siberia.
c) Including 41 stations occupied by the MAUD during 1918 to 1920 but published in Volume IV.
d) Not including 41 stations published in this volume which were occupied during 1918 to 1920; see preceding footnote.

Table 2 summarizes all of the Department's land results for the past 22 years by geographical divisions, including station-occupations and number of repeat localities and repeat occupations.

The ocean work of the Department was initiated in 1905. The early work in the Pacific Ocean during 1905 to 1908 was carried out on the chartered brigantine GALILEE. In 1909 a

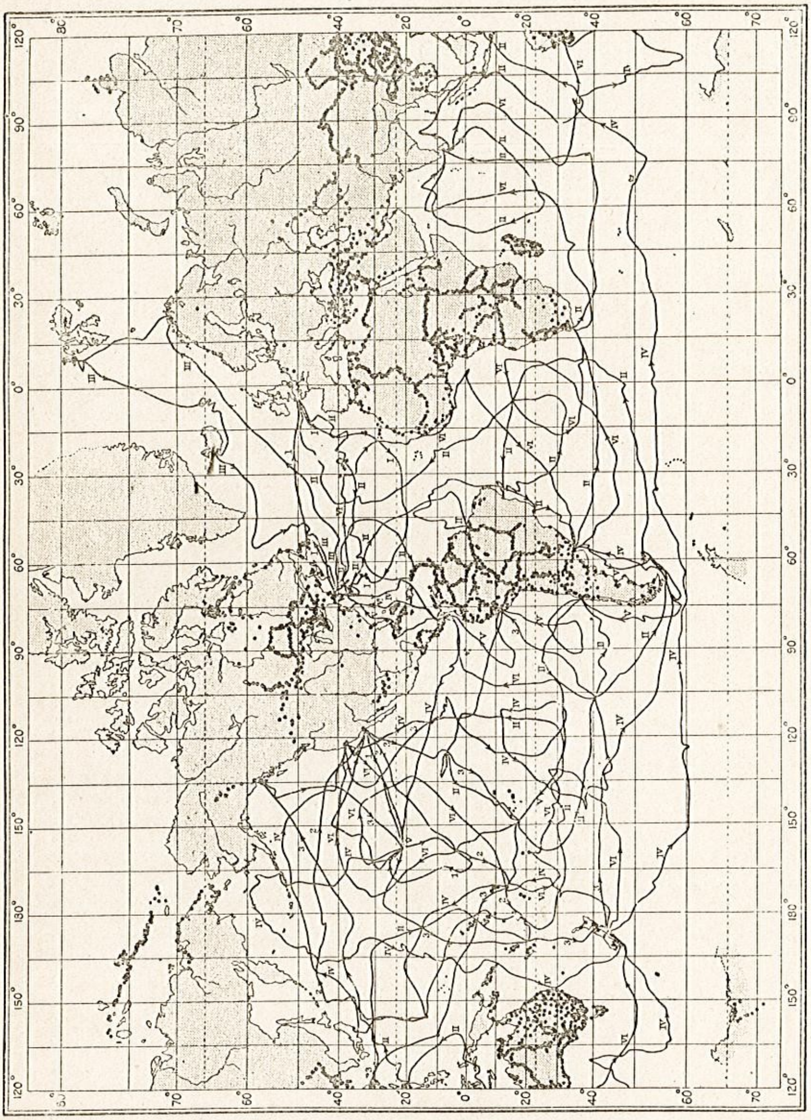


Fig. 1. — Magnetic Survey-Work of the Carnegie Institution of Washington during 1905-1926 (Cruises of the *Galilee* are indicated by Arabic numbers, those of the *Carnegie* by Roman numerals; black dots show the land stations).

specially designed non-magnetic vessel, the CARNEGIE, was built, and all our work at sea since that time has been done with this vessel excepting a special expedition into Hudson Bay in 1919 on a chartered schooner. The summary of ocean magnetic work

TABLE 2.—*Summary of Land Operations Showing Details of Station-Occupations and of Repeat-Localities,* 1905 *to* 1926.

Geographical-divisions	Station-occupations			Repeat-localities	
	Primary	Auxiliary	Secondary	Number	Occupations
Africa	1,083	78	13	113	253
Asia (*a*)	782	130	251	64	163
Australasia	613	57	78	96	250
Europe	94	31	9	14	39
North America	600	127	32	79	217
South America	823	117	32	112	304
Islands :					
Atlantic	154	115	47	30	79
Indian	94	16	9	4	11
Mediterranean	8	0	0	3	6
Pacific	188	48	25	44	109
Antarctic regions	25	1	5	2	4
Totals	4,464	720	501	561	1,435
Total station–occupations					5,685

(*a*) Including stations occupied by the MAUD in the Arctic Sea off the coast of Siberia.

TABLE 3.—*Summary of Magnetic Work at Sea by the* GALILEE *and the* CARNEGIE *during Eight Cruises in* 1905-1921.

Ocean and approximate epochs of observation	No. of nautical miles	No. of obs'd values		Cruise inter-sections used for annual-change data	Square statute miles per station	
		Declination	Inclination and hor. int.		Declination	Inclination and hor. int.
Pacific : 1905-08, 1912, 1915-16, 1921	181,423	1,800	1,183	47	35,600	53,700
Atlantic : North, 1909-10, 1913-14, 1919; South, 1910-13, 1920	92,053	1,039	682	27	30,300	46,300
Indian: 1911, 1920	43,060	477	282	7	59,100	99,800
Total	316,536	3,316	2,147	81	37,300	57,500

of the GALILEE and the CARNEGIE during 1905 to 1921 as given in Table 3 (see also Fig. 1) shows the total number of observed values of declination to be over 3,300, and of inclination and horizontal intensity to be over 2,100, the stations being distributed in the Pacific, Atlantic, and Indian oceans in the proportion of about 4, 2, and 1, respectively. While the oceans have now been quite thoroughly traversed between parallels 60° north and 60° south, there still remain areas of 500,000 square miles or more in extent, especially in the Pacific Ocean, within which no magnetic observations have been made.

The results of the ocean work have been incorporated in the isomagnetic charts of the leading hydrographic offices, and chart-errors, which reached an appreciable magnitude in 1905, are now within limits sufficient for all economic purposes and to a large degree for general magnetic investigations. Such as do exist may usually be attributed to imperfect knowledge of the secular changes which are more complicated even over the deep see than was supposed to be the case.

A comprehensive exhibit of the general uniformity of distribution of the repeat-localities is presented by the equal-area map in Figure 2 (1) upon which the total numbers of repeat-stations for areas of convenient size are represented by numbers within circles (the numbers within the squares are the corresponding numbers of secular-variation positions derived from the ocean surveys).

A summary showing the totals of repeat-localities as distributed in the arbitrary divisions indicated by the heavy lines in Figure 2 is given in Table 4.

During the earlier work of the CARNEGIE, atmospheric-electric observations were made at sea primarily to develop methods and appliances for the determination of electric distribution. Much of this preliminary work gave relative values only, but as the result of this work and of experimental work in the laboratory it was possible, beginning in March 1915 wich the fourth cruise of the vessel, to make systematic absolute determinations of atmospheric-electric elements at sea.

The atmospheric-electric results at sea from 1915 to 1921 include potential gradient (see Fig. 3), negative and positive ionic content, conductivity, and ionic mobility, penetrating radiation, and radioactive content, together with accompanying detailed meteorological data. They are summarized in Table 5 for 955 stations in all oceans at which one or more elements were observed and for 96 series for diurnal variation of one or more elements including four hours or more of observation.

(1) The base used for this figure is the "homolosine equal-area projection" prepared by Professor J. Paul GOODE, copyright by the University of Chicago and used with permission.

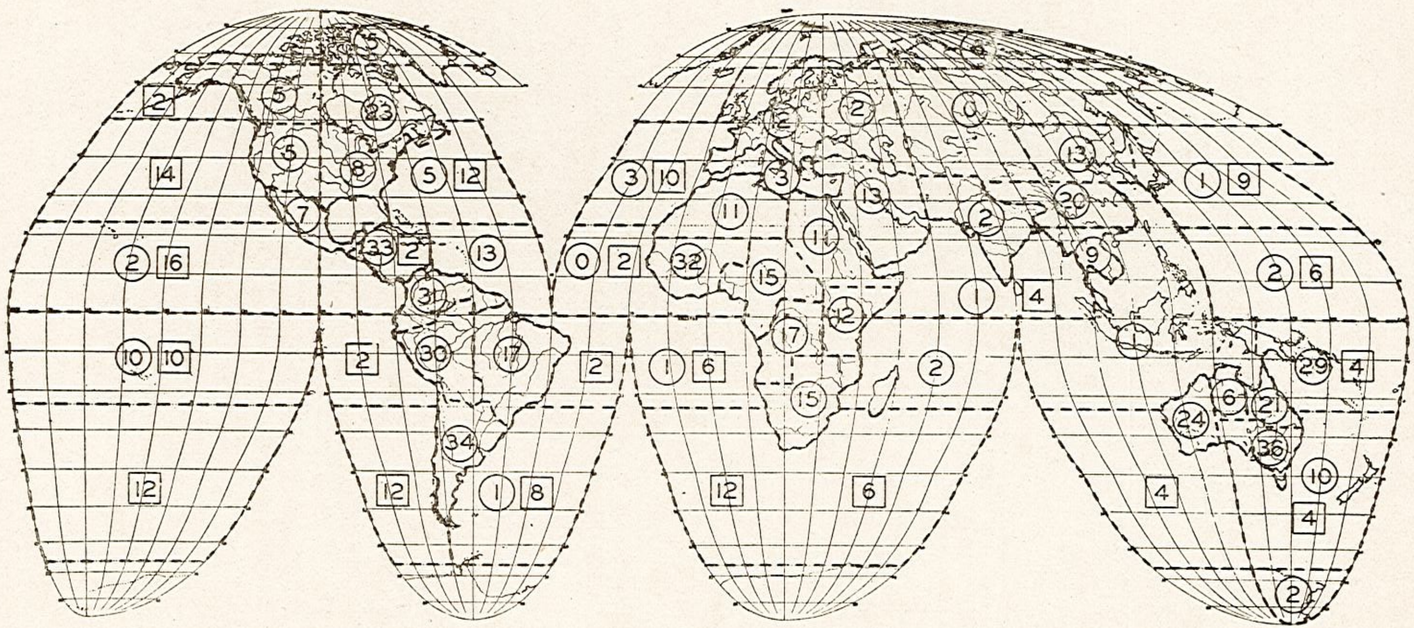


Fig. 2. — Regional Distribution of Magnetic Secular-Variation Data through 1926, obtained by the Carnegie Institution of Washington (Numbers in circles apply for land work and in squares for sea work; base map is that of J. Paul Goode, copyright by the University of Chicago Press).

Table 4. — *Summary Showing Regional Distribution of Secular-Variation Magnetic Data Department Terrestrial Magnetism, Carnegie Institution of Washington,* 1905-26 *Arranged According to Arbitrary Geographical Divisions Indicated on Figure* 2.

Geogr. division	Region or country		No. localities
1	Alaska and Western Canada		5
2	Greenland		5
3	Eastern Canada	16	
	Newfoundland and Labrador	7	23
4	Western United States		5
5	Eastern United States		8
6	Bermuda		5
7	Mexico		7
8	Central America	26	
	West Indies (West)	7	33
9	West Indies (East)		13
10	Colombia	9	
	Ecuador	4	
	Venezuela	9	
	Guiana	9	31
11	Peru	21	
	Bolivia	4	
	Brazil (West)	5	30
12	Brazil (East)		17
13	Chile	14	
	Argentina	17	
	Paraguay	2	
	Uruguay	1	34
14	Falkland Islands		1
15	Hawaiian Islands	1	
	Fanning Islands	1	2
16	Cook Islands	1	
	Samoan Islands	3	
	Society Islands	1	
	Tokelau Islands	3	
	Tonga Islands	2	10
17	Cape Verde Islands		0
18	Madeira Islands	1	
	Canary Islands	2	3
19	Europe (West)		12
20	Europe (East), Batum and Tiflis		2
21	Mediterranean		3
22	Asia Minor	11	
	Arabia	2	13
23	Morocco	5	
	Algeria	2	
	Algerian Sahara	1	
	Tunisia	2	
	Tripolitania	1	11
24	West Africa	22	
	Gambia	1	
	Gold Coast	3	
	Sierra Leone	3	
	Liberia	3	32
25	Nigeria	8	
	French Equator. Africa	4	
	Cameroun	3	15
26	Egypt	4	
	Sudan	1	
	Abyssinia	3	
	Eritrea	2	
	Somaliland	1	11
27	Belgian Congo	8	
	Angola	9	17
28	Uganda	2	
	Kenya Colony	6	
	Tanganyka	4	12
29	St. Helena Island		1
30	Southwest Africa	6	
	British South and Central Africa	6	
	Portuguese East Africa	3	15
31	Zanzibar	1	
	Madagascar	1	2
32	North Siberia		6
33	South Siberia		0
34	India		2
35	North China		13
36	Middle China		20
37	South China	5	
	Indo-China	3	
	Straits Settlements	1	9
38	Japan		1
39	Marshall Islands	1	
	Marianas	1	2
40	East Indies (Java)		1
41	Western Australia		24
42	Northern Territory		6
43	Queensland		21
44	South Australia, New South Wales, Victoria, and Tasmania		36
45	New Zealand	9	
	Lord Howe Island	1	10
46	Bismarck Archipelago	1	
	Ellice Islands	8	
	Fiji Islands	1	
	New Caledonia and Loyalty Islands	5	
	New Guinea	6	
	New Hebrides	1	
	Solomon Islands	7	29
47	Anctarctic		2
	Ceylon		1
	Grand total		561

