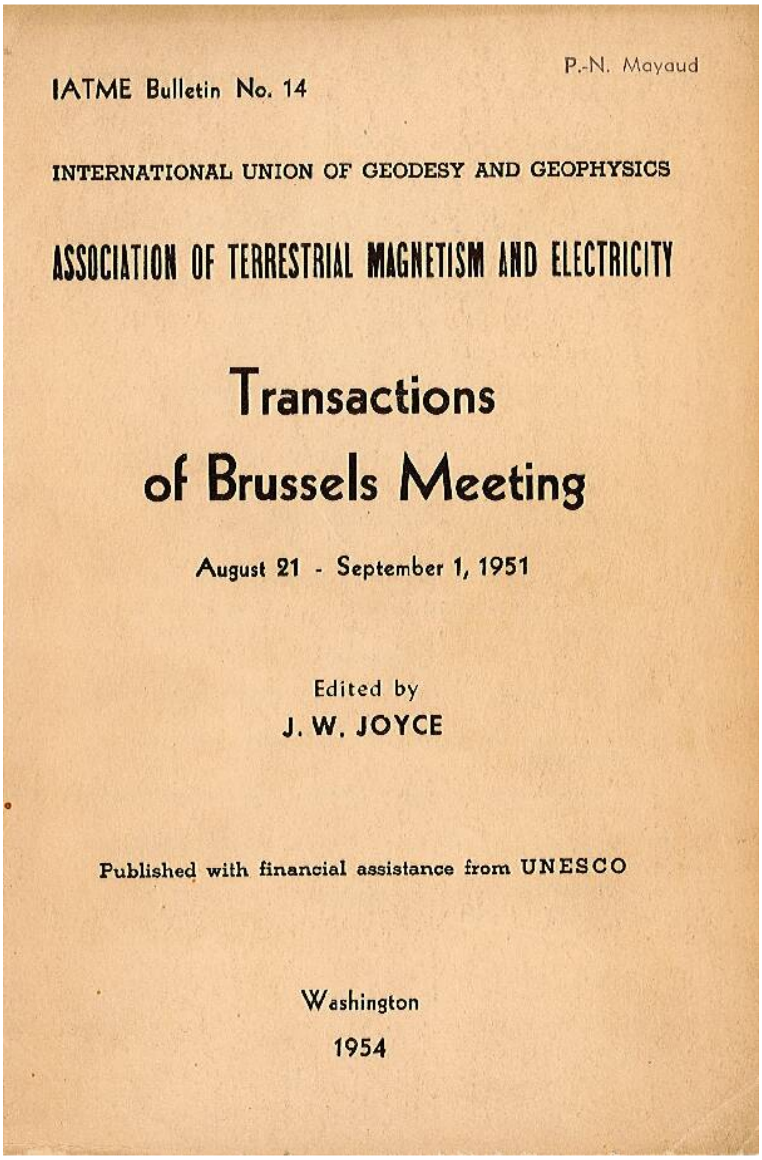
P.-N. Mayaud

IATME Bulletin No. 14

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

Transactions of Brussels Meeting

August 21 - September 1, 1951

Edited by
J. W. JOYCE

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X. Proposals

The following proposals have been submitted to the International Union of Geodesy and Geophysics for consideration at the Brussels meeting:

1. BY THE FRENCH NATIONAL COMMITTEE:

(a) Au cas où réforme étendue de l'union paraitrait nécessaire, le Comité National Francais recommande la création d'une Association Internationale de Géophysique Interne (ou Physique de l'Intérieur de la Terre) comprenant en principe trois Sections jouissant d'une structure propre administrative et financière:

(1) Une Section de Volcanologie, prenant la suite de l'actuelle Association,
(2) Une Section de Séismologie, prenant la suite de l'actuelle Association,
(3) Une Section dont le domaine couvrirait l'ensemble de la dynamique interne du Globe.

Le Comité National Francais recommande au sujet de cette nouvelle organisation que les Sections de Volcanologie et de Séismologie conservent un budget du meme ordre que le budget actuel des Associations correspondantes.

Il émet un avis défavorable a la création d'une Section de Géophysique appliquée, dont les aspects scientifiques relèvent des organismes déjà existants.

Il ne lui parait pas non plus indiqué d'envisager pour le moment la création d'autres Sections dans la nouvelle organisation projetée.

(b) La question de la diminution éventuelle de la cotisation en faveur de certain petits etats.

2. BY THE FRENCH NATIONAL COMMITTEE:

que les travaux relatifs à la Physique de la Haute Atmosphère ne cessent de se développer et prennent de plus en plus d'intérêt;

qu'il est du ressort de l'U.G.G.I. de rechercher les moyens les plus efficaces de promouvoir et coordonner les recherches dan ce domaine très particulier,

que les techniques mises en oeuvre doivent en raison de leur caractère très spécial être développées au sein d'un organisme nettement distinct;

qu'aucune des Associations actuellement existantes n'a dans ses attributions l'ensemble des études se rapportant aux problèmes de la Haute Atmosphère;

que par suite, il existe un risque de voir certains aspects ne pas être suffisamment pris en considération et d'autres, au contraire, discutés indépendamment dans plusieurs Associations différentes;

que des raisons impérieuses déjà plusieurs fois évoquées s'opposent à la création d'une nouvelle Association au sein de l'U.G.G.I.,

estime:

qu'il y aurait lieu de prendre les mesures convenables pour assurer aux Physiciens de la Haute Atmosphère les possibilites de discussion et d'organisation de leurs travaux;

que la solution la plus simple parait être:

de créer une Section "Haute Atmosphère" au sein de l'Association Internationale de Magnétisme;

de donner à cette Section une certaine autonomie analogue à celle dont jouissent les cinq Sections de l'Association de Géodésie;

que le programme des études poursuivies dans le cadre de cette Section devra être précisé en accord avec l'U.R.S.I. et la Commission Mixte de l'Ionosphère et limité à l'étude des régions de l'atmosphère qui sont actuellement sans influence reconnue sur les phénomènes Météorologiques.

3. BY THE BRITISH NATIONAL COMMITTEE:

(1) That the scope and functions of the Associations of Seismology and Volcanology be considered in relation to the subjects covered by the Joint Committee on the Physics of the Earth's Interior.

(2) That all Associations be urged to publish and distribute their proces verbaux (transactions, summaries, etc.) as soon as possible after the Assembly to which they refer and that reports of proceedings and of all scientific communications be kept as brief as is consistent with clarity; and that in general only brief summaries of scientific papers be published by the Associations, leaving the papers themselves to be published in the appropriate journals.

(3) That the distribution of the publications of the Union and its several Associations be arranged centrally through the national committees or other adhering organizations in each member country.

(4) That the Associations be reminded that their activities should not begin and end with preparation for and publication of papers resulting from the triennial Assemblies, but that their activities should be maintained continuously.

(5) That there should be critical inquiry into the functions of all the permanent services sponsored partially or wholly by U.G.G.I. and that the financial arrangements of the Union and its Associations be overhauled with particular reference to the percentage allocations to the constituent Associations, taking into account U.N.E.S.C.O. policy regarding grants in aid and keeping in mind that some Associations have more permanent services to maintain than others, and that some have a much wider field of interest than others.

(6) That the Association of Physical Oceanography should continue to maintain as an essential activity the Copenhagen standard sea-water supply service.

4. BY THE MIXED COMMISSION ON THE IONOSPHERE:

Proposal for an International Polar Year in 1957-58

Resolution

That, for the reasons attached, the Third International Polar Year be nominated for 1957-58 and that, in view of the length of time necessary for adequate organization of the complex physical equipment now potentially available, an International Polar Commission be appointed in 1951 to supervise planning.

This resolution is transmitted by the Mixed Commission on the Ionosphere for the approval of the Unions affected and sponsoring this Commission, and for action by I.C.S.U.

****

Supporting material

Some very fine studies of the earth's atmosphere were made during the First and Second International Polar Years in 1882-83 and 1932-33, respectively. For example, during the first year FRITZ made a remarkable study of the geographical distribution of aurorae but little has been done to extend this work on the necessary world scale in more recent times.

Since the Second International Polar Year in 1932-33 there have been many critical developments in the study of the earth's atmosphere from both the technical and theoretical standpoints. In 1932 there were no panoramic or multifrequency ionospheric records. The separation between the E and the F regions had been recognized but not that between Fl and F2. Substantially no data were available on which a world-wide study of the ionosphere could be based. High altitude rockets were not available, nor radiosondes capable of ascending to a height of 20 kilometers. The interest in atmospheric exploration has now progressed to the point where the cooperation that would be afforded by a third international polar year could go far towards solving outstanding problems of ionospheric structure, of movements in the high atmosphere, of magnetic and ionospheric storms and of aurorae. Because the last polar year took place at a time of sunspot minimum, it would be beneficial if the next one were associated with a sunspot maximum. This would be achieved if an interval of 25 years were placed between the second and third polar years, one-half of the interval between the first and second. It is in this way that the year 1957-58 comes to be recommended for adoption as the third international polar year.