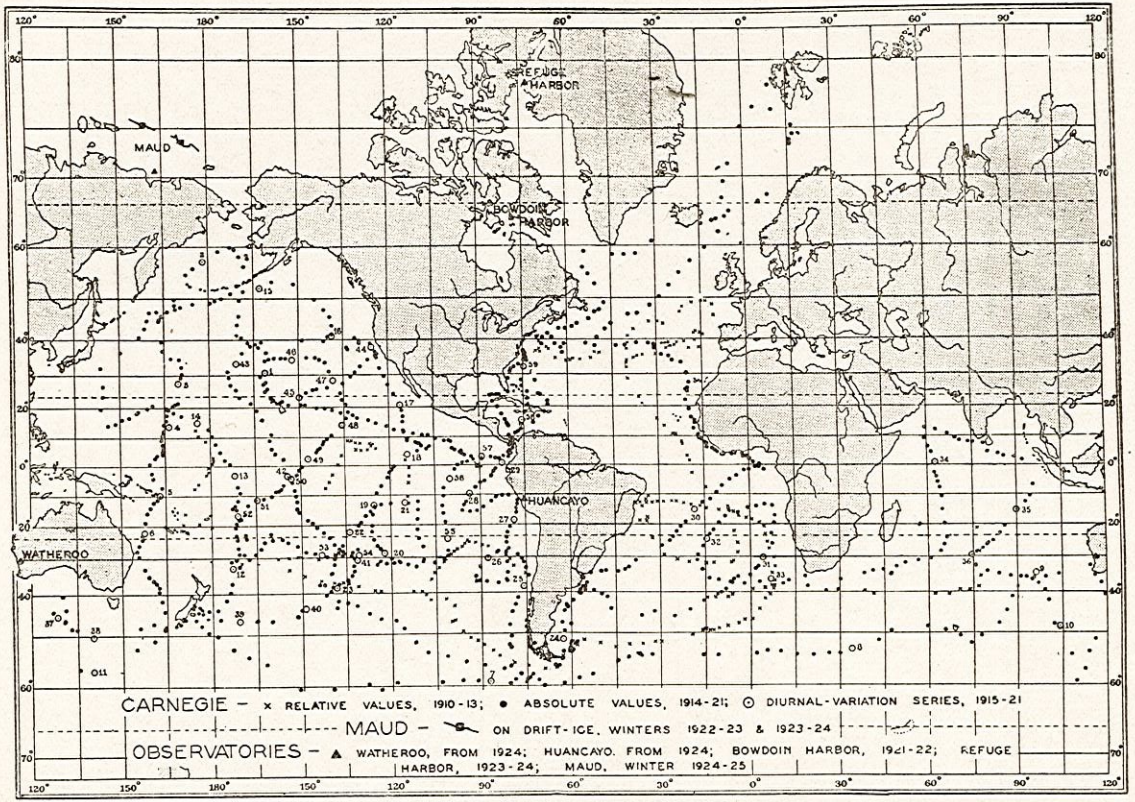


Fig. 3. — Electric Survey-Work of the Carnegie Institution of Washington during 1910-1926
(Distribution of atmospheric potential-gradient stations of the *Carnegie*, of the *Maud*, and at observatories).

TABLE 5.—*Atmospheric-Electric Stations at Sea and Diurnal-Variation Series during Cruises of the* CARNEGIE, 1915-1921, *for One or More Elements and Series of Four Hours or More.*

Cruise	Ocean							
	Atlantic		Pacific		Indian		Southern	
	No. of stations	No. of D. V. series	No. of stations	No. of D. V. series	No. of stations	No. of D. V. series	No. of stations	No. of D. V. series
IV....	22	1	293	27	—	—	76	14
V.....	38	2	66	7	—	—	—	—
VI....	164	8	178	27	118	10	—	—
Totals.	224	11	537	61	118	10	76	14
Total for all oceans 1915–1921 : stations, 955; diurnal–variation series, 96								

Carnegie Institution of Washington, Department of Terrestrial Magnetism,

July 15, 1927.

MEMORANDUM REGARDING REPORT ON THE WORK OF THE SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY OF THE FRENCH COMMITTEE OF GEODESY AND GEOPHYSICS FOR THE PRAGUE MEETING

By J. A. Fleming

The Department is naturally greatly interested in the proposed work in the Pacific Islands and also in the statements regarding the laws concerned with the secular variations. There is no doubt that Professor Mathias may find of interest in this connection the work by H. W. Fisk on secular variations in South America which includes the oceanic areas of the Pacific and the Atlantic adjacent (*Terr. Magn.*, v. sq, 1924, pp. 139-148).

The report regarding the work in Tunisia and Algeria is of interest also to the Department particularly in view of our concentration of observation in the continent of Africa in order to make a study of the secular variations over that continent. The Department would be glad to receive results at stations in Tunis and Algeria as soon as available.

The proposed magnetic survey of Indo-China promises to be of unusual interest because of the location of the center of maximum horizontal-intensity in that country. Professor Mathias will doubtless be interested in the results obtained by the Department in Indo-China since 1921 which are now in the course of publication in Volume VI of the Department's *Researches*. Copies of the first proofs from this volume giving the tables of results during 1921 to 1926 for the islands and countries in which the French Committee is interested are attached.

The Department is especially pleased to learn that the plans for the work in the Pacific contemplate the comparison of the instruments used at its Watheroo Observatory. This is particularly opportune in advancing the subject of inter-comparisons of standards by the various countries since the *Carnegie* will also compare instruments at Watheroo, at Apia, and at Christchurch.

Carnegie Institution of Washington
Department of Terrestrial Magnetism,

August 11, 1927.

Latest data concerning Magnetic Observatories, 1927

Compiled by J. A. Fleming

Observatory	Lat.	Long.	Latest Publication ([1])	Latest Magnetic Elements					Person in Charge of Magnetic Work in 1927
				Year	Decl'n (D)	Incl'n (I)	Hor. Int. (H)	Ver. Int. (Z)	
	° ′	° ′			° ′	° ′	c. g. s.	c. g. s.	
Matochkin Shar	73 16 N	56 24 E	1928	1924	20 37.5 E	80 05.4 N	.09491	.54326	—
Godhavn	69 14 N	55 32 W	—	—	—	—	—	—	J. Olsen
Sodankylä	67 22 N	26 39 E	1928	1924	1 41 2 E	75 45.4 N	.12490	.49204	E. Sucksdorff
Lerwick	60 09 N	1 11 W	1928	1926	15 02.8 W	72 37.1 N	.14618	.46699	A. A. R. Goldie
Pavlovsk (Sloutzk)	59 41 N	30 29 E	1928	1926	3 34.7 E	71 31.5 N	.15715	.47035	P. Gousiev
Sitka	57 03 N	135 20 W	1924	1927 ([2])	30 23.5 E	74.27.6 N	.15491	.55394	F. P. Ulrich
Ekaterinburg (Sverdlosk)	56 50 N	60 38 E	1928	1926	11 01.0 E	72 08.5 N	.16643	.51033	R. Abels
Rude Skov	55 51 N	12 27 E	1928	1927	6 33.4 W	69 11.6 N	.16974	.44670	J. Egedal
Kasan (Samistsche)	55 50 N	48 51 E	1928	1926	9 03.3 E	70 18.3 N	.17191	.48028	W. Uljanin
Koutchino	55 46 N	37 58 E	—	—	—	—	—	—	A. Zaborowsky
Eskdalemuir	55 19 N	3 12 W	1928	1926	15 25.3 W	69 40.3 N	.16648	.44939	A. H. R. Goldie
Meanook	54 37 N	113 20 W	1928	1926	27 04.2 E	77 53.8 N	.12832	.59844	R. F. Stupart
Stonyhurst	53 51 N	2 28 W	1928	1927	14 26.5 W	68 43.5 N	.17231	.44251	J. P. Rowland, S. J.
Wilhelmshaven	53 32 N	8 09 E	1913	1911	11 28.2 W	67 30.7 N	.18110	.43747	E. Stück (1919)
Irkutsk (Zuja)	52 28 N	104 02 E	1928	1926	0 42.9 E	71 16.8 N	.19023	.56141	A. I. Pödder
Potsdam	52 23 N	13 04 E	1928	1926	6 20.6 W	66 42.6 N	.18503	.42982	Ad. Schmidt
Seddin	52 17 N	13 01 E	1928	1926	6 22.3 W	66 39.7 N	.18539	.42968	O. Venske
Swider	52 07 N	21 15 E	1926	1924 ([2])	2 58.0 W	66 42.0 N	.18645	.43294	St. Kalinowski
De Bilt	52 06 N	5 11 E	1927	1926	10 13.1 W	66 55.5 N	.18337	.43040	G. van Dijk
Valencia	51 56 N	10 15 W	1928	1926 ([3])	18 10.8 W	68 00.1 N	.17835	.44147	L. H. G. Dines
Bochum	51 29 N	7 14 E	1923	1926	9 19.7 W	—	—	—	W. Löhr
Kew	51 28 N	0 19 W	1927	1924	13 45.1 W	66 90.5 N	.18392	.43205	Charles Chree
Greenwich	51 28 N	0 00	1927	1925	13 09.9 W	66 51.4 N	.18414	.43080	F. W. Dyson
Abinger	51 11 N	0 23 W	1927	1927	12 58.4 W	66 36.2 N	.18575	.42932	F. W. Dyson
Uccle	50 48 N	4 21 E	—	1925	10 52.7 W	—	—	—	A. Hermant

Latest data concerning Magnetic Observatories, 1927

Observatory	Lat.	Long.	Latest Publication (1)	Latest Magnetic Elements: Year	Decl'n (D)	Incl'n (I)	Hor. Int. (H)	Ver. int. (Z)	Person in Charge of Magnetic Work in 1927
	° ′	° ′			° ′	° ′	c. g. s.	c. g. s.	
Hermsdorf	50 46 N	16 14 E	—	1913	6 58.2 W	—	—	—	Schmalenbach
Prague	50 05 N	14 25 E	1928	1926	5 27.7 W	—	—	—	V. Láska
Val Joyeux	48 49 N	2 01 E	1928	1926	11 43.8 W	64 39.2 N	.19650	.41482	L. Eblé.
Munich	48 09 N	11 37 E	—	1926	6 54.2 W	—	—	—	F. Burmeister
O'Gyalla (Stará Ďala)	47 53 N	18 12 E	1928	1926	3 57.2 W	—	—	—	V. Láska
Nantes (Petit-Port)	47 15 N	1 34 W	1928	1926 (4)	12 48.2 W	63 40.3 N	.20227	.40876	E. Tabesse
Odessa	46 26 N	30 46 E	1928	1925	1 36.4 W	63 18.9 N	.21213	.42206	M. Aganin
Pola	44 52 N	13 51 E	1923	1922	6 28.0 W	60 12.8 N	.22090	.38591	Teodoro Haas
Agincourt	43 47 N	79 16 W	1928	1927	7 16.4 W	74 44.3 N	.15664	.57412	R. F. Stupart
Karsani	41 50 N	44 42 E	1927	1926	4 12.3 E	58 03.0 N	.24694	.39595	M. Nodia
Capodimonte (Naples)	40 52 N	14 15 E	—	1922	6 25.7 W	57 02.6 N	.23705	.36563	A. Bemporad
Ebro (Tortosa)	40 49 N	0 31 E	1928	1926	10 59.1 W	57 27.7 N	.23362	.36617	Luis Rodés, S. J.
Coimbra	40 12 N	8 25 W	1925	1926 (2)	14 28.5 W	58 12.4 N	.23144	37337	A. F. de Carvalho
Cheltenham	38 44 N	76 50 W	1927	1927 (2)	6 45.8 W	71 02.9 N	.18765	.54646	George Hartnell
Athens	37 59 N	23 42 E	1910	1908 (4)	4 53.0 W	52 11.7 N	.26197	.33613	D. Eginitis
San Miguel	37 46 N	25 39 W	1928	1926 (5)	18 50.9 W	60 00.4 N	.23247	.40275	J. Agostinho
San Fernando	36 28 N	6 12 W	1928	1927 (3)	12 59.1 W	53 37 7 N	.25051	.34021	León Herrero
Kakioka	36 14 N	140 11 E	1923	1916	5 17.6 W	49 31.7 N	.29743	.34859	S. Imamiti
Tsingtau	36 04 N	120 19 E	1922	1920 (-)	4 12.9 W	52 07.0 N	.30817	.39610	Kao Kiun
Tucson	32 15 N	110 50 W	1925	1927	13 44.1 E	59 32.6 N	.26585	.45210	A. K. Ludy
Lukiapang	31 19 N	121 02 E	1927	1922	3 25.1 W	40 30.5 N	.33204	.33799	J. de Moidrey, S. J.
Dehra Dun	30 19 N	78 03 E	1928	1926	1 26.3 E	45 26.1 N	.32933	.33436	R. H. Thomas
Helwan	29 52 N	31 20 E	1928	1922	1 07.8 W	41 17.8 N	.29957	.26316	P. A. Curry
Hongkong	22 18 N	114 10 E	1928	1927	0 31.7 W	30 39.9 N	.37376	.22161	T. F. Claxton
Honolulu	21 19 N	158 04 W	1924	1927 ( )	10 04.7 E	39 28.9 N	.28634	.23589	J. H. Peters
Teoloyucan	19 45 N	99 11 W	1923	1925 (2)	9 14.6 E	—	—	—	R. O. Sandoval
Toungoo (6)	18 56 N	96 27 E	1928	1923	0 31.9 W	23 06.1 N	.39207	.16725	—

Latest data concerning Magnetic Observatories, 1927

Observatory	Lat.	Long.	Latest Publication (1)	Latest Magnetic Elements: Year	Decl'n (D)	Incl'n (I)	Hor Int. (H)	Ver. Int. (Z)	Person in Charge of Magnetic Work in 1927
	° ′	° ′			° ′	° ′	c. g. s.	c. g. s	
Alibag	18 38 N	72 52 E	1928	1923	0 08.9 E	25 09.6 N	.36985 (7)	.17372 (7)	S. K. Banerji
Vieques (8) (Porto Rico)	18 09 N	65 27 W	1925	1924 (2)	4 14.9 W	51 41.9 N	.27510	.34908	W. M. Hill
Antipolo	14 36 N	121 10 E	1927	1924	0 31.5 E	15 59.7 N	.38201	.10950	M. Saderra Masó
Kodaikánal (6)	10 14 N	77 28 E	1928	1923	2 00.7 W	4 41.3 S	.37950	.03117	—
Batavia-Buitenzorg	6 11 S	106 49 E	1927	1924 (9)	0 52.6 E	32 02.8 S	.36839	.23062	S. W. Visser
St. Paul de Loanda	8 48 S	13 13 E	—	1919	14 49.0 W	—	—	—	—
Huancayo	12 03 S	75 20 W	—	1927 (3)	7 50.7 E	1 17.3 N	.29737	.00669	O. W. Torreson
Apia	13 48 S	171 46 W	1927	1926	10 26.1 E	30 08.3 S	.35216	.20446	C. J. Westland
Tananarive	18 55 S	47 32 E	1921	1918	8 04.2 W	53 23 6 S	.22260	.29966	E. Colin, S. J. (1918)
Mauritius	20 06 S	57 33 E	1928	1927	11 32.0 W	52 28.8 S	.22804	.29701	A. Walter
La Quiaca	22 08 S	65 43 W	—	1926 (3)	5 21.5 E	12 26.5 S	.26429	.05831	H. Valentiner
Vassouras	22 24 S	43 39 W	1927	1926	12 10.5 W	15 31.2 S	.24293	.07205	G. Soares
Watheroo	30 19 S	115 53 W	—	1927 (2)	4 16.3 W	64 11.9 S	.24671	.51029	H. F. Johnston
Pilar	31 40 S	63 53 W	1926	1926	6 58.2 E	25 44.0 S	.24934	.12018	O. Lützow-Holm
Toolangi	37 32 S	145 28 E	1927	1926	8 10.9 E	67 46.9 S	.22917	.56107	J. M. Baldwin
Christchurch	43 32 S	172 37 E	1928	1927	17 31.3 E	68 16 2 S	.22135	.55538	H. F. Skey
Orcadas	60 43 S	44 47 W	1913	1912 (5)	4 46.5 E	54 26.0 S	.25343	.35442	—

(1) Year of publication of latest volume known to have been issued. (2) Latest values of the magnetic elements communicated by letter.
(3) Absolute observations only. (4) Electric-car disturbances.
(5) Values of D are from magnetograms: others are from absolute observations.
(6) Observatory was discontinued September 30, 1923; values given are for the nine months January to September.
(7) A revised value of inertia adopted and used from 1923 makes changes of — .00021 and — .00010, respectively, in all published values of H and Z from 1904 through 1922.
(8) Observary was discontinued October 31, 1924, to be replaced by one near San Juan, Porto Rico; values for 1923 are the means for ten months January to October. (9) Final mean values from magnetograms.

Carnegie Institution of Washington, Department of Terrestrial Magnetism, J. A. FLEMING.

L'AIMANTATION DES LAVES DE L'ETNA ET L'ORIENTATION DU CHAMP TERRESTRE EN SICILE DU XIIe AU XVIIe SIÈCLE

Par Raymond CHEVALLIER, *Préparateur au Collège de France*

Il résulte des travaux de Melloni, Folgheraiter, Brunhes, etc., que les laves, au cours de leur refroidissement, s'aimantent suivant le champ magnétique où elles sont placées et conservent cette aimantation invariable pendant des milliers d'années. Il est donc possible, en déterminant la direction de l'aimantation d'une coulée de date connue, de retrouver l'orientation du champ terrestre à l'époque où elle s'est figée et au point particulier du globe où elle est placée. On sait que les mesures directes ne remontant pas au dela du XVIIe siècle, les renseignements obtenus par cette voie sont les seuls actuellement à notre disposition pour l'étude du magnétisme de la Terre.

J'ai cherché à faire une étude de ce genre sur un certain nombre de laves historiques de l'Etna, dans l'espoir de retrouver les variations séculaires de la déclinaison en Sicile du XIIe siècle à nos jours.

Sur les échantillons prélevés, on avait préalablement taillé un plan horizontal et repéré la direction du méridien géographique déduit de la détermination de la position du soleil à un instant donné. L'aimantation des blocs était mesurée en grandeur et direction par une méthode d'induction basée sur le résultat suivant :

Si l'on place le bloc à étudier au centre d'une bobine plate fermée sur un galvanomètre balistique et qu'on lui donne une position telle qu'en l'extrayant brusquement le galvanomètre n'accuse aucune déviation, on en déduit que l'aimantation est dans le plan des spires de la bobine plate. On détermine ainsi, dans la lave, deux plans dont l'intersection fournit la direction cherchée, qui, rapportée au plan horizontal et au méridien géographique, donne l'inclinaison et la déclinaison à l'époque de la solidification.

Toutefois pour interpréter les nombres, il fallait savoir ce que l'on peut entendre par déclinaison sur un massif volcanique où les déterminations actuelles oscillent dans un intervalle de 20°. Des mesures sur le pourtour du volcan m'ont montré que les masses aimantées immédiatement voisines ont une action prépondérante et qu'il n'y a presque pas de perturbation globale du massif. La moyenne des mesures actuelles sur une superficie suffisamment grande fournit, à peu près, la déclinaison régulière à quelque distance du volcan.

Ceci étant établi, voici les résultats principaux auxquels cette étude a conduit :

1. La moyenne des déclinaisons figées par une coulée, fournit approximativement la déclinaison hors du volcan à l'époque de l'éruption et permet bien de suivre les variations séculaires, mais l'inclinaison est beaucoup plus troublée et ne saurait être utilisée sans correction.

2. L'intensité d'aimantation variable dans les régions superficielles tend vers une limite inférieure dans les régions centrales. Cette limite inférieure seule est constante le long d'une coulée. Pour les divers courants historiques elle s'est d'ailleurs montrée sensiblement fixe et voisine de 0.008 C. G. S. Cette aimantation peut atteindre 0.015 à la surface et 0.1 à certains « punti distinti. »

3. Ces courants historiques fournissent une courbe de *déclinaison* qui prolonge exactement la courbe connue. Elle passe du côté *oriental* vers 1630, par un minimum de 18° *orientaux* vers 1440 et redevient occidentale vers 1240, fournissant une période de 750 *ans* si toutefois le phénomène continue à être périodique. Les arches orientale et occidentale, sans avoir même forme, ont d'ailleurs une même amplitude de 18° et une même longueur de 375 *ans*.

4. La courbe d'inclinaison tout en restant comprise entre 50° et 60°, montre au contraire des discontinuités que j'attribue aux laves sous-jacentes.

5. La coulée de la Sona que des raisons diverses localisent entre la décadence romaine et l'invasion normande, correspond exactement au point de vue magnétique à l'éruption de 812 et non de 1169 comme on l'avait supposé (1).

(1) Cette note est le résumé d'un travail paru, sous le même titre, dans les *Annales de Physique*, 10e série, t. IV, pp. 5-162, 1925.

ON ROCK MAGNETISM

By P. L. Mercanton

Volcanic rocks give an image of the magnetic field of the earth at the time of their solidification. As the magnetic field required to modify their weak magnetism is very considerable and as in comparatively recent times the magnetic field of the earth was never considerable in comparison to what it is to-day, the rocks may be considered to have preserved their original magnetization. So M. Chevallier found for the Etna that slightly magnetic rocks represent a photography of the magnetic state of the earth at the time when these rocks had sufficiently cooled down. A comparison of rocks from the two hemispheres is therefore highly interesting.

In tertiary rocks from Greenland the direction of the inclination is very different from the actual one, and even inverse. Equally tertiary rocks from Australia show likewise inverse inclination. In Tertiary times we have therefore to do with a characteristic inversion of magnetic inclination between Greenland and Australia.

By verification in the laboratory in materials from various parts of the world, one would have soon a table of the repartition of ancient magnetism.

ON "NON-CYCLIC CORRECTIONS" AT THE WATHEROO OBSERVATORY

By J. A. Fleming and H. M. W. Edmonds

The so-called non-cyclic changes in magnetic declination, horizontal intensity, and vertical intensity as obtained at the Watheroo Magnetic Observatory during the years 1919 to 1924 for the means of five differences and of ten differences for the same hours on successive days have been tabulated (see specimen Table 1). The tabular values for the ten selected days are for the two adjacent hours preceding and following 0^h local zonal time, which hours usually are very quiet and regular. Those for the five international quiet days as indicated in the International List of Character of Days are for the two adjacent hours preceding and following 0^h Greenwich mean time, that is, 8^h local zonal time, when there begins a decided change in the diurnal trend; for values deduced from data for one or two hours later, there would probably be a greater variation in the two adjacent differences.

The values obtained for the five days (international quiet, referred to Greenwich mean time) and for the ten days (selected quiet referred to local zonal time) differ very frequently in sign for declination and at times for horizontal intensity and vertical intensity. They also differ considerably in value. Considering such changes as a possible reflection largely of secular changes, it is seen that they differ enormously in value from those which would be obtained from considerations of secular variation, not only in magnitude but also in sign for horizontal intensity and vertical intensity. Moreover, decidedly different values may be obtained depending upon the particular hours selected.

The method of discussion above may be objected to on the score of non-uniformity of data as regards working from groups all based on Greenwich mean time. Therefore, as a test, the data for vertical intensity at Watheroo for the year 1919 were tabulated to show the hourly values before and after the begin-

TABLE I.—*Mean Daily "Non-Cyclic Correction" in Magnetic Declination at the Watheroo Magnetic Observatory for each month during* 1919 *to* 1924.