It should perhaps be explained that the expression "polar year" in the document implies not only a year in which special observations would be made in polar regions, but also one in which observatories in all latitudes would cooperate to the maximum extent so as to give as complete a picture as possible of world-wide atmospheric phenomena. It is also assumed that the antarctic would receive its full share of attention.

Objectives of the Third International Polar Year--The principal objectives of the third international polar year would be to provide information for understanding:

(1) the physics of magnetic and ionospheric storms and other disturbances peculiar to polar regions (such as magnetic bays and giant pulsations).
(2) the physics of aurorae.
(3) The structure and circulation of the atmosphere in the polar regions, where absorption and radiation of the energy by the atmosphere play important roles.

Additional objectives will no doubt be designated by the I.A.U., the I.G.G.U., particularly by its Associations of Meteorology, Oceanography and Hydrology.

There is a particular need for a complete morphology of the disturbances associated with particular storms from the ionospheric, magnetic and auroral standpoints. Really complete information about one particular disturbance from all standpoints would lead to more progress than quite a large amount of more or less random data from which only statistical conclusions could be drawn.

Types of observations to be made during the Third International Polar Year--A preliminary survey suggests that the types of observations to be made shall include the following:

(1) Radio--Ionospheric sounding by fast multifrequency or panoramic methods. Accurate height measurements (to say 0.1 km) by special apparatus. Numerical measurements of radio wave absorption, reflection and scattering. Tracking of moving irregularities in Es and F2 regions. All aspects of storm and other anomalous phenomena, auroral echoes, frequency spectrum of auroral noise.

(2) Magnetic--Measurements of magnetic field at great heights by rockets. Estimation of width, intensity distribution and height of current systems. Development and decay of the current systems of storms over short periods of time. Observations of pulsations and bays by equipment with sufficiently short time constants.

(3) Aurorae--Cine and still photography of forms and movements. Total radiation and absolute intensity of lines. Height variation in intensity of selected lines using modern filters for isolation of the lines. Doppler shifts in selected lines. Morphology of auroral disturbances both on the average and for particular storms from a large number of stations providing highly objective data.

(4) Rockets--Measurement of upper air winds using artificial meteor trails. Measurement of magnetic fields at high altitudes in the auroral zone during storms. Measurements of ion/electron ratios, particularly on the dark side of the earth. Detection of "windows" in the high atmosphere at optical frequencies.

(5) Ozone--Effect of magnetic and meteorological storms on the spatial and height distribution of ozone. Observation by the Dobson method and direct observations by radiosondes.

(6) Cosmic rays--Effect of solar flares and magnetic storms on the intensity of cosmic rays. Variation with height and with latitude near and within the auroral zone. Recording of increases associated with solar flares especially associated with polar high altitude stations.

(7) Troposphere--Observations of the zonal semi-diurnal pressure oscillation and any other features proposed by the Association of Meteorology of U.G.G.I.

(8) Astronomical--A highly organized program of solar observations will be needed to provide all possible information on associated solar phenomena during the intensive polar year observations.

Recommendations--Great advances in our understanding of the physics of the earth's atmosphere are to be expected by combining special observations in the north and south polar regions with observations of a similar nature carried out at lower latitudes. It is therefore recommended that:

(a) The year 1957-58 be designated an International Polar Year.

(b) A Commission be set up by I.C.S.U. similar to that established for previous polar years to encourage, through the various Unions and their National Committees, the establishment of a proper network of observing stations.

(c) In view of the complexities of the apparatus needed to exploit the potentialities of modern technique, the above Commission be established in 1951, so as to give at least five full years of preparation and trial.

(d) A permanent secretariat should be formed to operate during the most active period of the Commission's work, from about two years prior to the polar year until about three years after the polar year.

5. BY THE MIXED COMMISSION ON THE IONOSPHERE:

The Mixed Commission on the Ionosphere gave provisional support to the suggestions on "Upper Atmospheric Nomenclature" contained in the following memorandum prepared by Prof. S. Chapman.

It is proposed that stratosphere shall signify solely the nearly isothermal region above the troposphere; that the layer between the stratosphere and the deep temperature minimum between 60 and 100 km be called the mesosphere; that the layer of rising temperature above this minimum be called the thermosphere. On the basis of composition, it is proposed to divide the atmosphere into the homosphere (of substantially uniform composition from the ground upwards) and the heterosphere (of different composition). On the basis of electron density, a correlative to ionosphere is proposed, the neutrosphere. Using pause to signify upper boundary, the stratopause, mesopause, homopause and neutropause are defined. Peak is suggested as the name for a level of maximum, e.g., mesopeak, ozone peak, E or F peak. Incline and decline are names suggested for the parts of a peaked layer below and above the peak, e.g., mesoincline (for the layer of rising temperature just above the stratosphere), mesodecline, E or F incline or decline. A "dip" in a peaked layer is called a syncline.

(1) There seems scope for a few additional terms connected with the upper atmosphere.

(2) Various bases of characterization of different atmospheric regions and levels are in use, e.g., the presence of ozone or of ionization makes it inconvenient to use the terms ozone layer (or ozonosphere) and ionosphere (due to Watson Watt); similarly for the exosphere, the high region whence there is escape of molecules from the atmosphere. These terms are modeled on the names given by Teisserenc de Bort, troposphere and stratosphere, based on the thermal stratification first revealed by his sounding devices (kites, balloons).

(3) As used by de Bort, stratosphere signified the nearly isothermal region above the troposphere; in contrast to H. Flohn and R. Penndorf[1], I would prefer to restrict the term to this original meaning, despite its occasional use in recent years for any level above the troposphere.

(4) Extending this thermal classification, I propose the name mesosphere for for the layer between the top of the stratosphere and the major minimum of temperature existing between 60 and 100 km (the exact level is still uncertain), and the name thermosphere for the layer of upward increasing temperature above that level.

(5) Like Flohn and Penndorf, I would advocate extended use (though in a manner different from theirs) of the term pause to signify upper boundary, as introduced by Sir Napier Shaw in the term tropopause.

(6) Taking stratosphere to denote the nearly isothermal region above the troposphere, its upper boundary, where the temperature first begins to increase upwards more rapidly than is common in the lower stratosphere, would be the stratopause, and the mesosphere would extend from this level to the mesopause,[2] at the level of the deep temperature minimum already mentioned.

(7) It is uncertain whether this usage can advantageously be applied to the ozone[3] or to the E and F ionospheric layers, because of the indefiniteness of their upper boundaries.

(8) For these layers and the mesosphere, the defining characteristic (ozone density, electron density, temperature) first increases upwards and then decreases. I suggest that in each case the level of maximum be called the peak, e.g., the E and F peaks, and the mesopeak (this word, though hybrid, seems more acceptable than the fully Greek word mesoacme). It is a matter of speculation whether or not the thermosphere has a thermopeak.

The ozone layer can be considered under two aspects, both important, namely, absolute concentration or density, and relative concentration (the ratio ozone to air, by volume); these have different levels of maximum, which I suggest should be called the absolute ozone peak and the relative ozone peak, respectively.

(9) The parts of such "peaked" layers which lie below and above the peak, where the defining characteristic is respectively increasing and decreasing upwards, may conveniently be called the incline and decline, e.g., mesoincline, mesodecline, ozone or E or F incline or decline; and the usage may also be extended to thermoincline, although we do not know whether or where there is a thermopeak.

(10) If at some times and places a layer has two peaks (major and minor), the the region between them, containing a minor minimum, may be called a syncline. Some rocket flights have suggested the presence of an ozone syncline, and some rocket data on upper air temperatures have indicated a mesosyncline, though in both cases there is some doubt as to their reality.

(11) It may be useful also to classify atmospheric levels on the basis of composition. The main causes tending to non-uniformity of composition are diffusion (countered by turbulence) and photodissociation (countered by recombination). As long as they modify the composition only very slightly (e.g., in regard to rare constituents like ozone), the scale height of the atmosphere is simply proportional to the absolute temperature (if the variation of gravity with height is neglected). The temperature-scale-height relation becomes more complicated where the composition changes materially with height. The name homosphere is suggested for the part of the atmosphere from the ground up to the level (probably about 100 km) where the composition first begins to change materially; this level would be called the homopause. The name heterosphere is proposed for the overlying region of different composition. The name homosphere may not need frequent mention, but for some years discussion is likely to remain active as to the level of the homopause, and as to the nature of heterospheric air (at higher levels), which means a very different gas from that at ground level.

(12) Similarly a term correlative to ionosphere is proposed, to provide a complete characterization of the atmosphere on the basis of electronic presence or absence: the name neutrosphere is proposed for the region below the ionosphere, where the concentration of electrons is insignificant (apart from thunderstorms or meteor trails), at least from the standpoint of the radio physicist; and where the air particles are almost all neutral, far more completely so than in the ionosphere. The transition level between the neutrosphere and the ionosphere is the neutropause,a word more likely than neutrosphere to be often needed, e.g., "the neutropause is lowered during a solar flare."

(13) The various layers or "spheres" are of course not exclusive, nor are they co-terminous; the ozone layer includes the troposphere, stratosphere and at least part of the mesosphere; the D layer probably overlaps the mesodecline, the ionosphere probably includes the whole of the thermosphere and heterosphere

(which probable have different lower borders, the mesopause perhaps being below the homopause); in addition, the ionosphere probably overlaps the mesosphere and homosphere.

(14) "Upper atmosphere" is a useful term, but its meaning depends on the context, and it is probably not convenient to limit its meaning too definitely; the weather forecaster may use it to mean the stratosphere and perhaps part of the troposphere, whereas to the radio physicist it may signify a region above the stratosphere as here defined.

(15) Precision may be gained while retaining brevity, in referring to different atmospheric levels, by using upper, middle or lower in conjunction with the specialized names of the layers or sub-layers; e.g., one may say that only the middle part of the mesosphere has a temperature above 0° C, or that the E decline may be in the lower heterosphere.

(16) It seems premature to name definite heights in the case of several of the layers and levels (peaks and pauses). As in the case of the tropopause, the actual heights may vary with latitude, season, and from day to day.

(17) The three figures illustrate the nomenclature here proposed for the regions and levels classified according to temperature (T), composition and electron density (n_e). The graphs of T and n_e represent distributions such as are now generally supposed to exist, but are very tentative; the scales of height h are not the same in the three diagrams, and all three scales (h, T, n_e) may be non-uniform.

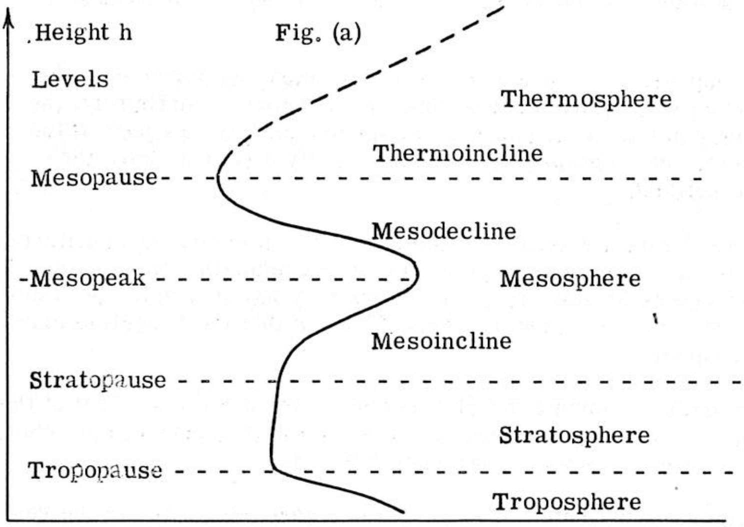
(18) In conclusion I should like to support C. T. Elvey's proposal[4] of the name airglow (suggested by O. Struve) to signify the light emitted by the atmosphere, other than the aurora (and lightning). Ordinary airglow will signify the (non-auroral) light of the night sky, but for further distinction one may call this the night airglow, in contrast to the twilight (sunset or dawn) airglow, and to the day airglow, which should now be observable from balloons and rockets that rise above the level at which the down-scattered light is very faint.

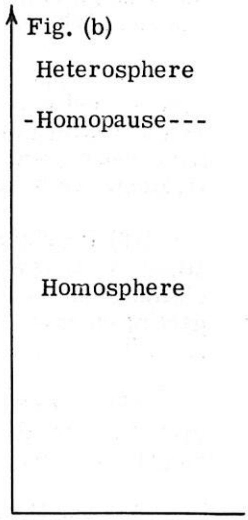
(19) I should like to acknowledge the privilege of discussions on this matter with D. R. Bates and M. Nicolet; and I have their authority for mentioning that they are in general sympathy with the proposals here made, though they are not responsible for them.

Notes

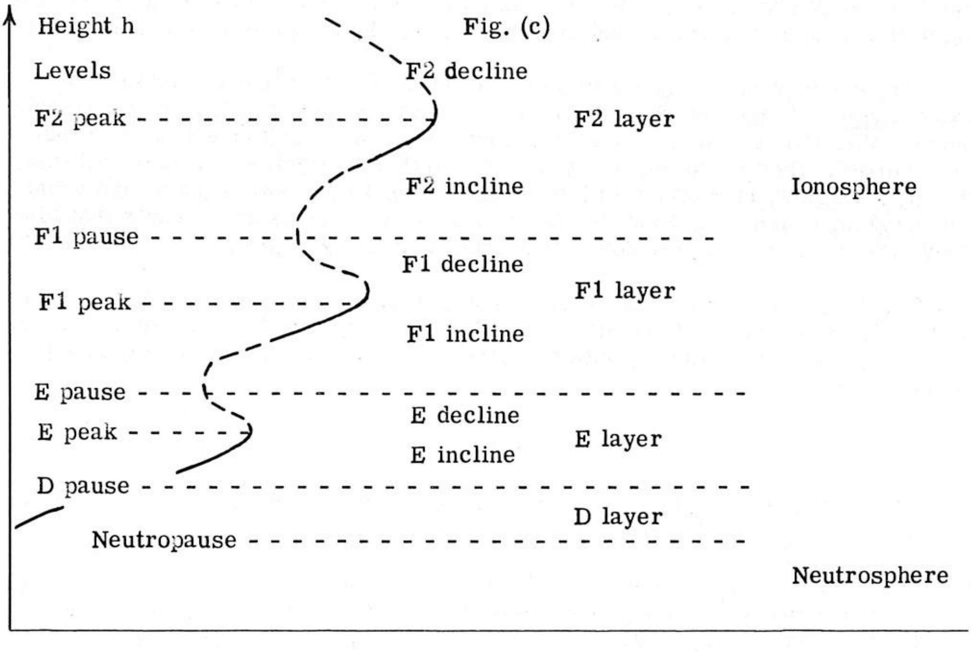
(1) H. Flohn and R. Penndorf, "The stratification of the atmosphere", Bull. Amer. Met. Soc., 31, 71-77, 126-130, 1950.

(2) In reference (1) this is called the "upper tropopause", although the name "upper troposphere" is not given to what is here (paragraph 9) called the mesodecline, and although "stratosphere" is used for the layer extending up to this level. Instead of mesodecline the name "upper mixing layer" is used, based on considerations of composition, although the layer is defined on a thermal basis, and although present evidence indicated that mixing is effective throughout the whole region from the ground to a level above the mesopeak (paragraph 8); see K. F. Chackett, F. A. Paneth and E. J. Wilson, "The chemical composition of the stratosphere at 70 km height", Nature, 164, 128, 1949. (It may be remarked that the samples referred to in this publication probably represent air typical of a level somewhat below 60 km rather than 70 km).





Temperature T



n_e electron density

(3) In reference (1) the mesopeak is called the "ozonopause", but it is doubtful whether the rather indefinite upper boundary of the ozone layer should be identified with the level of maximum temperature in the mesosphere.

(4) C. T. Elvey, "Note on the spectrum of the airglow in the red region", Astrophys. J., 111, 432-433, 1950.

6. BY THE JOINT COMMISSION ON HIGH ALTITUDE RESEARCH STATIONS:

"WORLD DAYS" in Upper Atmospheric Research

(Resolution by Joint Commission on High Altitude Research Stations)

With increasing activity in upper-atmosphere research, in many fields, complete coordination of effort becomes more and more difficult. Certain phases of the studies are on a routine continuous basis; others represent special activities designed to cover a limited period of time. Rocket observations are, perhaps, the most significant studies of the latter group.

In order to obtain as high a concentration as possible of upper-air data, it is recommended that a set of special days be designated as "world days" or "international days". These should consist of approximately two days per month, one near new and the other near full moon. In addition, certain special world days may be designated, to coincide with such natural phenomena as total solar eclipses or major meteor showers.