(West declination of north-seeking end of magnet reckoned as positive)

Year	1919				1920			
Group of days	5 inter. quiet		10 selected		5 inter. quiet		10 selected	
Hours (*a*)	−0.5, 23.5	0.5, 24.5	−0.5, 23.5	0.5, 24.5	−0.5, 23.5	0.5, 24.5	−0.5, 23.5	0.5, 24.5
	′	′	′	′	′	′	′	′
Jan.	−0.12	+0.06	−0.22	−0.02	−0.40	−1.00	+0.09	+0.07
Feb.	+0.75	+1.47	+0.05	−0.43	−0.48	−0.68	+0.24	+0.26
Mar.	+0.28	+0.48	+0.33	−0.02	+0.08	+0.10	+0.30	+0.26
Apr.	−0.30	−0.36	+0.65	+0.62	−0.12	−0.22	+0.35	+0.27
May	−0.06	+0.34	+0.21	+0.11	+0.10	+0.06	+0.03	+0.02
June	0.00	+0.16	+0.08	+0.07	−0.30	−0.26	−0.10	0.00
July	+0.14	+0.06	+0.20	+0.12	+0.24	+0.30	+0.11	+0.12
Aug.	−0.12	+0.30	+0.65	+0.23	−0.14	−0.48	+0.28	+0.26
Sep.	+0.32	+0.08	+0.46	+0.15	−0.26	−0.44	+0.17	+0.31
Oct.	−0.28	−0.60	+0.01	+0.24	+0.32	+0.36	+0.23	+0.10
Nov.	+0.14	+0.38	0.00	0.00	−0.82	−1.34	+0.11	+0.19
Dec.	+0.24	+0.76	+0.05	+0.21	+0.08	−0.58	+0.03	−0.26
Means	+0.09	+0.26	+0.20	+0.11	−0.14	−0.35	+0.15	+0.13
Obs'd annual change	+0′.4		+0′.6		+0′.2		+0′.4	

Year	1921				1922			
	′	′	′	′	′	′	′	′
Jan.	+0.98	+1.46	+0.18	−0.05	−0.30	+0.24	+0.21	+0.27
Feb.	+0.64	+0.48	+0.29	+0.15	−0.04	−0.40	−0.12	+0.15
Mar.	+0.06	+0.28	+0.07	−0.16	−0.16	+0.10	+0.53	+0.15
Apr.	+0.28	+0.72	+0.11	+0.05	+0.12	+0.26	+0.12	−0.11
May	+0.10	+0.12	+0.19	+0.12	−0.22	−0.36	+0.14	+0.14
June	+0.30	+0.38	+0.24	+0.58	+0.12	+0.10	+0.05	+0.04
July	−0.20	−0.24	−0.09	−0.20	−0.36	−0.26	+0.06	−0.05
Aug.	−0.58	−0.62	+0.43	+0.38	−0.20	−0.06	0.00	−0.04
Sep.	+0.12	+0.08	+0.06	−0.16	−0.30	−0.20	−0.40	−0.41
Oct.	+0.10	+0.04	+0.21	+0.35	+0.46	+0.20	+0.75	+0.73
Nov.	−0.46	−0.66	−0.05	−0.15	−0.06	−0.14	+0.12	+0.15
Dec.	−0.26	−0.20	−0.10	+0.04	+0.50	+0.90	+0.20	+0.03
Means	+0.09	+0.15	+0.13	+0.08	−0.04	+0.03	+0.14	+0.09
Obs'd annual change	+0′.6		+0′.4		+1′.0		+1′.2	

(*a*) Reference is to Greenwich mean hours used for five international quiet days and to local zonal time (8 hours east of Greenwich) for the ten selected days.

TABLE I *(suite)*

Year	1923				1924			
Group of days	5 inter. quiet		10 selected		5 inter. quiet		10 selected	
Hours (*a*)	−0.5, 23.5	0.5, 24.5	−0.5, 23.5	0.5, 24.5	−0.5, 23.5	0.5, 24.5	−0.5, 23.5	0.5, 24.5
	′	′	′	′	′	′	′	′
Jan.	+0.12	+0.40	+0.09	+0.11	+0.20	+0.52	+0.25	+0.18
Feb.	—0.28	—0.02	+0.40	+0.26	—0.36	—0.28	+0.16	+0.23
Mar.	+0.24	+0.12	+0.24	+0.22	+0.08	+0.24	+0.18	+0.26
Apr.	+0.26	+0.28	+0.18	+0.11	+0.02	—0.06	+0.06	+0.02
May	+0.36	+0.40	+0.13	+0.12	—0.10	+0.16	+0.14	+0.04
June	+0.10	+0.30	+0.30	+0.15	0.00	+0.28	+0.08	+0.10
July	—0.08	—0.12	+0.12	+0.22	+0.36	+0.38	+0.05	+0.03
Aug.	—0.20	0.00	+0.09	+0.03	—0.20	—0.38	+0.14	+0.12
Sep.	—0.04	—0.06	0.00	+0.07	+0.56	+0.62	+0.55	+0.21
Oct.	+0.04	—0.10	+0.15	+0.02	—0.18	—0.08	+0.02	+0.03
Nov.	—0.24	—0.40	+0.08	+0.09	—0.18	+0.16	+0.24	+0.02
Dec.	—0.36	—0.74	+0.31	+0.15	+0.24	—0.24	+0.07	—0.01
Means	—0.01	+0.00	+0.17	+0.13	+0.04	+0.12	+0.16	+0.10
Obs'd annual change	+ 1′.3		+ 1′.5		+ 1′.6		+ 1′.5	

ning of the Greenwich-mean-time day for each of the five international quiet days and for each of the five next quiet days as indicated in the Internatonal List of Character of Days. (Because of incomplete records data for February 25 and March 18 had to be omitted in the five international-quiet-day groups and February 6, 15 and 16, and March 16 had to be used instead of February 1924, and 26, and March 5, respectively, in the five next quiet days as indicated by the International List.) Comparison of the results for individual days in this tabulation shows great differences in non-cyclic-change values according to the particular days used and the number of days used.

Test-compilations were made also for groups of successive quiet days in horizontal intensity according to the international selection as follows: (*a*) October 16, 17, 18, and 19, 1921; (*b*) April 4, 5, 6, and 7, 1922; and (*c*) March 8, 9, 10, and 11, 1923. The non-cyclic differences were determined for the successive Greenwich hours by using the means of hourly values in each group for the first three and for the last three days. The resulting successive total non-cyclic differences (first value being for means preceding hour 23-24, second for 0-1, third for

1-2, etc., last two for 23-24 and for following 0-1), expressed in gammas (0.00001 C. G. S. unit), are :

(*a*) October 16, 17, 18, and 17, 19, 1921

+ 8.0,	+ 9.7,	+ 10.7,	+ 15.0,	+ 12.0,	+ 15.3	+ 14.0,
0.0,	0.0,	+ 0.6,	+ 0.3,	+ 1.0,	+ 1.3	+ 1.7,
+ 11.3,	+ 6.7,	+ 3.0,	+ 2.3,	+ 1.4,	0.0	
+ 2.6,	+ 1.7,	+ 1.3,	+ 1.7,	+ 0 7,	— 1.0	

Mean of all, + 4.8

(*b*) April 4, 5, 6, and 5, 6, 7, 1922

+ 2.0,	+ 1.0,	+ 0.7,	0.0,	+ 2.6,	+ 5.3,	+ 7.0,
+ 2.0,	+ 2.3,	+ 2.3,	+ 3.3,	+ 4.0,	+ 4.0,	+ 3.0,
+ 5.6,	+ 3.4,	+ 2.3,	+ 2.0,	+ 3.4,	+ 2.0,	
+ 2.7,	+ 3.4,	+ 4.7,	+ 5.0,	+ 6.3,	+ 8.6	

Mean of all, + 3.3

(*c*) March 8, 9, 10, and 9, 10, 11, 1923

+ 0.3,	+ 0.6,	+ 2.6,	+ 4.3,	+ 1.7,	+ 0.4,	+ 8.7,
— 1.3,	— 1.0,	— 1.3,	— 1.0,	— 1.0,	— 0.7,	— 0.4,
+ 3.3,	+ 4.0,	+ 1.0,	— 1.0,	— 1.6.	— 1.0,	
— 0.3,	— 0.3,	— 0.7,	— 0 6,	— 1.3,	— 1.3	

Mean of all, + 0.5

Comparison of results above shows great differences in daily non-cyclic-change values according to the hour used from which to determine the change.

Thus the magnitude of any non-cyclic correction apparently will depend upon the particular selection of hours for beginning and ending made for any given set of days. It, therefore, seems that publications of observatory results should give values without correction for non-cyclic changes. There will probably always be a question as to the method of applying any such change, and at any future time this method may be the more readily modified if the original data are supplied. It is further to be noted that the number of days involved in determining such changes is usually too small to prevent a moderate irregularity in one day from influencing the correction as determined. In any case, the uncertainties of scaling, of temperature, of temperature-correction, and of scale-values will frequently approach a magnitude comparable with such non-cyclic corrections.

It is almost invariably true that one or more of the five best selected days show some feature which in itself is frequently sufficient to vitiate any deduction regarding a non-cyclic correction. This uncertainty is naturally increased for observatories in the higher latitudes where the definition of quiet, that is, normal, days is even more difficult.

Carnegie Institution of Washington,
Department of Terrestrial Magnetism,

July 20, 1927.

ON CORRECTIONS TO AMPLITUDES AND PHASE-ANGLES COMPUTED BY HARMONIC ANALYSES FOR NON-CYCLIC CHANGES ASSUMED TO BE LINEAR

By C. C. Ennis

In view of the uncertainties emphasized in the foregoing note by Messrs. Fleming and Edmonds it seems desirable, pending results of further research and test of hypotheses regarding non-cyclic changes, to make harmonic analyses of observed data without corrections for such changes. Investigators desiring the amplitudes and phase-angles as they would have been obtained if linear non-cyclic corrections had been applied can derive them easily by means of the factors indicated below. The letters *a* and *b* with appropriate subscripts are the computed values of the Fourier coefficients based on the uncorrected data and *a′* and *b′* with appropriate subscripts are those based on the data as corrected linearly for total non-cyclic change, C, over the interval considered.

For 24 equidistant values		For 12 equidistant values	
$a_1'=a_1-0.0417C$	$b_1'=b_1+0.316C$	$a_1'=a_1-0.0833C$	$b_1'=b_1+0.311C$
$a_2'=a_2-0.0417C$	$b_2'=b_2+0.156C$	$a_2'=a_2-0.0833C$	$b_2'=b_2+0.144C$
$a_3'=a_3-0.0417C$	$b_3'=b_3+0.101C$	$a_3'=a_3-0.0833C$	$b_3'=b_3+0.0833C$
$a_4'=a_4-0.0417C$	$b_4'=b_4+0.0722C$	$a_4'=a_4-0.0833C$	$b_4'=b_4+0.0481C$
$a_5'=a_5-0.0417C$	$b_5'=b_5=0\ 0543C$	$a_5'=a_5-0.0833C$	$b_5'=b_5+0.0223C$
$a_6'=a_6-0.0417C$	$b_6'=b_6+0.0417C$	$a_6'=a_6-0.0833C$	
$A'_{(mean)}=A_{(mean)}-0\ 0208C$		$A'_{(mean)}=A_{(mean)}-0.0417C$	

Carnegie Institution of Washington,
Department of Terrestrial Magnetism.

July 20, 1927.

NOTE ON DISTRIBUTION-CONSTANTS OF MAGNETOMETERS

By Charles CHREE

We occasionally encounter the formula

$$P = \frac{(A_1 - A_2)}{(A_1 r_1^{-2} - A_2 r_2^{-2})},$$

where A_1 and A_2 are the first approximation values obtained for $\frac{m}{H}$ from deflections at two distances r_1 and r_2. Q and R in the deflection formula

$$2mr^{-3}(1 + Pr^{-2} + Qr^{-4} + Rr^{-6} \ldots\ldots)$$

are neglected. The more correct formula, under the conditions supposed, is

$$P = \frac{(A_1 - A_2)}{(A_2 r_1^{-2} - A_1 r_2^{-2})}.$$

The error arises through an old formula which replaced $(1 + Pr^{-2})^{-1}$ by $1 - Pr^{-2}$. Taking $r = 30$ cm. and $P = +7.5$, a fair average value for a Kew pattern magnetometer, we have $(1 + Pr^{-2})^{-1} = 0.99174$, while $1 - Pr^{-2} = 0.99167$, a comparatively trifling difference though not negligible. But there are cases in which it is more serious.

If we suppose a magnet of length l to be replaceable by two poles, with a pole distance $2\lambda = lp$, where p is the same for the deflecting and deflected magnets, the latter being of length l^1, we have

$$P = 2\lambda^2 - 3\lambda^{1\,2} = \left(\frac{1}{2}\right)(pl)^2 \left\{1 - \left(\frac{3}{2}\right)\left(\frac{l_1}{l}\right)^2\right\}.$$

If we suppose $\frac{l^1}{l} = .4667$ — the case in which Q really does vanish — we get $P = 0.337\ (pl)^2$ approximately. Accepting for convenience 0.8 in place of Borgen's value 0.805 for p, we find for the average Kew pattern collimator magnet, the length of which is about 9.25 cm., $P = +\ 18.4$ approximately. And if for r we take 22.5 cm., a distance in use at some observatories, we have $(1 + Br^{-2})^{-1} = 0.\ 96493$, while $1 - Pr^{-2} = 0.96365$. Larger values of P and so larger errors are theoretically possible, the extreme value being got by supposing $\frac{l^1}{l}$ negligible. In this case, for the collimator magnet postulated above, we have $P = +\ 27.4$. The question of what is the best value of $\frac{l^1}{l}$ in practice is a difficult one. A small mirror on a mirror magnet has its disadvantages, and so has a large mirror on a small magnet.