If some experiment of a non-routine character is envisaged, relative to conditions in the upper atmosphere or associated phenomena, it is recommended that the experiment be performed on a world day if there is no specific reason for choosing another time. This program will lead automatically to the securing of concentrated atmospheric data at special times and will effect coordination with a minimum of trouble of the experimenters. Associated studies may include such fields as:

Rocket firings	Solar radio noise
Plane and balloon flights	Upper-air meteorology
Night-sky brightness	Cosmic-ray experiments
Auroral measures	Super-refraction of sound by upper air
Solar activity	Magnetic disturbances
Ionospheric studies	Ozone measurements, etc.
Radio absorption	

The following proposals have been submitted to the Association of Terrestrial Magnetism and Electricity for consideration at the Brussels meeting:

7. BY E. B. ROBERTS:

"The Association approves and adopts the following 'International Standards for Geomagnetic Operations and Publication of Results' as a working guide to proper performance and coordination of the work."

[The following text in English is the authoritative language of "Inter-American Standards for Geomagnetic Operations and Publication of Results", approved by the V General Assembly of the Pan American Institute of Geography and History at Santiago, Chile, in October 1950, and recommended for use of the Governments of the American Nations. It was composed after submission in provisional form to the officers of this Association, and to the members of several of the Committees, and reflects full consideration of their various replies and recommendations. Adoption in identical form would result in world-wide uniform standards for work practices and publication procedures.]

International Standards for Geomagnetic Operations and Publication of Results

1.0 Standard Instruments. Every institution interested in geomagnetic work (surveys, observatories, instrument-makers) should provide an efficient quantitative apparatus for testing nonmagnetic material to be used in the construction of new geomagnetic instruments and of observatory buildings; instruments already in use should also be tested by means of this apparatus or other methods (IATME Res. 3, 1939). Instruments for the determination of D and I should be adjusted so that their corrections do not exceed the standard error of a single observation (IATME Res. 4b, 1939).

1.1 Primary Standards. Instruments owned by the Carnegie Institution of Washington, long accepted as standard instruments for the measure of declination, horizontal intensity, and inclination, and now operated by the United States, are available and may be used as the Standards of Magnetic Measurements. European Standards formally recognized by the International Association of Terrestrial Magnetism and Electricity may also be used in a similar manner. The quantitative values of all such recognized standards shall be related by comparison observations of high precision. The quantitative values of all other instrumental indications shall be related to such standards through an adequate system of intercomparisons.

1.2 Secondary Standards. Instruments to be compared and maintained by the Republic of Argentina at a permanent observatory shall be accepted as Secondary Standards of Magnetic Measurements for South America. Similar instruments in Europe or other regions of the world, recognized by the International Association of Terrestrial Magnetism and Electricity, shall be similarly accepted for the regions concerned. Such secondary instruments shall be compared with a Primary Standard and the relationship determined with an error not in excess of 0′.5 in declination, 5 gammas in horizontal intensity, and 0′.5 in inclination.

1.3 National Standards. Each adhering country will undertake to maintain National Standard instruments, and to compare them with the Primary or Secondary Standards specified above to determine the relationship with with an error not in excess of 0′.5 in declination, 10 gammas in horizontal intensity, and 0′.5 in inclination.

1.4 Comparison Practices. The comparisons specified in this section shall be performed by skilled observers, who shall transport the instruments to the standard stations of reference for calibration and determination of index error. Comparison programs should be reported to the IATME Committee to Promote International Comparisons of Magnetic Standards and coordinated with the work of this committee. Quartz Horizontal Magnetometers (QHM's) shall be acceptable instruments for intercomparisons of horizontal intensity.

2.0 Field Instruments. See also 1.0.

2.1 Quality. Instruments shall be of recognized types and of good quality, free of magnetic impurities, and having no large or variable index corrections. Inclination instruments shall be of the inductor type, except in high latitudes, where other types are found superior.

2.2 Comparison. Instruments shall be calibrated by comparison with National Standards provided in section 1.0 before and after each season of field use, or at least once a year.

3.0 Basic Magnetic Surveys.

3.1 Purpose. Basic surveys shall show the general trend and pattern of the magnetic field, and the nature and extent of major anomalies. They shall not include examination of the intricate pattern of the field. They will be acceptable if they permit sure and satisfactory construction of isomagnetic lines in smooth general pattern. The declination should be shown everywhere in general with an error not in excess of 30′.

3.2 Sites of Stations. Stations shall be so placed to be representative of large adjacent areas, shall be spaced in general not more than 150 km apart, and shall be known by use of at least two nearby test stations to be free of serious local disturbances.

3.3 Marking and Describing of Stations. Permanent monuments and full descriptions shall be provided, to permit positive recovery of stations and the detection of any disturbing changes which might affect the station values.

3.4 Instrumental Procedure. Observing procedure shall result in errors not exceeding 2.′0 in declination, 30 gammas in horizontal intensity, and 2.′0 in inclination, after application of all instrumental corrections, and reduction for diurnal variation.

4.0 Repeat Stations.

4.1 Purpose. Selected stations of the basic survey, not more than 600 km apart, shall be used to supplement the permanent observatories in obtaining secular-variation rates.

4.2 Selection. Since the special use of these stations is periodic reoccupation to detect secular changes, very special care shall be exercised to select stations unlikely to suffer future artificial magnetic disturbance. The sites must be proven by test to have no magnetic gradients greater than 10′/100 m.

4.3 Supporting Stations. At least half, uniformly distributed, shall each be supported by one similar twin station within 10 km.

4.4 Occupation. Occupation shall be repeated each 5 years, or more often when secular change rates are abnormally high. Where practicable, repeat observations should be made in years ending in 4 and 9, to afford the best data for isomagnetic chart compilations in years ending in 5 and 0.

4.5 Instrumental Procedure. Procedure shall be generally the same as for basic magnetic surveys, but with special emphasis upon exactness of reoccupation, especially regarding instrument height. Observations shall be extended over at least two, and preferably three, days.

5.0 Observatories.

5.1 Control for Field Observations. Field observations shall be corrected for daily or irregular variation by reference to the variation records of the nearest fixed magnetic observatories.

5.2 Observatory Site Requirements. Observatories should be located in accordance with a planned scheme of world distribution. Magnetic anomalies should be avoided so that magnetic gradients are practically zero throughout an observatory area. Also to be avoided are artificial disturbances such as iron objects, electrical machinery, or direct-current electric lines.

5.3 Instrument Requirements. See also 1.0.

5.31 Absolute Instruments. The work of each observatory shall be based upon absolute instruments, which shall be the best available magnetometers and earth inductors and which may comprise the National Standard instruments required by paragraph 1.3. These shall be maintained and used to afford base values consistent with the requirements of paragraph 1.3.

5.32 Variometers. These shall be of a type and so maintained and operated as to produce variation records with numerical errors of individual readings less than those of the absolute instruments. Variometers should be examined at regular intervals not exceeding two years, particularly for tests of the directions of the magnetic axes of the variometer magnets (IATME Res. 4a, 1939).

5.4 Supplemental Automatic Stations. Secondary variation recording stations shall be established where possible, in order to supplement the indications of the observatories, and to furnish more detailed information regarding the areal distribution of secular changes, particularly in declination. These shall be spaced about 1000 km apart. Special attention and closer distribution shall be provided for areas between the geographic and geomagnetic equators, where daily variation of horizontal intensity is large. Automatic recording stations have been installed and operated at low cost in the United States, and have been found to operate reliably for several months at a time.

6.0 Publications.

6.1 Charts. Suitable isomagnetic charts shall be published, as far as justified by available data, as follows: isogonic charts each five years; other isomagnetic charts, especially isodynamic and isoclinic, each ten years. Isomagnetic charts shall include isoporic lines.

6.2 Field Results and Secular Change Data. Digests of field station values, and of secular change information, shall be published periodically as often as possible.

6.3 Magnetograms. Reproductions, to some convenient scale with necessary scale values, of magnetograms shall be published within a reasonable time, together with available information on daily, monthly, and annual means.

6.4 Hourly Tabulations. Tabulations of scaled hourly mean values of all components shall be published within a reasonable time if at all possible. These tabulations should be supported by estimates of any missing values; means of days, months, and years; hourly means of 5 international quiet and 5 international disturbed days of each month; data on absolute observations, scale values, base-line values; temperature coefficients; orientation tests; comparisons with standard instruments; and as far as practicable,other data mentioned in IATME Res. 10, 1939.

6.5 International Activity Figures. Upon request, suitable periodic reports and data shall be furnished to any officially designated organization engaged in the compilation of international activity figures.

6.6 Report of Mean Values. Each observatory should furnish to all interested agencies, as soon as possible after each period, semi-annual, or annual, summaries of preliminary mean values of declination, horizontal intensity, and inclination.

8. BY JOHN A. FLEMING AND H. F. JOHNSTON:

In view of the desirability and necessity of maintaining a Thesaurus of annual values of the geomagnetic elements for all functioning observatories and the stimulus thereby given to prompt reductions of records and secular-variation discussions, be it

RESOLVED, That the Association designate a committee of five to be charged with the responsibility of collecting and soliciting observatory data and of compiling annual values of D, H, I, Z, F, X, and Y and to arrange for publication and distribution at regular intervals at the expense of the Association.

9. BY M. HASEGAWA:

In view of the recent progress of researches in geomagnetism in connection with all allied natural phenomena, and of the importance of geomagnetic disturbances, the Association urges and supports such publications as "The International Disturbance Catalogue".

[Note: The Japanese Ionospheric Research Committee issues a "Disturbance Catalogue" covering disturbances in the ionosphere, geomagnetic field, field intensity of radio waves, cosmic rays, solar phenomena, and other related phenomena recorded in Japan, supplemented by some world-wide observations, although the latter are rather heterogeneous in quality and distribution.]

XI. Appointment of Committees

XII. Resolutions

STATEMENT SUMMARIZING THE PROCEEDINGS OF THE INTERNATIONAL ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY AT THE BRUSSELS MEETING

By S. Chapman

(Presented at the Final Plenary Session of the International Union of Geodesy and Geophysics, September 1, 1951)

The earth's magnetic field changes, slowly by ordinary human reckoning, though very rapidly as compared with geological changes. This necessitates perpetual renewal of magnetic surveying aided by the continuous magnetic records of magnetic observatories. Much good work done in this field, since the Oslo Assembly, has been reported to the Association, but the ocean magnetic survey has fallen greatly into arrear, and some magnetic observatories are still out of action owing to the ravages of war. Advances in the technique of airborne magnetic survey instruments have been reported.

Valuable progress has been made towards an understanding of the centuries-old question, why is the earth a somewhat irregular and slowly changing magnet. Many of the solutions suggested have departed from the classical laws of physics and imply that the outer rocky mantle of the earth, though substantially non-magnetic, nevertheless contributes to the earth's field. These solutions have now been proved inadmissible, by the measurement of the magnetic field in deep mines.

It now seems probable that the earth's magnetism has its origin in the liquid core, and is connected with electric currents flowing there, which are in some way - not yet clarified - connected with a general circulatory motion in the core. It seems highly probable that there are changing eddies in this general motion, and that by dynamo action these eddies produce subsidiary electric current systems, near the surface of the core; the regional anomalies of the earth's field, and its secular variation, are ascribed to these subsidiary electric currents.

The study of the transient magnetic variations gives information about the electric conductivity within the earth down to a depth of several hundred kilometers, in the rocky mantle surrounding the earth's core. Progress has been made in linking these results with the general physical theory of matter.

The sun frequently disturbs the earth's magnetic field to a slight but highly interesting degree. Since the Oslo Assembly definite confirmation has been obtained, from the spectrum of the aurora polaris, of the theory that magnetic storms and aurorae are due to the ejection from the sun of some of its atmospheric gas; this theory has long been held, but on somewhat indirect evidence. The particles of the solar gas, traveling with great speed, are much affected by the geomagnetic field when they arrive near the earth. They have now been detected during strong aurorae, while traveling downwards through our upper atmosphere.

It is important for many reasons to characterize the changing activity of the geomagnetic disturbance produced by such solar particles. To meet demands from many sources, including the radio-communication authorities, an index of magnetic disturbances is assigned to each successive interval of three hours, based upon the data afforded by a widespread network of magnetic observatories. Important progress has been made in this work since the Oslo Assembly.

Apart from the geomagnetic disturbance produced by the solar eruptions just mentioned, the sun by its wave radiation and gravitational force generates electric currents in the earth's upper atmosphere. Rockets have lately been projected up to great heights in order to locate these electric currents by magnetic measurements.

A remarkable intensification of these currents near the magnetic equator has been successfully investigated in America, Africa, and India under the auspices of one of our committees.

The Association has lately re-issued its valuable Atlas of Auroral Forms.

Our Association has held joint meetings on upper atmospheric layers with the Association of Meteorology, and discussions are proceeding to enable this subject to be more suitably and amply provided for within the Union.

Finally, useful progress has been made in the investigation of the small but extremely interesting influence of the moon upon the earth's magnetism.

PARTICIPATION IN THE BRUSSELS MEETING OF THE ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY, AUGUST 21-31, 1951

(The presence in the various sessions is indicated by "p". Attendance at Presidential Address on August 22 omitted.)

Name	Country	Meeting of August												
		21 pm	23 am	23 pm	24 am	24 pm	27 am	27 pm	28 am	28 pm	29 am	29 pm	30 am	31 am
Abel, R. B.	U.S.A.	..	..	..	..	..	..	p	..	..	..	..	..	..
Absalom, H. W. L.	Great Britain	p	..	p	p	p	..	p	..	..	..	p	p	p
Ambolt, N.	Sweden	p	p	p	p	p	p	p	p	p	p	p	p	p
Angervo, J. M.	Finland	..	..	..	p	p	..	..	..	..	..	..	..	..
Angström, A.	Sweden	..	..	..	..	p	..	..	..	..	..	..	..	..
Ankara, S. A.	Turkey	..	..	..	..	..	..	p	..	..	..	..	..	..
Ashbel, J.	Israel	..	..	..	p	p	..	..	..	..	..	..	..	..
Baars, B.	Netherlands	..	..	..	..	..	..	..	..	..	..	..	p	..
Balsley, J. R., Jr.	U.S.A.	..	..	p	p	p	p	p	p	..	..	..	..	..
Barbier, D.	France	p	p	p	p	..	p	p	p	..	..	..	..	p
Bartels, J.	Germany	p	p	p	p	p	p	p	p	..	p	p	p	p
Bates, D. R.	Great Britain	..	..	..	p	p	..	..	..	..	..	..	..	..
Beals, C. S.	Canada	..	..	p	..	..	..	..	p	..	..	..	..	..
Bedke, H. H.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Beling, J. K.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Bernard, E. A.	Belgian Congo	..	..	..	p	..	..	..	..	..	..	..	..	..
Bernard, René	France	p	p	p	p	p	..	..	..	..	..	..	..	..
Bertrand, J.	Belgium	p	..	..	p	p	..	p	..	..	..	..	..	..
Bessemoulin	France	p	..	..	..	..	..	..	..	..	..	..	..	..
Birch, F.	U.S.A.	..	..	..	..	..	..	p	..	..	..	..	p	..
Bock, R.	Germany	p	p	p	..	..	p	p	p	p	p	..	p	p
Bossolasco, M.	Italy	p	p	..	p	..	..	p	..	p	p	..	p	..
Bossy, L.	Belgium	..	..	..	p	p	p	p	..	..	..	..	..	..
Bowen, E. G.	Australia	..	..	..	p	..	..	..	..	..	..	..	..	..
Braekken, H.	Norway	p	..	..	p	..	..	..	..	..	..	..	..	..
Bramhall, E. H.	U.S.A.	..	p	..	p	p	..	..	..	..	..	..	..	..
Brewer, A. W.	Great Britain	..	..	..	p	p	..	..	p	..	..	..	..	..
Bricard, J.	France	..	..	..	p	p	..	..	p	..	p	..	p	..
Browne, B. C.	Great Britain	..	..	..	..	..	..	p	..	..	..	..	..	..
Bucher, W. H.	U.S.A.	..	..	..	..	..	..	..	..	..	..	..	p	..
Bullard, E. C.	Great Britain	..	..	..	..	..	..	p	..	..	..	..	..	..
Bullerwell, W.	Great Britain	..	..	..	..	..	..	p	p	..	..	..	..	..
Bureau, R.	France	..	..	..	p	..	..	..	p	..	..	..	p	..
Burmeister, F.	Germany	p	p	p	..	..	p	p	p	..	p	..	p	..
Burrows, C. R.	U.S.A.	..	..	..	p	p	..	..	..	..	..	..	..	..
Byers, H. R.	U.S.A.	p	..	..	p	p	..	..	..	..	..	..	..	..
Cagniard, L.	France	p	p	p	..	..	p	p	p	p	..	..	p	p
Cardús, J. O.	Spain	p	p	p	..	..	p	p	p	..	..	p	p	p
Cecchini, A.	France	p	p	p	p	p	p	p	p	p	p	p	..	..
Chapman, S.	Great Britain	p	p	p	p	p	p	p	p	..	..	..	p	p
Charnock, H.	Great Britain	..	..	..	..	p	..	..	..	..	..	..	..	..
Chilton, D.	Great Britain	..	..	..	p	p	..	..	..	..	..	..	..	..
Cialdea, R.	Italy	..	..	..	..	..	..	..	..	..	..	..	p	p
Clay, J.	Netherlands	..	..	..	p	p	..	..	..	..	..	..	..	..
Coulomb, J.	France	p	p	p	p	p	p	p	p	..	..	p	p	p
Currie, B. W.	Canada	p	p	p	p	..	p	p	p	..	..	p	..	p
Dail, J. H.	U.S.A.	..	..	..	..	..	..	p	..	..	..	..	..	..
Dauvillier, A.	France	..	..	p	..	..	p	p	p	..	..	p	..	p
Davies, D. R.	Great Britain	..	..	..	p	p	..	..	..	..	..	..	..	..
Davies, Frank T.	Canada	p	p	p	p	p	p	p	..	p	p	p	p	p
Debrach, J.	Morocco	p	..	..	..	..	..	..	..	..	..	..	..	..
Desper, D. D.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Dessens, H.	France	..	..	..	..	..	..	..	..	..	..	..	p	..
Dieminger, W.	Germany	p	p	p	p	p	..	..	p	p	..	..	p	..
Dobson, G. M. B.	Great Britain	..	..	..	p	p	..	..	..	..	..	..	..	..
Dubief	France	p	..	..	..	..	..	..	..	..	..	..	..	..
du Jonchay, I.	France	..	..	..	p	..	..	..	..	..	..	..	..	..
Egedal, J.	Denmark	p	p	p	p	p	p	p	p	p	p	p	p	p
Errulat, F.	Germany	p	p	p	..	p	p	p	p	..	..	p	p	p
Ewing, M.	U.S.A.	..	..	..	..	..	..	p	..	..	..	..	..	..
Ferraro, V. C. A.	Great Britain	p	p	p	p	p	p	p	p	p	p	p	..	..
Flohn, H.	Germany	..	..	..	p	..	..	..	..	..	..	..	..	..
Forbush, S. E.	U.S.A.	..	..	..	..	..	p	p	p	..	p	..	..	..
Forster, B. F.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Frankenberger, Z.	Germany	..	p	p	p	p	p	p	p	..	..	p	p	p
Fritz, S.	U.S.A.	..	..	..	p	p	..	p	..	..	..	..	..	..