Considerations other than the values of P and Q have to be taken into account, still these remain of fundamental importance. Under the conditions supposed above, neglecting all terms depending on the cross-sections of the magnets, we have

$P = p^2 l^2 f_2(z)$, $Q = p^4 l^4 f_4(z)$, $R = p^6 l^6 f_6(z)$, where $z = \frac{l^1}{l}$, and

$$f_2(z) = \left(\frac{1}{4}\right)(2 - 3z^2),$$

$$f_4(z) = \left(\frac{3}{128}\right)(8 - 40z^2 + 15z^4),$$

$$f_6(z) = \left(\frac{1}{256}\right)(16 - 168z^2 + 210z^4 - 35z^6).$$

The following are approximate values of the functions for a few selected values of z :

z	0	.3318	.4	.4667	.6714	.8165	.9048	1.0
$f_2(z)$	+.500	+.417	+.380	+.337	+.162	.000	—.114	—.250
$f_4(z)$	+.187	+.089	+.046	.000	—.164	—.281	—.344	—.398
$f_6(z)$	+.062	.000	—.022	—.043	—.079	—.051	.000	+.090

P is positive or negative according as z is less than or greater than .8165, the value for wich it vanishes. Similarly Q is positive or negative according as z is less or greater than .4667. R is negative for values of z intermediate between .3318 and .9048, the two values for which it vanishes. Otherwise it is positive. The numerically greatest negative value 0.79 of $f_6(z)$ occurs when z is .6714, and as values of z as large as 0.9 are not encountered in practice, this is the largest value we need consider. With it we obtain the following values of $\frac{R}{r^6}$ supposing the collimator magnet of length 9.25 cm.,

$r =$	22.5 cms.	25 cms.	30 cms
$\frac{R}{r^6} =$	.000100	.000053	.000018

The neglect of R entails an error of only 1 part in 50,000 when the deflection distance is 30 cms., but of 1 part in 10,000 when the distance is only 22.5 cms.

Mean values obtained for a number of Kew pattern magnetometers by three different makers gave for $\frac{l^1}{l}$ the respective values .688, .685 and .698. The corresponding values of R are only a trifle smaller than that just considered. This suggests that 22.5 cms. is too short a deflection distance for the ordinary unifilar. If the invariability of p were a physical fact, a value of z such as 0.4, intermediate between the values for which R and Q vanish, would have much to commend it, as Q and R would be both much less than in the ordinary magnetometer. But with such short mirror magnets P in practice as well as in theory is very big. This would not so much matter if P remained constant, but this unfortunately does not seem to be generally the case. For a given value of z, P, Q, and R all diminish as l is reduced. But this entails reduction of the magnetic moment of the deflecting magnet, and so of the deflection angles. An improvement of the steel, leading to a marked increase of magnetic moment, would be very valuable, as it would permit of longer deflection distances and reduce the importance of the P, Q correction.

The following mode of approaching the subject may interest the observer who confines himself to two deflection distances. If we deflect at two distances r_1 and r_2, and calculate P in the usual way ,what we really find is a quantity P_{12} given by

$$P_{12} = P + Q(r_1^{-2} + r_2^{-2}) + R(r_1^{-4} + r_1^{-2}r_2^{-2} + r_2^{-4}) + \cdots\cdots$$

When R is negligible, and u is written for r^{-2}, we have

$$P_{12} = P + Q(u_1 + u_2).$$

If we employed another pair of distances r_2 and r_3, we should get a new value for P given by

$$P_{23} = P + Q(u_2 + u_3).$$

Combining the two results, we obtain

$$P = \{ (u_1 + u_2)P_{23} - (u_2 + u_3)P_{12} \} \div (u_1 - u_3)$$
$$Q = (P_{12} - P_{23}) \div (u_1 - u_3).$$

Converting the factors into numbers, we have

r_1	r_2	r_3	P	Q
22.5	30	40	$\frac{(16 P_{23} - 9 P_{12})}{7}$	$741 (P_{12} - P_{23})$
25	30	40	$\frac{(976 P_{23} - 625 P_{12})}{351}$	$1026 (P_{12} - P_{23})$
30	35	40	$\frac{(1\,360 P_{23} - 1\,017 P_{12})}{343}$	$2057 (P_{12} - P_{23})$
25	35	45	$\frac{(2\,997 P_{23} - 1\,625 P_{12})}{1\,372}$	$904 (P_{12} - P_{23})$

A check is supplied by the fact that if P_{12} and P_{23} are equal, each must equal the true P, and Q must vanish. We may observe every time at the three distances, or we may confine ourselves to two distances, r_1 and r_2 one day, and r_2 and r_3 another. In this way, without adding to its labours, a station where deflections are taken at only two distances could readily acquire the material for calculating the true P and Q. This procedure is not, however, to be recommended if the number of absolute observations is very small, e. g. one a month.

A disquieting phenomenon, variously commented on, is the apparent fluctuation of P and Q from year. It is probable that the values obtained for P and Q are always affected to some extent by instrumental or observational deficiencies. For instance, accuracy even to 0.001 cm. in *all* the deflection distances is perhaps hardly likely, and the consequences of an error of .001 cm. may be by no means negligible, as the following results show :

Deflection distances			Correction required to P when correction .001 cm. made to			Correction required to Q when correction .001 cm. made to		
r_1	r_2	r_3	r_1	r_2	r_3	r_1	r_2	r_3
cm.	cm.	cm.						
22.5	30	40	— 0.20	+ 0.62	— 0.35	+ 114	— 238	+ 114
25	35	45	— 0.18	+ 0.71	— 0.45	+ 138	— 339	+ 187
30	35	40	— 1.01	+ 2.64	— 1.55	+ 698	— 1520	+ 806

The effect on P or Q of an error of given amount in a deflection distance depends largely on what are the other deflection distances. Its importance increases as the distance between the deflection distances is reduced. From this point of view 25, 35, and 45 cms. is a much better choice than 30, 35, and 40 cms.

The sensitiveness of P and Q to errors in the deflection distances may explain some of their apparent fluctuations. Even supposing no alteration to occur in the actual bar divisions through age or neglect, the setting of the magnet carriage to a division depends on individual idiosyncrasies. If these alter, or the observer is changed, the result may be the same as if a real change of distance occured. A change as small as 0.0005 cm. distance, when 30, 35, and 40 cms. are the three deflection distances, would account for the quite large change of 1.3 in P.

A study of the deflection formula may bring out more clearly the possible consequences of instrumental defects. Suppose then we have a horizontal magnet of moment m and pole distance 2λ, whose centre is at the origin, and whose axis coincides with the axis of x, then the component parallel to x of the magnetic force exerted at a point x, y, z, when y and x are small and z is vertical, is to a second approximation

$$2mx^{-3}\left\{1 + (2\lambda^2 - 3y^2 - 3z^2)x^{-2}\right\}.$$

If $z \neq 0$ and $y = \lambda^1$, the coefficient of x^{-2} within the larger bracket becomes $2\lambda^2 - 3\lambda^{1^2}$, the usual expression for P, with $2\lambda^1$ the pole distance of the deflection magnet. But suppose that the centre of this magnet lies not in the axis of x, but a small distance b on one side of it (still in the horizontal plane). Then y has the different values $\lambda^1 + b$ and $\lambda^1 - b$ for the two poles, and the mean of the deflecting forces on the two poles is

$$2mx^{-3}\left\{1 + (2\lambda^2 - 3\lambda^{1^2} - 3b^2)x^{-2}\right\}.$$

Another possibility is that the axis of the "mirror" magnet really lies a small horizontal distance ξ on one side of the zero on the deflection bar. The mean of the deflecting forces exerted by the deflecting magnet when on the east and west arms of the bar when we go as far as terms in ξ^2 is then

$$2mx^{-3}(1 + 6\,\xi^2 x^{-2}).$$

Thus the quantity we call P, and which would be $2\lambda^2 - 3\lambda^{1^2}$ if the construction were perfect, is really

$$2\lambda^2 - 3(\lambda^{1^2} + b^2) - \frac{3}{2}\Big)\,(z_1^2 + z_2^2) + 6\xi^2,$$

where z_1 and z_2 are the heights of the two poles of the mirror magnet above (or below) the horizontal plane containing the axis of the deflecting magnet. Changes in b, ξ, z_1 or z_2 will simulate changes in λ and λ^1.

No magnetometer is ideally perfect, as is abundantly evident from the differences observed between the deflection angles obtained with the magnet on the east and west arms. A possible cause of this is lack of perfect centering of the suspension fibre in the mirror magnet tube. The exact position of the suspension might vary with the position of the torsion head. This might influence the values of both ξ and b.

A point bearing on the values of z^1 and z^2, though seemingly not of much practical importance, appears of interest. The deflection bar is not really horizontal throughout, as it bends ; and, if the magnet carriage is accurately constructed, the deflecting magnet is parallel to the tangent drawn to the deflection bar at the deflection distance. The inclination of the deflecting magnet to the horizontal increases with the deflection distance. The height of the mirror magnet is adjusted once and for all with the aid of a sighting tube ; which, like the magnet, is parallel to the tangent to the bar at the observation point. But the sighting tube, being lighter than the magnet, is less inclined to the horizon than the magnet would be if in its place. Unless there is a standard distance for the sighting operation, the consequences vary from day to day. Fortunately, the uncertainty seems comparatively unimportant, and a general idea of the magnitudes involved will suffice. The increase δr of the deflection distance r caused by the bending is approximately $h\theta$, where h is the height of the axis of the deflecting magnet above the centre of the cross-section of the deflection bar, and θ is the inclination to the horizon of the tangent to the bar at the distance r. The elevation δz of the point where the prolongation of the axis of the deflecting magnet cuts the vertical through the centre of the deflection bar is $r\theta$, if we neglect the very small droop at the centre of the bar's cross-section. Thus

$$\delta z = \left(\frac{r}{h}\right) \delta r.$$

Now in the ordinary Kew pattern magnetometer h is about 5 cms., while .0035 cms. and .0045 cms. are fair average values for δr for the deflection distances 30 cm. and 40 cm. Thus we get as approximate values, for these two deflection distances,

$$\delta z_{30} = 0.021 \text{ cm. and } \delta z_{40} = 0.036 \text{ cm.}$$

The values of δz in the case of the original observation with the sighting tube is unlikely to be much in excess of δz_{40} or to be much less than δz_{30}. Thus the error in z through the mere bending of the tube is of the order 0.02 cm. and the consequent contribution to P is only of the order 0.001. Lack of horizontality of the mirror magnet, and stretching of its supporting fibre during the observation, are more likely causes of sensible trouble. It would certainly be worth while looking out for possible consequences when a new suspension is fitted to a mirror magnet, or when a new observer is introduced.

A word or two on the effect of errors in the deflection distances on the calculated value of H itself may be useful. Approximate values of the errors δH in H due to errors δr_1, δr_2, δr_3 — measured in centimetres — in the deflection distances are as follows:

r_1	r_2	r_3	Value of $\frac{\delta H}{H}$		
22.5	30	40	$-.040\,\delta r_1$	$+.147\,\delta r_2$	$-.125\,\delta r_3$
25	35	45	$-.028\,\delta r_1$	$+.134\,\delta r_2$	$-.122\,\delta r_3$
30	35	40	$-.178\,\delta r_1$	$+.528\,\delta r_2$	$-.366\,\delta r_3$

At a place where H = .185 an error of .001 cm. in the accepted value of the 35 cm. length would cause an error of 10γ or of only 2γ in the value of H, according as the three deflection distances were 30, 35, and 40 cms. In the former case accuracy to 0.0005 cm. is insufficient to preclude a very sensible error in H. Accuracy to 1γ requires a much higher standard of instrumental accuracy where H is high than where it is low.

Fortunately, errors of the same sign in the three distances tend to some extent to neutralise one another. If, for example,

$$\frac{\delta r_1}{r_1} = \frac{\delta r_2}{r_2} = \frac{\delta r_3}{r_3} = e,$$

we have

$$\frac{\delta H}{H} = -\frac{3e}{2}.$$

In this case, if δr_2 at 35 cms. were .0005 cm., we have

$$\frac{\delta H}{H} = \frac{1}{50{,}000} \text{ approximately.}$$

This means in practice that errors due to imperfect temperature correction or lack of accuracy in the bending experiment are much less serious than errors of measurement affecting only one particular deflection distance.

In view of the many possible sources of error, the wonder is not that magnetometers give different results for H, but that their agreement is so close as it is. Everything considered, the unifilar magnetometer has proved a remarkably satisfactory instrument. But its limitations should be recognised. If coil magnetometers admitting of systematic accuracy to 1γ come into existence, the unifilar magnetometer had better be regarded as a secondary standard for field work and the less wealthy observatories. It might then suffice to deflect at one or at most at two distances, making use of corrections derived from comparisons with a coil magnetometer at the central station of the country. Many of the numerical results given above are derived from a paper in the *Philosophical Magazine*, Aug. 1904, p. 113

Richmond, Surrey, England, February 4 1926.

PRELIMINARY NOTES ON INTENSITY-CONSTANTS OF C. I. W. MAGNETOMETERS

By J. A. FLEMING and H. W FISK

The constants of most concern in the determination of horizontal intensity by the usual magnetic method with a magnetometer, are : (*a*) Moment of inertia of the oscillating magnet with its suspension system, and (*b*) the so-called distribution-coefficient for the deflecting magnets (suspended magnet in oscillation observations) and deflected magnet in deflection observations.