PARTICIPATION IN THE BRUSSELS MEETING OF THE ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY, AUGUST 21-31, 1951--Continued

Name	Country	Meeting of August												
		21 pm	23 am	23 pm	24 am	24 pm	27 am	27 pm	28 am	28 pm	29 am	29 pm	30 am	31 am
Fultz, D.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Gaibar-Puertas, C.	Spain	p	p	..	..	..	..	..	..	p	..	p	..	p
Garland, G. D.	Canada	..	..	..	..	..	..	p	..	..	..	..	p	..
Garstang, R. H.	Great Britain	p	p	p	p	..	..	..	..	..	..	..	..	..
Gassmann, F.	Switzerland	p	p	..	..	..	..	..	..	..	..	..	..	..
Gast, P. R.	U.S.A.	..	..	..	p	p	..	..	..	..	..	..	..	..
Gibson, W. M.	U.S.A.	p	..	p	..	..	..	..	..	..	p	p	..	..
Giesecke, A. A., Jr.	Peru	p	p	p	p	p	..	p	..	..	p	p	p	p
Giorgi, M.	Italy	p	p	..	..	..	..	p	p	p	..	..	..	..
Godefroy, A.	France	p	p	p	p	..	..	..	..	p	..	p	p	..
Gold, E.	Great Britain	..	..	..	p	..	..	..	..	..	..	..	..	..
Goody, R. M.	Great Britain	..	..	..	p	p	..	..	..	..	..	..	..	..
Gordon, W. E.	U.S.A.	..	..	..	p	p	..	..	..	..	..	..	..	..
Götz, F. W. P.	Switzerland	..	..	..	p	p	..	..	..	..	..	..	..	..
Gowan, E. H.	Canada	..	..	..	..	p	..	..	..	..	..	..	..	..
Grenet, G.	France	..	p	p	..	..	p	..	..	..	p	..	..	..
Grosjean, P. V.	Belgian Congo	..	..	..	p	..	..	..	..	..	..	..	..	..
Gunn, Ross	U.S.A.	..	..	..	p	p	..	..	..	..	..	..	..	..
Haalck, F.	Germany	p	..	..	..	..	..	..	..	..	..	..	..	..
Hafstad, Mrs. K. C.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Harang, L.	Norway	..	..	p	p	p	..	..	..	..	..	..	..	..
Hasegawa, M.	Japan	p	p	p	..	p	p	p	p	..	p	..	p	p
Hatakeyama, H.	Japan	..	..	..	p	..	..	..	..	..	..	..	..	..
Hazlewood, E. L.	U.S.A.	..	..	..	..	..	..	p	..	..	..	..	..	..
Hedström, H.	Sweden	..	p	..	..	..	..	..	..	..	..	..	..	..
Hee, Mme. A.	France	..	p	p	p	..	p	p	p	p	..	..	p	p
Heezen, B. C.	U.S.A.	..	..	..	..	..	..	p	..	..	..	..	..	..
Heinrichs, G.	Belgian Congo	p	p	p	p	..	p	..	p	p	p	p	p	..
Hellgren, G.	Sweden	p	p	p	p	p	p	..	p	..	..	p	p	..
Hendricks, C. V.	U.S.A.	..	..	..	..	p	..	..	..	..	..	..	..	..
Herlofson, M.	Sweden	..	..	..	p	p	..	..	..	..	..	..	..	..
Herrinck, P.	Belgian Congo	p	p	..	p	p	p	p	..	..	..	..	..	..
Hide, R.	Great Britain	p	..	p	p	..	..	..	..	..	..	..	..	..
Hill, M. N.	Great Britain	p	..	..	..	..	..	..	..	..	..	..	..	..
Hoge, Edmond	Belgium	p	p	p	p	p	..	p	p	p	..	p	..	..
Hughes, H.	Great Britain	p	..	p	p	p	..	p	p	..	..	..	p	..
Hulburt, E. O.	U.S.A.	p	..	..	p	p	..	..	..	..	..	p	..	..
Jacobs, W. C.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Jarman, C. A.	Great Britain	p	p	p	p	p	p	p	p	p	p	..	p	..
Jeffreys, Berthe	Great Britain	..	..	..	p	..	..	..	..	..	..	..	..	..
Jeffreys, Harold	Great Britain	..	..	..	..	..	..	..	..	..	..	..	p	..
Johnston, H. F.	U.S.A.	..	p	..	p	..	p	p	p	..	p	p	..	p
Johnston, R. D.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Jones, Sir H. Spencer	Great Britain	p	p	p	p	p	p	p	p	..	p	p	p	p
Joyce, J. W.	U.S.A.	p	p	p	p	p	p	p	p	..	..	..	p	p
Junge	Germany	..	..	..	p	p	..	..	..	..	..	..	..	..
Kamel, M.	Egypt	p	p	p	p	p	..	p	..	p	p	..	..	..
Kaplan, J.	U.S.A.	p	p	..	p	p	p	p	p	..	..	..	p	..
Kerr, F. J.	Australia	..	..	..	p	p	..	..	..	..	..	..	..	..
Keränen, J.	Finland	p	p	p	p	p	..	..	..	..	..	..	..	..
Kjaer, Rolf	Norway	p	p	p	..	..	p	..	p	..	p	..	..	p
Koenigsfeld, L.	Belgium	p	p	p	p	p	p	p	p	..	p	..	p	p
Kunetz, G.	France	..	..	p	p	p	..	p	p	p	..	p	..	..
Kvifte, G.	Norway	..	p	p	p	p	p	p	p	p	..	..	..	p
Labrouste, Mme.	France	p	..	..	..	..	..	..	..	..	..	..	..	..
Lahaye, E.	Belgium	p	p	..	p	p	p	p	p	..	p	p	p	p
Langer, R. M.	U.S.A.	..	..	..	..	p	..	..	..	..	..	..	..	..
Laursen, V.	Denmark	p	p	p	p	p	p	p	p	p	p	p	p	p
Lowes, F. J.	Great Britain	p	..	..	..	..	..	..	..	..	..	..	..	..
Lundquist, S.	Sweden	p	..	p	..	p	..	p	..	..	..	..	..	..
MacVittie, G. C.	Great Britain	..	..	..	p	..	..	..	..	..	..	..	..	..
Madwar, M. R.	Egypt	p	..	p	p	p	..	p	p	..	..	p	p	p
Malmquist, D.	Sweden	p	p	p	p	p	p	p	p	..	..	p	p	..
Mariolopoulos, E. G.	Greece	..	..	..	p	..	..	..	..	..	..	..	..	..
Marshall, J. S.	Canada	..	..	..	p	..	..	..	..	..	..	..	..	..
Mason, B. J.	Great Britain	..	..	..	p	..	..	..	..	..	..	..	..	..
Medi, E.	Italy	p	p	..	..	..	p	p	..	p	..	..	p	p
Mendes, F. J.	Portugal	..	..	..	p	p	..	..	..	..	..	..	..	..

PARTICIPATION IN THE BRUSSELS MEETING OF THE ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY, AUGUST 21-31, 1951--Concluded

Name	Country	Meeting of August												
		21 pm	23 am	23 pm	24 am	24 pm	27 am	27 pm	28 am	28 pm	29 am	29 pm	30 am	31 am
Mendes, Simoes A.	Portugal	..	p	p	p	p	p	p	p	..	p	..	p	p
Menzel, W.	Germany	p	p	p	p	p	p	..	p	..	..	..	..	..
Möller, F.	Germany	..	..	..	p	p	..	..	..	..	..	..	..	..
Moore, A. F.	Great Britain	..	..	p	..	..	..	..	..	..	..	..	..	..
Morelli, C.	Italy	..	..	..	..	..	..	p	..	..	..	..	..	p
Moseley, E. A.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Mügge, R.	Germany	..	..	..	p	..	..	..	..	..	..	..	..	..
Nanda, J. N.	India	..	..	..	..	..	..	p	p	..	..	..	..	..
Newell, H. E., Jr.	U.S.A.	p	..	..	p	p	..	..	..	..	..	..	..	..
Nicolet, M.	Belgium	p	..	..	..	..	p	p	p	..	..	..	p	p
Norinder, H.	Sweden	p	..	..	..	p	..	..	p	..	p	..	..	..
Normand, Sir Charles	Great Britain	..	..	..	p	p	..	..	..	..	..	..	..	..
Nyberg, A.	Sweden	..	..	..	p	..	..	..	..	..	..	..	..	..
Oliver, E. D.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Omholt, A.	Norway	..	..	p	p	p	p	p	..	p	..	..	..	..
Palmer, H. P.	Great Britain	..	..	..	..	p	..	..	..	..	..	..	..	..
Pasquill, F.	Great Britain	..	..	..	p	p	..	..	..	..	..	..	..	..
Pekeris, C. L.	Israel	..	..	..	p	p	..	..	..	..	..	..	..	..
Petersen, Helge	Denmark	..	..	..	p	p	..	..	..	..	..	..	..	..
Pettit, Miss H. B.	U.S.A.	..	..	..	p	p	..	p	..	..	..	..	..	..
Phemister, J.	Great Britain	..	..	..	..	..	..	p	..	..	..	..	..	..
Piraux, Ph.	Belgium	..	p	p	..	p	p	..	..	..	..	..	..	..
Price, A. T.	Great Britain	p	p	p	p	p	..	p	..	p	..	..	p	p
Priestley, C. H. B.	Australia	..	..	..	p	p	..	..	..	..	..	..	..	..
Ramdas, L. A.	India	..	..	..	p	p	..	..	..	..	..	..	..	..
Rankine, A. O.	Great Britain	..	..	..	p	..	..	p	p	p	..	..	p	..
Rayner, J. M.	Australia	p	p	p	..	..	..	p	p	..	..	..	..	..
Roach, F. E.	U.S.A.	..	p	p	p	p	p	..	..	..	..	..	..	p
Robinson, G. D.	Great Britain	..	..	..	p	..	..	..	..	..	..	..	..	..
Rodriguez-Navarro,J.	Spain	..	p	p	..	..	p	p	p	p	p	..	..	p
Romañá, A.	Spain	p	p	p	..	..	p	p	p	p	p	p	p	p
Ross, A. D.	Australia	..	..	p	..	p	..	..	..	..	..	..	..	..
Runcorn, S. K.	Great Britain	p	..	p	..	..	..	p	p	p	..	..	p	..
Ruska, Walter	U.S.A.	p	p	..	..	..	..	..	..	..	..	..	..	..
Schairer, J. F.	U.S.A.	..	..	..	..	..	..	..	..	p	..	..	..	..
Schieldrup-Paulsen,H.	Norway	..	..	..	p	..	..	..	..	..	..	..	..	..
Schonstedt, E. O.	U.S.A.	p	p	p	p	p	p	p	p	..	..	..	p	..
Sheppard, P. A.	Great Britain	..	..	..	p	..	..	..	..	..	..	..	..	..
Shotton, F. W.	Great Britain	..	..	p	..	..	..	..	..	..	..	..	..	..
Singer, S. F.	U.S.A.	p	..	..	p	p	..	..	..	..	..	..	..	..
Slichter, L. B.	U.S.A.	..	..	..	p	p	..	..	..	..	..	p	p	..
Snead, V. O.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Snyder, F. F.	U.S.A.	..	..	..	p	..	..	..	..	..	..	..	..	..
Solberg, H.	Norway	..	..	..	p	..	..	..	..	..	..	..	..	..
Spengler, K. C.	U.S.A.	..	..	..	..	p	..	..	..	..	..	..	..	..
Stagg, J. M.	Great Britain	..	..	..	p	..	..	..	..	..	..	..	..	..
Starbuck, L.	Hong Kong	..	..	..	p	..	..	..	..	..	..	..	..	..
Stranz, D.	Germany/Sweden	..	..	p	p	p	..	..	..	..	..	..	..	..
Sucksdorff, E.	Finland	p	p	p	p	p	p	p	p	p	p	p	p	p
Swings, P.	Belgium	..	..	..	..	p	..	..	..	..	..	..	..	..
Tatel, H. E.	U.S.A.	..	..	..	..	..	..	p	..	p	p	..	p	..
Thellier, E.	France	p	p	p	p	p	p	p	p	p	p	p	p	p
Thellier, Mme. O.	France	p	p	p	p	..	p	p	p	p	p	p	p	p
Tousey, R.	U.S.A.	..	..	..	p	p	..	p	..	..	..	..	..	..
Vandenplas, A.	Belgium	..	..	..	..	..	..	p	..	..	..	..	..	..
Vassy, Mme. A.	France	..	p	..	p	p	..	p	p	..	..	..	..	..
Vassy, E.	France	..	p	..	p	p	..	p	..	..	..	..	..	..
Vegard, L.	Norway	p	..	..	p	p	p	p	..	p	..	..	..	..
Veldkamp, J.	Netherlands	..	..	..	p	..	p	p	..	..	..	..	p	p
Wasserfall, K. F.	Norway	p	..	..	p	p	p	p	p	p	..	..	p	p
Werner, F.	Germany	p	..	..	..	..	..	..	..	..	..	..	..	..
Werner, S.	Sweden	p	p	p	p	p	p	p	p	..	..	p	p	..
Wilkes, M. V.	Great Britain	p	p	p	p	p	..	p	p	..	..	..	p	p
Wilson, C. D. V.	Great Britain	p	..	..	..	..	..	..	..	..	..	..	..	..
Wilson, J. T.	Canada	..	..	..	..	..	..	..	..	..	..	..	p	..
Wiser, P.	Belgium	p	..	..	..	..	..	..	..	..	..	..	..	..
Wormell, T. W.	Great Britain	..	..	..	p	p	..	..	..	..	..	p	..	..

MINUTES OF THE BRUSSELS MEETING
AUGUST 21-31, 1951

Session of August 21, 1951

The meeting was called to order by the President, Professor Chapman, at 14:30 in the Salle de Marbre du Palais des Académies.

The following special committees were appointed:

Nominations Committee

Dr. C. S. Beals	(Canada)
Mr. A. A. Giesecke, Jr.	(Peru)
Prof. J. Keränen	(Finland)
Prof. E. Lahaye	(Belgium)
Mr. J. M. Rayner	(Australia)

Budget Committee

Dr. N. Ambolt	(Sweden)
Dr. E. C. Bullard	(Great Britain)
Mr. G. Grenet	(France)

Resolutions Committee

Prof. J. Kaplan	(U.S.A.)
Rev. Fr. A. Romañá	(Spain)
Prof. E. Thellier	(France)

These Committees will select their respective chairmen and arrange for their meetings as required.