The Department now has an accumulation of long series of observations using three deflection distances for magnetometers of its modified Survey-of-India type (since 1907) and of its magnetometer-inductor (since 1914). These types of instruments are described in detail in volumes I, II, and IV of the "Researches of the Department of Terrestrial Magnetism". The results of this long experience both from observations at fixed stations, for example, in comparisons at magnetic observatories throughout the world, and from field stations with observations taken under the usual difficult conditions prevailing at a field station, emphasize three precautions to be taken in the control of constants. These are : (1) Careful redeterminations of inertia from time to time to control changes due to oxidation and wear of the magnet as well as of its suspension arrangements, (2) provision of suitable arrangements to protect the deflecting magnet during observations of deflection and to protect also the deflection bar against sudden or irregular changes of temperature, and (3) provision of means by which the effective deflection distances may be invariable for the same instrument. Summaries of detailed reports concerned with such matters have been given in volumes II and IV of the Department's "Researches" in those sections devoted to the results of comparisons of magnetic standards (for 1905-1914 in Volume II and for 1915-1921 in Volume IV. During the period 1922 to date, the results of study and investigation of additional data accumulated indicate no reason to modify our original conclusions in these matters.

As regards the necessity of inertia determinations, it may be pointed out that the practice of the Department is to determine carefully before and following each field campaign with an instrument the moment of inertia of the oscillating magnet and its suspension ; observations to determine the inertia are also made at times in the field to serve as controls under field conditions. If we assume that the constants of the instrument other than inertia have not been changed in the course of the field work, then the observed difference in the correction on the standards determined before and after the field work at the Standardizing Magnetic Observatory in Washington may be assumed as a measure of the change in inertia of the oscillating magnet and its suspension. Comparison of this difference with an actual difference in the determined moment of inertia using the same standard inertia-bars for the observational work before and after the field work expressed in terms of resulting values of horizontal intensity should in this case be in agreement with the observed difference of correction. This proof almost invariably results from such work. As examples, the following may be cited for several of the Department's instruments :

Magnetometer No	Dates of comparison		Observed differences from (1) to (2)	
	(1)	(2)	Correction on I. M. S.	Inertia change
9	Feb. 1918	May 1922	— 0.00058 H	— 0.00064 H
13	Feb. 1910	Sep. 1922	— 0.00090 H	— 0.00078 H
24	May 1921	Mar. 1924	— 0.00106 H	— 0.00094 H
27	Mar. 1923	May 1924	— 0.00006 H	— 0.00008 H

The above are typical of the majority of the results obtained for the various instruments. Their evidence certainly is positive and may be taken not only as a confirmation of actual change in inertia but also as indication that no changes had taken place in the other constants concerned in determinations of intensity for the respective instruments.

The question of adequate control of temperature during deflections has not received the attention it demands. In our practice the thermometer and magnet are enclosed in a wooden housing. Even in such housings there is an appreciable change during observations definitely ascribable, for example, to the warmth of the hand. Naturally this change would be greater in winter when the difference between the temperatures of the hand and of the air is greater. They will also differ with observers. Even in a large room of an observatory there are differences between magnets east and magnets west depending on the direction of the Sun, while in a tent or hut this difference is much greater. The uncertainty in the amount of lag in temperature between the mercury of the thermometer and the steel of the magnet leave a margin sufficient to account for much of the smaller variations in the deflection angles upon which the computation of the distribution-coefficients depends. For magnetometers, therefore, in which precautions not equal to those used by us, as, for example, in many of the older types of the Kew instruments, great irregularity must be expected in the determination of the distribution-coefficients because of unknown thermal conditions for the deflecting magnet and for the deflection bar upon which to supply proper corrections for temperature effects. Thus reference to the formulas involved show that for the ordinary instrument an uncompensated difference of $0^{\circ}.1$ in temperature may produce quite appreciable differences in the resulting value of the first distribution-coefficient P or the second distribution-coefficient Q as determined from observations made at three distances. Therefore, in the compilation of distribution coefficients from results at field stations we may not find as good agreements in the resulting values of distribution-coefficients for the various instruments as in the case of observations made in observatories where naturally the protection against sudden and irregular changes in temperature are superior. It is thought that a great part of the apparent uncertainty and irregularity in determinations of distribution-coefficients may be ascribable to uncertainties of temperature corrections.

In all instruments designed by the Department the importance of maintaining invariable deflection distances in all observations has been given first consideration. We have found that this is satisfactorily accomplished by designing deflection bars in such a way that the housings for the deflecting magnets may be placed automatically at the given deflection distance. This is readily and easily accomplished by providing either tapered slots across the deflection bar or tapered holes in the deflection bar in which corresponding tapered center pins of the magnet housings engage. It is of course assumed that the observers use every care and precaution to maintain level of instruments during observations and to maintain centering of fiber suspensions.

It has been found to require so little additional time to observe deflections always at three distances rather than at two that, following the earlier years of the Department's operations, all observations have been made at three distances, thus providing data both for field observations and for standardization observations from which compilations of the first second distribution-factors may be made. The dimensions of the magnets for all the magnetometers of the Department have been adopted so that theoretically the value of the second distribution-coefficient Q would be zero. In general, however, it is found that the observed value of the first coefficient P is generally different from the theoretical value and frequently by as much as five to ten per cent, while Q has a sensible value. It has, however, been found that the use of an equivalent coefficient P' for the two distribution-coefficients meets all practical requirements both of field and observatory work within the limit of accuracy which may be reasonably expected by the magnetic method, namely, 0.0002 H. In this connection, the results of the compilations of data obtained since 1921 by the Department at Washington, in the field, and at observatories is quite in accord for these types of instruments with the compilations previously reported upon in the Volume IV. The conclusion is that for magnets made of high-grade, homogeneous magnet steel, and properly treated when originally magnetized, the distribution-coefficients, assuming ordinary care in transportation and during field work, are sensibly constant over long periods. Apparent deviations from constancy indicated at times by compilations are usually traceable to blunders or to uncertainties in actual temperature conditions in field observations.

The performance of the C. I. W. magnetometer No. 3, the standard instrument of the Department using magnetic methods since 1907, has continued to be consistent. Evidence of this is best given by a review of the resulting values of the equivalent distribution coefficient P' from the beginning of its use in the Department. These are as follows :

Year	Number of deflection sets at three distances	Resulting value of equivalent distribution coefficient P'	Deviation of computed value of H for the year from value that would have resulted had mean P' for 1907-1925 been used (1)
1907	13	13.01	— 0.00015 H
1908	51	13.21	— 0.00004 H
1910	101	12.85	— 0.00024 H
1914	113	13.41	+ 0.00003 H
1915	112	13.44	+ 0.00005 H
1916	98	13.44	+ 0.00004 H
1917	98	13.34	— 0.00006 H
1918	58	13.40	0.00000 H
1919	61	13.46	+ 0.00003 H
1921	115	13.54	+ 0.00008 H
1922	138	13.46	+ 0.00002 H
1923	67	13.49	+ 0.00002 H
1924	115	13.41	— 0.00002 H
1925	46	13.48	+ 0 00001 H
1926 (2)	48	13.48	+ 0.00001 H
Weighted mean	1234	13.381	— 0.000006 H

(1) Account being taken of inertia change as indicated below.
(2) Through June.

There has been a slight change in the moment of inertia of the oscillating magnet and its suspension for this instrument. This change has been thoroughly controlled by special inertia determinations from time to time. The net result is shown by the following formula

$$\log \pi^2 K = 3.214558 + 0.0000050\,(1920 - D)$$

where D refers to date concerned and K is the moment of inertia of the oscillating magnet together with its suspension. The last column of the above table certainly indicates that data obtained with this instrument are to be relied upon well within the limit $0.0002H$.

Carnegie Institution of Washington,
Department of Terrestrial Magnetism.

August 11, 1927.

MEMORANDUM WITH REGARD TO Dr. LA COUR'S SPECIAL REPORT FOR THE PRAGUE ASSEMBLY

By J. A. Fleming

Dr La Cour is quite right in this remark that, in arctic regions particularly, very great care is necessary in determining an exact time-scale both in the application of recorded data and in the consideration of absolute observations for the determination of base lines, and scale-values. He is to be congratuled in having developed a method by which the exact times of absolute observations are intensified in the day's photographic record, especially in the arctic regions where disturbances are frequent and rapid. For observatories in the temperate and tropic zones, where disturbances are not so common, it is thought that the plan of having the time of absolute observation definitely marked on the magnetogram is not essential, although it would of course permit some economy in the reduction and scaling of results. At the Department's observatories great care has been exercised to develop time-marking means by which actual Greenwich mean times to the nearest second are clearly and distinctly indicated on the records, through the provision of master-clock and program-machine ; the feature has been added that the hourly time-marks on *all* automatic records at one observatory apply for the precise Greenwich mean hour to the nearest two seconds. Greatest care is also exercised at the Department's observatories to eliminate by adjustment all errors due to parallax and, in order to have the means of checking absolutely against such errors, automatic records of scale-values on the trace itself at different times determined by the master-clock are made regularly, thus providing means for checking the correctness of the hourly time-marks.

As regards a time precision of two seconds in a recorded feature on a magnetogram, there may be some question as to whether so fine a limit can be realized because of inertia and damping conditions prohibiting so nearly instantaneous record of natural disturbances.

The desirability of having atmospheric-electric registering apparatus at the Godhavn Observatory cannot be over-emphasized, and it is hoped that the Danish Government may see its way clear in the near future to make provision for such work at that Observatory.

It is gratifying to note from the report the provisions made for intercomparisons of standard instruments at Godhavn by the addition of extra piers. It may be noted in this connection that both the Watheroo and Huancayo observatories, as well as the Standardizing Magnetic Observatory at Washington of the Department of Terrestrial Magnetism, are provided with extra piers and conveniences primarily for the purpose of making it possible to carry out intercomparisons of instruments readily and efficiently. The need of arrangements by which stations and instruments may be exchanged in any standardization observations to eliminate possible station-differences is of first importance in any intercomparison work.

Dr. La Cour is to be congratulated upon the success attending his electromagnetic method of determining the vertical and horizontal intensity as evidenced by the results at Godhavn. He will be interested to know that the Department's development of a coil rotating at constant speed is well under way, and that hope is entertained for the completion within the coming year of an apparatus which may be readily used in the field for electromagnetic determinations of the intensity of the Earth's field by this method.

Carnegie Institution of Washington,
Department of Terrestrial Magnetism.

August 11, 1927.

ON TERMINOLOGY AND SYMBOLS IN ATMOSPHERIC ELECTRICITY

By H. FREEBORN JOHNSTON,

Observer-in charge, Watheroo Observatory

It is suggested that Prof. Maurain be supported in his view (1) that the distinction between the symbols for positive and negative ions should be made by employing an ordinary symbol for positive ions and that the symbol for negative ions be accented. In such case it would also be necessary to change the symbol for total conductivity to, perhaps, L. It is suggested that the designation for atmospheric potential-gradient should not be X but rather P, which would avoid confusion with terrestrial magnetic intensity-component X. We note that Prof. Maurain has no designating letter for air-earth current, which it is suggested should be i. The letter q is used to represent no less than three different things, either the ratio of λ_+ to λ_-, or the ratio of a_+ to a_-, or the rate of production of ions per cubic centimeter per second. I think that q should be retained for the ratio of λ_+ to λ_- and other letters used for other quantities. The ratio of a_+ to a_- could be called d, which is the beginning letter of dissipation. The number of ions produced per centimeter per second could be named δ, since α, β, and γ are being used. There is no mention of a letter for the radioactive emanations in the atmosphere which in accordance with the nomenclature used by us is Q, expressed in curies per cubic centimeter. It is suggested that R be used to designate the number of pairs of ions produced in a closed vessel by the penetrating radiation, and that B be used to designate the atmospheric-potential-gradient reduction factor.

June 1, 1927.

(1) See page 19 of Bulletin No. 6, Section of Terrestrial Magnetism and Electricity, International Geodetic and Geophysical Union, November, 1926.

ON NEED OF MEASUREMENTS OF DUST-CONTENT IN THE STUDY OF ATMOSPHERIC-ELECTRIC PHENOMENA

By G. R. Wait

The expectation that the presence of dust particles and Aitken's nucleation-centers in the atmosphere are effective in altering the values of certain of the atmospheric-electric elements is borne out by available but scanty observational data. The results of Chree and Watson at Kew indicate that the value of the potential gradient there is considerably altered by the amount of dust (as measured by the Owens pollution-recorder) in the atmosphere. The results suggest the need of obtaining data of the amount of dust by a more sensitive method. Except in those localities where considerable pollution exists, the pollution-recorder would fail to record a noticeable variation in the amount of dust. With an Owens jet dust-counter, much more valuable data could be obtained.

The data taken at the Watheroo Magnetic Observatory with an Aitken counter (for the loan of which the Observatory is indebted to the Commonwealth Meteorological Bureau of Victoria) show the extent to which the Aitken nucleationcenters may be effective in altering the two conductivities and the potential gradient. The results suggest need of additional comparisons, not only at this station but at many others as well, in order to reveal to what extent we shall be able to correct the atmospheric-electric data for the presence of nucleation-centers.

Most data now favor the assumption that the Aitken apparatus counts only hygroscopic particules and the Owens only dust particles. This being so, then it is unlikely that any definite relationship between the two holds. At a number of different stations, observations show the number of particles by the Aitken instrument to be approximately one hundred times hhose by the Owens instrument. Thus at Watheroo it was tardly possible to make a count with the Owens counter. The number found at the laboratory in Washington with an Owens counter has never exceeded 200, while the Aitken instrument gave in general from 10,000 to 20,000. It is likely then, in spite of the larger size of the dust particle, that a more definite relationship at these stations will be found between the atmospheric-electric elements and the Aitken nucleation-centers. However, especially at those stations where the dust-content is higher, it would be desirable to have data taken with both types of instruments.

Carnegie Institution of Washington,
Department of Terrestrial Magnetism.

July 18, 1927

NOTE ON ACTIVITIES IN ATMOSPHERIC-ELECTRIC INVESTIGATIONS (1)

W. F. G. Swann

The only matters needing report in connection with my activities in atmospheric electricity are briefly noted in the following paragraphs.

(1) I have developed a theory which is explained in its title as follows : A modification of the Electromagnetic Equations consistent with restricted relativity and providing a possible explanation of the origin of the Earth's electric charge, of the Earth's magnetic field, and of gravitation. This paper was published in abstract form towards the end of my paper on "The Earth's Electric and Magnetic Phenomena", in the Journal of the Franklin Institute for February, 1926. It is now in process of publication in extended form in the Philosophical Magazine. It will also appear in the publication of the papers presented at the International Mathematical Congress in Toronto a couple of years ago.

(2) I have completed in Norway an investigation concerning a search for a possible corpuscular radiation of cosmic origin and the result is contained in the following sentence : Experiments indicate that the absolute magnitude of a current absorbed by a copper cylinder 20.6 cm in diameter and 19.3 cm high is no more than 1.5 per cent of that which would have been obtained by the complete absorption of a vertical corpuscular-current of densities sufficient to account for the replenishement of the Earth's charge.

(3) I have completed an investigation on the measurement of residual ionization in air with pressure up to 1,000 pounds per square inch, measurements having been carried out at the summit of Pike's Peak, Colorado Springs, and at New Haven. The results of this investigation will shortly be published.

(1) Abstract-report prepared at the request of the Union for the Prague Assembly of the International Geodetic and Geophysical Union.

(4) Extending number (1) to the magnetic field of sunspots it appears that peripheral velocities of the order of 80 kilometers per second are capable of giving rise to magnetic fields of the order of 2,000 gauss. Moreover, the indications are that Jupiter should have a very large magnetic field, a field of the order of 60,000 gauss.

Sloane Laboratory,
Yale University,
New Haven, Conn.

IONIZATION IN THE UPPER ATMOSPHERE

By E. O. Hulburt

Abstract.—The more important agencies which may conceivably cause the ionization of the upper atmosphere of the Earth are the ultra-violet light, alpha- and beta-particles of solar origin, the penetrating radiation of cosmic origin, and the ionizing radiations from terrestrial sources. Experiments with the electromagnetic waves of wireless telegraphy, together with theories of the propagation of these waves over the surface of the Earth, show that the electron density increases with the height above the Earth reaching a value of about 4×10^5; above this height the electron density is not know, except that it does not go on increasing. Using the pressures in the upper atmosphere as given in the classical theory of Humphreys, Jeans, and others, and the J. J. Thomson theory of recombination of ions together with the observed attachment constant of electrons and neutral oxygen molecules, the ionization is found to agree roughly with the wireless data for daylight. At night, however, there is disagreement. Abandoning the classical upper-atmospheric pressures, it is found that an ionization agreable to radio is secured by an irregularity in the pressure-height curve around 100 to 250 kilometers. It may be, however, that the classical pressures are correct and that other agencies of ionization exist. Considerations of the effects of cosmic radiation seem to lead to difficulties. Effects of alpha-particles from the sun are apparently allowable.

Naval Research Laboratory,
Washington, D. C.

ON THE RELIABILITY OF EARTH-CURRENT POTENTIAL MEASUREMENTS

By O. H. Gish

An estimate of the reliability or signifiance of the values recorded from earth-current lines is possible if for each component at a given station two, or preferably more, independent registrations are obtained. This has, however, seldom been done, with the result that when using earth-current data the investigator is in much the same position as the navigator on a ship which has but one chronometer.

At the Watheroo Magnetic Observatory three independent registrations of each component are obtained. This arrangement has proven very helpful in distinguishing the features of extremely local character from those of general interest, and has made possible the idendification and elimination of some extraneous effects. The evidence furnished by three years of record at this Observatory strongly indicate :

1. That no conclusions can be drawn regarding the existence of a constant earth-current component. The greater part of the measured value is an effect of extremely local character, most likely an electrochemical contact e.m.f.

2. That the annual variation in the recorded values is chiefly an effect of extremely local character, apparently caused more or less directly by changes in the moisture content of the soil near the electrodes.

3. That the diurnal variation derived from the hourly means for a month is, with proper installation of electrodes, very reliable. However, without at least a duplicate system of electrodes, certain extraneous effects having a diurnal period may creep in undetected.

4. That disturbances of period of a few hours or less can be determined with least difficulty.

It is the writer's view that these conclusions apply to earth-current data in general, and he hopes that the implications of conclusions 1 and 2 will be given more attention in the future, especially by authors of general treatises on the subject of earth-currents.

Carnegie Institution of Washington,
Department of Terrestrial Magnetism.

July 13, 1927.

ON THE RELATIVELY LARGE VALUES OF EARTH-CURRENT POTENTIAL RECORDED AT THE EBRO OBSERVATORY

By O. H. Gish

The series of earth-current registrations at the Observatorio del Ebro, owing to its length, its almost complete continuity, its undoubted freedom from vagabond currents, and its homogeneity in so far as concerns personal equation and instrumental factors, constitutes an exceedingly valuable asset to the science of geophysics. The magnitude of the diurnal range derived from these records has, however, been a matter of some concern since for both components this is about fivefold that calculated from theory (1).

It was no doubt with this situation in mind that the Reverend Ignacio Puig in September 1926 suggested that, if possible with the instruments brought to Tortosa for the purpose of making an earth-resistivity survey, the writer make an independent determination of the scale-values or constants used in evaluating the earth-current registrations. Fortunately a potentiometer used in the resistivity measurements had characteristics suitable for this purpose. This potentiometer was compared indirectly at the Observatory with two high-grade milliammeters by measuring the potential drop across a standard resistance, reversing the usual potentiometer method of measuring current. The instruments which were accessories for the resistivity measurements were previously compared with standards at the Watheroo Observatory and again later with similar standards at the Department of Terrestrial Magnetism at Washington. On the basis of these tests, it may be stated that the instrumental inaccuracy did not exceed ±0.2 millivolt. With this potentiometer the potential between the respective lines which terminated in the

(1) S. Chapman and T. T. Whitehead, " On the observations of earth-potential gradients at Ebro", *Terr. Mag.*, vol. 28, pp. 126-128, 1923.

recording room were measured directly, the registration being interrupted for the short interval necessary for the measurement. The greatest uncertainty in the potientiometer measurements arose from the fact that the earth-currents are continually changing. However, it was possible to make several comparisons at times when the earth-currents were comparatively steady, and for these measurements it is estimated that the uncertainty of an observation does not exceed ±0.5 millivolt. The comparisons which were obtained with the hearty cooperation of Father Puig are listed in the following table :

Date	Earth-current potentials		Remarks
Sept. 1926	From registration *	By potentiometer	
d h m	mv/km	mv/kv	
20 17 20	58.24	58.6	
22 16 21	23.60	23.0	N-S component
23 16 45	12.56	11.9	
23 16 46	11.60	11.1	W-E component

* Reductions made by Observatory staff.

These comparisons should remove all doubt as to the reality of the large diurnal ranges in the values registered at the Ebro Observatory. Although the possibility that an extraneous component of semi-diurnal period may enter into these registrations is not absolutely excluded, yet that possibility seems highly improbable, and it would seem rather that the recorded diurnal variations in earth-currents at Ebro constitute a set of facts to which theory must be made to conform.

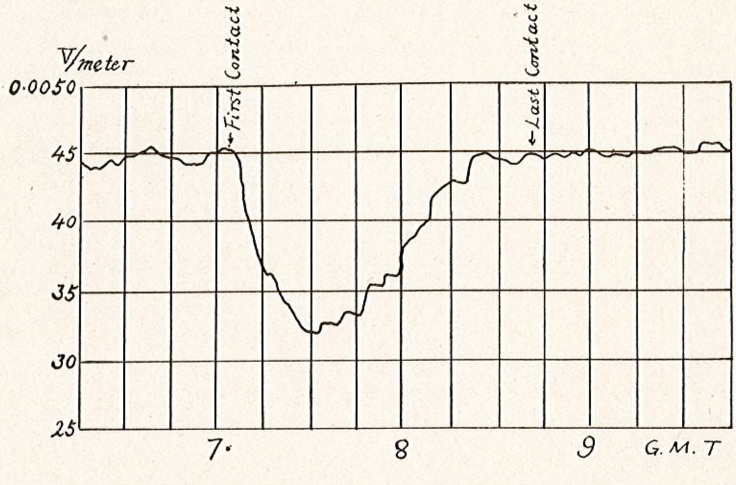
Carnegie Institution of Washington,
Department of Terrestrial Magnetism.

July 13, 1927.

THE DISTURBANCE OF THE EARTH-POTENTIAL DURING THE TOTAL SOLAR ECLIPSE OF JUNE 29, 1927, OBSERVED AT SENDAI JAPAN

By Saemontarô NAKAMURA

The earth-potential difference is continiously recorded since the April 1927 in the Geophysical Laboratory of Tôhoku Imperial University, Sendai. Two galvanized copper terminals are put 18.2 metres apart along the meridian. The potential difference between these two terminals is recorded by self-recording potentiometer made by the Cambridge and Paul Instrument Co. The northern point has usually higher potential than the southern point.



At the beginning of the eclipse, the potential difference was 0.08148 volt or about 0.0045 volt/metre. At the first contact (7^h 4^m G. M. T.) the potential difference suddenly began to drop. nearly at 7^h 30^m, the minimum potential difference of

0.00320 volt/metre was observed. Then the potential difference graduelly increased and at the same epoch of the last contact (8^h 41^m) the initial value was regained.

As no remarkable disturbance was recorded on that day except this, and at the epochs of beginning and end of the disturbance well coincided with those of the first and last contact of the solar eclipse, the disturbance may be probably due to the solar eclipse.

Annexed figure gives the reproduction of the record.

Note on the Above Communication. — The character of the change in earth-current potential reported in this communication is such as to suggest a connection with the solar eclipse. That connection may, however, be rather indirect and the effect may be an extremely local one. I have never seen any record of a pronounced perturbation of earth-currents at times of solar eclipse, although observations on telegraph lines made during the eclipse of January 24, 1925, would have readily shown effects had there been any of the magnitude reported from Japan. This magnitude is about one thousand times what might be expected on the basis of the present theory of earth-currents. Furthermore, experience at the Watheroo Magnetic Observatory of the Department has shown that it is not chemical changes at the electrodes. Such changes can readily give rise to variations in potential of the magnitude reported, so that it would seem advisable to discuss this possibility in the report. Full details regarding the installation of electrodes (or earth-terminals) would also enable the reader to consider this feature. Perhaps it is already planned to make later a more detailed report.

O. H. Gish.

Carnegie Institution of Washington,
Department of Terrestrial Magnetism,

August 11, 1927.

REPORT UPON THE ORGANIZATION OF THE DEPARTMENT OF GEOPHYSICS AT THE COLORADO SCHOOL OF MINES, GOLDEN, COLORADO (¹)

By C. A. Heiland

In 1922, geophysical methods were used for the first time in the United States as an aid to detect mineral deposits, especially oil-bearing structures, which could not be found by geological investigations alone. The first instrument employed for that purpose was the Eoetvoes torsion balance ; shortly after, seismic investigations were started, and recently magnetic and electric methods have been taken up. Thus far, the mining industry had used geophysical methods comparatively little. Magnetometers have beens applied sometime in search for iron ores in our northern states ; for other ore deposits the electrical methods have been employed ; extensively, however, only in Canada.

Geophysical measurements for such practical purposes as outlined above have been made in this country by private corporations exclusively. Consulting engineers, as well as companies, have done contracting work with one or more geophysical methods or the large operating oil concerns have organized their own geophysical staffs. An idea of the amount of geophysical work as done at present may be obtened perhaps by conceiving that at present about five consulting engineers and about twelve companies are making geophysical measurements on the contract basis and that, on the other hand, about one hundred torsion balances, twenty seismographs, and fifty magnetometers are in used by the geophysical staffs of oil companies.

The development of applied geophysics in this country as characterized above has given rise to two serious problems. The

(¹) Report prepared at the request of the Union for the Prague Assembly of the International Geodetic and Geophysical Union.

first is the need of men who are trained equally well in the theory and the operation of geophysical instruments. The second is the need of a central and impartial place where researches on problems of applied geophysics are done and made public. In view of the fact that the essential features of most geophysical methods are kept secret yet, and that every company which starts this kind of work has, usually, to go back to the very beginning, the need for scientific public research for the benefit of the industry is obvious in order that time shall not be wasted in useless experimenting.

In consideration of these needs, the President of the Colorado School of Mines, Dr M. F. Coolbaugh, decided in 1926 to establish a Department of Geophysics at the School. The organization of this Department, which began in January, 1927, was entrusted to the writer. The establishment of such a department, the first of its character in this country, at a mining School, also aims to encourage the mining industry to apply the methods in question more than it has done before.

The program, which has been outlined for this work, consists of two parts, (1) the educational program, and (2) the research program.

We feel that a sufficient ability to handle any applied geophysical method intelligently cannot be attained by any person without a good foundation in general geophysics. Therefore a course in general geophysics is given at the school which is open to seniors and postgraduate students, and required for members of the special courses which concern theory and operation of instruments. From the next academic year on, the general course will be given in two semesters and will cover the following subjects : (1) The history of the Earth (cosmogonical hypotheses, paleogeography, paleoclimatology) ; (2) constitution and dynamics of the atmosphere (meteorology, atmospheric electricity, propagation of sound, etc) ; (3) constitution and dynamics of the hydrosphere (hydrology, oceanography, tides) ; (4) the constitution and dynamics of the lithosphere (density, gravity, isostasy, earth-magnetism, chemical and physical constitution of the interior of the earth, radio-activity, earth-electricity, movement of the earth in space, bodily tides, volcanism, earthquakes, etc.). Because of its importance in applied geophysics, more emphasis is placed upon item (4) than upon items (1) to (3).

The operation of any geophysical instrument is confined to the special courses which are open for postgraduates only. In these courses, first in general the theory of the respective instruments is taught in detail, then some work is done in the laboratory, and finally the instruments are taken out to obtain practical field work. In the first semester, after the organization of the department, a special course in the theory and operation of the torsion balance was given. In the next semester, the theory and operation of magnetic variometers will be taken up. After that, a seismological course probably will follow ; a course in electrical methods is also planned for the future. At present the School has a photographic recording torsion-balance and two magnetic field-balances for the horizontal and vertical intensity. In order to present the magnetometer course as well as is desirable, the recording of magnetic variations is indispensable ; therefore, the very next thing planned is the erection of a magnetic observatory where three components—probably *D*, *H*, and *Z*—are to be recorded continuously. By the erection of a continuously recording magnetic observatory we also hope to contribute to the advancement of theoretical investigations, which are made in regard to the relationship of terrestrial magnetism and earth-electricity to atmospheric electricity and activity of the Sun, especially in this country by the well-know Department of Terrestrial Magnetism of the Carnegie Institution of Washington and the Division of Terrestrial Magnetism and Seismology of the U. S. Coast and Geodetic Survey.

The purchase, or construction, of a seismograph will also be a necessity sooner or later. We are also contemplating having our own precision-mechanics workshop on the campus in the very near future, in order to make all necessary instrument work as inexpensive as possible.

As far as the activities in the new department, aside from the educational program, are concerned, we felt that the first requirement for all studies in applied geophysics would be a thorough knowledge of the respective literature ; however, at present, this is comparatively difficult to obtain because, first of all, a textbook on applied or general geophysics is not available yet in this country ; secondly, because the literature on applied geophysics is scattered in journals of very different character. We have decided, therefore, to compile all articles—on applied geophysics as well as on general geophysics, the study of which is important for applied geophysics—which have been published, especially recently, in all countries of the world. This "Bibliography on Applied Geophysics" will be published as soon as possible.

The research work planned for the future in the department is, naturally, stipulated by the equipment which we have at present. As far as the torsion balance is concerned, it is our aim to make this method, which so far has been applied to the greatest extent to oil propositions, also practical for use in mining by practical and theoretical investigations. Our research work pertaining to magnetic methods is to start with investigations about the physical, especially thermic, properties of their fundamental constituents—the magnets. The generosity of one of the leading manufactures of geophysical instruments has enabled us to start these and the ensuing investigations. The school has been presented with three apparatuses especially designed for these purposes. Extensive researches are also planned on the magnetization of rocks, in view of the fact that is one of the most complex phenomena, and it seems to be worth while, especially from the physico-chemical standpoint, to investigate the conditions under which an induced and a permanent magnetization of rocks is originated.

Colorado School of Mines,
Golden, Colorado.

PART VI

GENERAL INFORMATION

STATUTES

(See *Bull. No.* 3, *Sec. T M. and E., pages* 7-11 *and* 16-20)

LIST OF ADHERING COUNTRIES, 1927

(*See this Bulletin, No.* 7, *page* 7)

OFFICERS OF THE UNION AND OF ITS SECTIONS

(*See this Bulletin, No.* 7, *page* 47)

National Sections, or Committees, for Terrestrial Magnetism and Electricity (1), 1927

Country	President or Chairman	Vice-President or Vice-Chairman	Secretary	Approx. No. of. Members (2)
Argentina	—	—	—	—
Australia	—	—	—	4
Belgium	M. Lagrange	—	—	1
Brazil	(Dr. H. Morize)	—	—	—
Canada	W. E. W. Jackson	—	W. H. Herbert	3
Chile	—	—	—	—
Czechoslovakia	(Profs. S. Hanzlik and B. Salamon)			
Denmark	(Dr. D. La Cour)	—	—	—
Egypt	—	—	—	—
Finland	(Prof. G. Melander)	—	—	—
France	General G. Ferrié	—	Prof. E. Mathias	27
Greece	(Prof. D. Eginitis)	—	—	—
Holland	—	—	—	—
Italy	Prof. L. de Marchi	Prof. L. Palazzo	D. Pacini	30
Japan	—	—	—	13
Mexico	(Prof. J. Gallo)	—	—	2
Morocco	(Dr. J. Liouville)	—	—	—
New Zealand	(Dr. E. Marsden)	—	—	—
Norway	(Dr. H. U. Sverdrup)	—	—	4
Peru	—	—	—	—
Poland	—	—	—	2
Portugal	—	—	—	—
Siam	—	—	—	—
South Africa	—	—	—	—
Spain	B. Cabrera Felipe	Luis Rodés, S. J.	U. de Azpiazu	3
Sweden	V. Carlheim-Gyllensköld	—	—	5
Switzerland	—	—	—	—
Tunis	—	—	—	—
United Kingdom	Dr. G. C. Simpson	—	—	9
United States	Comdr. N. H. Heck	Dr. J. H. Dellinger	J. A. Fleming	25
Uruguay	—	—	—	—
Yugo-Slavia	—	—	—	—

(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), 1927

Country	President or Chairman	Vice-President or Vice-Chairman	Secretary	Approx. No. of Members (2)
Argentina	Director, Instituto Geográfico Militar	—	—	—
Australia (3)	(Sir David Masson)	—	E. F. J. Love	12
Belgium	Col. H. Seligmann	P. Stroobant	O. Somville	12
Brazil	(Dr. H. Morize)	—	—	1
Canada	Noel J. Ogilvie	—	E. A. Hodgson	31
Chile (4)	—	—	—	—
Czechoslovakia	Dr. V. Láska	Dr. F. Nusl	Dr. B. Salamon Dr. J. Pantoflicek	17
Denmark	Prof. N. E. Nörlund	—	Prof. H. Knudsen	6
Egypt	—	—	F. S. Richards	4
Finland	—	—	Dr. G. Komppa	8
France	A. Lacroix	G. Bigourdan, H. Deslandres, G. Ferrié, E. Fichot, A. Rateau, M. Rollet de l'Isle	General G. Perrier	200
Greece	General D. Pétritis	Prof. D. Chondros	Prof. D. Lampadarios	10
Holland	Prof. H. J. Heuvelink	Dr. E. van Everdingen	Dr. C. Braak	34
Italy	Prof. L. de Marchi	—	Prof. G. Magrini	90
Japan	Dr. K. Nakamura	Prof. A. Imamura	S. Kikusawa	30
Mexico	(Dr. P. C. Sanchez)	—	—	2
Morocco	(Dr. J. Liouville)	—	—	1
New Zealand	—	—	(Dr. E. Marsden)	5
Norway	Prof. C. Störmer	Dr. K. S. Klingenberg	Dr. H. U. Sverdrup	18
Peru	D. F. Malaga Santolalla	—	Col. J. A. Vallejo	15
Poland	Prof. W. Natanson	—	Dr. S. Wroblenski	15
Portugal	Prof. F. M. Da Costa Lobo	F. Oom, M. Guerra	Nunez Ribeiro	5
Siam	(Royal Survey Dept. Bangkok)	—	—	1
South Africa	H. Spencer Jones	—	—	23
Spain	General J. de Elola	—	Lieut. Col. M. Cajen	30
Sweden	Dr. E. Trygger	Prof. H. Pleijel	Prof. V. Carlheim-Gyllensköld	13
Switzerland	Prof. R. Gautier	Prof. F. Baeschlin Prof. P. L. Mercanton	Dr. Th. Niethammer	14
Tunis	—	—	—	1
United Kingdom	Dr. G. C. Simpson	—	—	28
United States	Dr. H. S. Washington	G. W. Littlehales	J. A. Fleming	72
Uruguay	(Col. Juan Sicco)	—	—	1
Yugo-Slavia	General S. Boscovic	—	J. Mihailovic	2

(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.

(3) Sir David Masson is president of the National Research Council of Australia.

(4) Correspondence is sent to Legation of Chile, 22 Grosvenor Square, London, W. 1, England.

ADDRESSES (1)

Argentina

Directeur Général de l'Institut géographique Argentine, Buenos Aires.
M. Felix AGUILAR, Instituto geografico Militar, Buenos Aires.
M. le Général Ladislao FERNANDEZ, Ex-Director del Instituto Geografico Militar, Buenos Aires.
Director G. PLATE, Oficina Meteorologico Nacional, Paseo Colon, 974, Buenos Aires.

Australia

Dr. J. M. BALDWIN, Government Astronomer, South Yarra, Melbourne, Victoria.
R. H. CAMBAGE, Esq., 5 Elizabeth Street, Sydney, New South Wales.
W. E. COOKE, Esq., Government Astronomer, Sydney.
Prof. L. A. COTTON, The University, Sydney.
Sir EDGEWORTH DAVID, F. R. S., Sherbroke, Road, Hornsby, New South Wales.
G. F. DODWELL, Esq., The Observatory, Adelaide.
Dr. W. G. DUFFIELD, Solar Physics Observatory, Canberra, Federal Territory.
Prof. Kerr GRANT, Adelaide University, Adelaide, South Australia.
H. A. HUNT, Esq., Director, Central Weather Bureau, Melbourne.
Dr. E. F. J. LOVE, The University, Carlton, Melbourne.
Prof. Sir Thomas LYLE, F. R. S., Irving Road, Ioorak, Melbourne.
Sir David MASSON, University, Melbourne, Victoria.
Rev. E. F. PIGOT, S. J., Riverview College Observatory, Sydney.
Prof. A. C. D. RIVETT, 5 Elizabeth Street, Sydney, New South Wales.
Prof. A. D. ROSS, University of Western Australia, Perth, Western Australia.

Belgium

Dr. R. B. GOLDSCHMIDT, 54 Avenue des Arts, Bruxelles.
M. A. HERMANT, Météorologiste adjoint à l'Institut royal météoiologique, rue de Venise, 52, Ixelles-Bruxelles.
Commandant J. JAUMOTTE, Directeur de l'Institut royal météorologique, avenue Circulaire, 3, Uccle.
Prof. E. LAGRANGE, rue des Champs-Elysées, 60, Ixelles-Bruxelles.
J. MAURY, Directeur au Ministère des Colonies, avenue de l'Opale, 73, Schaerbeek
Colonel H. SELIGMANN, Directeur général honoraire de l'Institut cartographique militaire, rue de la Station, 48, Waterloo.
M. O. SOMVILLE, Astronome à l'Observatoire royal, avenue de la Floride, 64, Uccle.

(1) Of the following : Officers of International Geodetic and Geophysical Union and of its Sections ; Officers of National Committees ; Members of National Sections for Terrestrial Magnetism and Electricity ; and some correspondents.

Dr. P. STROOBANT, Directeur de l'Observatoire royal de Belgique, avenue circulaire, 7, Uccle.
M. E. VANDERLINDEN, Météorologiste à l'Institut royal météorologique de Belgique, chaussée de Waterloo, 1026, Uccle.

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Geodätisches Institut, Potsdam, Germany.
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Zentralanstalt für Meteorologie und Geodynamik, Hohe Warte, 38. Vienna, XIX, Austria.
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Editeur, Iberica, Palau, 3, Apartado 143, Barcelona, Spain.
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Editor, American Journal of Science, New Haven, Conn.
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