The following were appointed to serve as the representatives of the Association on joint committees with the Associations of the Union to determine Union positions on proposals made by the Mixed Commission on the Ionosphere (MCI) and the Joint Commission on High Altitude Research Stations (JCHARS):

Third Polar Year 1957-58 (MCI)--to meet with representatives of the Associations of Meteorology, Hydrology, and Physical Oceanography:

Dr. B. W. Currie	(Canada)
Mr. V. Laursen	(Denmark)

Upper Atmosphere Nomenclature (MCI)--to meet with representatives of the Associations of Meteorology, Hydrology, and Physical Oceanography:

Prof. S. Chapman	(Great Britain)
Prof. J. Kaplan	(U.S.A.)
Dr. M. Nicolet	(Belgium)

"World Days" (JCHARS)--to meet with representatives of the Associations of Meteorology and Physical Oceanography:

Mr. D. Barbier	(France)
Dr. J. Veldkamp	(Holland)

The Association of Terrestrial Magnetism and Electricity will act as coordinator of the Union position on the questions of the Third Polar Year and Upper Atmosphere Nomenclature. The Association of Meteorology is the coordinator for the Union position on "World Days"

Abstracts of the following National Reports were presented:

Belgium - by Prof. Lahaye
Italy - by Prof. Medi
Finland - by Dr. Sucksdorff
France - by Prof. Thellier
Sweden - by Prof. Norinder

The meeting adjourned at 15:30.

Session of August 22, 1951

President Chapman presented his Presidential Address at 11:15.

The meeting adjourned at 12:15.

Morning Session of August 23, 1951

President Chapman called the meeting to order at 10:00.

He then read the names of those geophysicists in the fields of terrestrial magnetism and electricity whose deaths since the Oslo Assembly had been reported to the Association (see pp. 23-24). Members were requested to advise the Secretary of any omissions. A moment of silence in memory of our departed colleagues was observed.

The Secretary presented his report. It was accepted by the Association.

Prof. Lahaye extended a cordial invitation to visit the Royal Meteorological Institute at Uccle Thursday afternoon, August 23. Transportation will leave the University at 16:15.

Mr. Laursen presented the completion report on the work of the Temporary Commission for the Liquidation of the Polar Year 1932-33. Following the adoption of this report by the Association, Dr. Price acknowledged the very valuable assistance that had been rendered by the Commission in making available the records of the Second Polar Year, and asked whether other arrangements would be made to continue to provide such services. Mr. Laursen replied that the Danish Meteorological Institute would continue to act in this capacity. President Chapman, on behalf of the Association, then expressed thanks to the Chairman of the Temporary Commission, Dr. Fleming, and to its Secretary, Mr. Laursen, for their excellent work in handling the affairs of the Polar Year and for their great assistance to the work of the Association in making instruments available and for processing and distributing Polar Year data and results. Appreciation was also expressed to the Danish Meteorological Institute for their continued help in servicing Polar Year records.

At the request of the President, Prof. Coulomb then presented the proposal made by the French National Committee that a section on "High Atmosphere" be created within the Association to provide for the needs of our colleagues working in the field of the physics of the upper atmosphere. Professor Kaplan then made the following proposal:

(1) That a permanent Committee of the Association of Terrestrial Magnetism and Electricity be appointed to arrange symposia and to consider other matters related to the upper atmosphere which may be of interest to the Association.

(2) That this Committee carry on discussions with URSI, the Association of Meteorology, and the Mixed Commission on the Ionosphere relative to the solution of the problem presented by the French proposal, and the Committee report to the Association at the next General Assembly.

(3) That a Committee consisting of magneticians and upper atmosphere physicists be appointed for this Assembly only, to report to the Association of Terrestrial Magnetism and Electricity, which in turn will report to the Assembly of the Union, the sense of the Association regarding the problem of the upper atmosphere; for example, that it is the sense of the Association that

(a) A Mixed Commission including members from the Association of Meteorology and the Association of Terrestrial Magnetism and Electricity be created, or

(b) That the name of the Association of Terrestrial Magnetism and Electricity be changed to include the upper atmosphere, or

(c) That the French proposal be accepted, or

(d) That some combination of (a), (b), and (c), or some other proposal be adopted.

The Association accepted these suggestions and the Nominations Committee was instructed to name the two committees, although it was indicated in the discussion that the temporary committee could also be the permanent committee if this was desirable.

The next item considered was the proposal of the Mixed Commission on the Ionosphere concerning a Third Polar Year in 1957-58.

Mr. Egedal commented that the observations during such a Polar Year period should be taken over all the earth, and that special interest is attached to observations near the magnetic equator because of the large daily variations in horizontal intensity and the bifurcation of the F2 layer of the ionosphere. He felt that there should be added to the list of objectives of a Third Polar Year as given by the Mixed Commission on the Ionosphere the following:

(1) The observation of the abnormal daily variations of magnetic elements at the magnetic equator.

(2) The determination of the special structure of the ionosphere in the region about the magnetic equator.

(3) The determination of the tidal phenomena in the equatorial regions of atmospheric, ionospheric, magnetic, and geoelectric quantities.

Mr. Egedal also suggested that if the Third Polar Year was to occur during a sunspot maximum, and he believed this to be desirable, the period would then fall in 1959-60, since this would be 2-1/2 sunspot periods from the sunspot minimum which occurred during the Second Polar Year 1932-33.

Mr. Egedal then introduced the following proposal on behalf of the Committee to Promote Observations of Daily Variations in the Horizontal Force Between and Near the Geographic and Magnetic Equators (Committee No. 11):

> If the organization of a Third Polar Year comprising observations from all over the world should not be practicable because of non-cooperation of certain great nations, the Committee No. 11 recommends the organization of an Equatorial Year at the sunspot maximum.

The President referred Mr. Egedal's remarks and the proposal from Committee No. 11 to the representatives of the Association (Mr. Laursen and Dr. Currie) on the Joint Third Polar Year Committee of the Union. The President stressed that the action did not bind the special representatives in any way and that they should adopt a course of action justified by a careful review of all pertinent factors available to them.

The next item of business was the appointment of members to represent the Association on the various joint commissions of the I.C.S.U. The following were named:

(1) Joint Commission on Solar and Terrestrial Relations

(a) Prof. E. Vassy	(France)
(b) Dr. S. K. Pramanik	(India)
(c) Dr. J. Bartels	(Germany)

(d) It was agreed that if the Association of Meteorology did not reappoint Prof. M. Nicolet (Belgium) as their representative, he be named as a fourth member from the Association of Terrestrial Magnetism and Electricity.

(2) Mixed Commission on the Ionosphere

(a) Prof. S. Chapman	(Great Britain)
(b) Mr. J. Egedal	(Denmark)
(c) Prof. C. W. Gartlein	(U.S.A.)
(d) Dr. M. Hasegawa	(Japan)
(e) Dr. D. F. Martyn	(Australia)
(f) Prof. E. Thellier	(France)

The President then read a letter from the Secretary requesting that his resignation be accepted because of increased official duties in connection with his professional position. The Association accepted this resignation with regret.

The election of the President, Vice-Presidents and Secretary were next considered. The Nominations Committee submitted the following names:

President:	Prof. J. Coulomb	(France)
Vice-Presidents:	Prof. S. Chapman	(Great Britain)
	Dr. J. Bartels	(Germany)
Secretary:	Mr. V. Laursen	(Denmark)

There being no further nominations, the President declared these candidates unanimously elected.

National Reports were then presented as follows:

Germany - by Prof. Errulat
Switzerland - by Dr. Gassmann
Japan - by Dr. Hasegawa
Peru - by Mr. Giesecke
Great Britain - by Sir Harold Spencer Jones

Sir Harold Spencer Jones then commented on the current status of the British non-magnetic ship "Research". She still lacks non-magnetic engines. He believed the Admiralty would gladly turn her over to any body, such as a United Nations agency, for example, UNESCO, if they could guarantee her completion and that she would be put to the use for which she was originally constructed.

In connection with the proposed "Upper Atmosphere Nomenclature", put forward by the Mixed Commission on the Ionosphere, Prof. Vegard remarked that:

(1) There is not yet a sufficient basis to justify the name "Thermosphere" for the region above the supposed minimum between 60-100 km. The temperature measurements from the auroral bands have shown that the temperature derived from the average rotational energy of molecules is very low, say -40° to -60° C- at any rate from about 90 to 150 km.

The supposition of a great increase of temperature upwards is based on uncertain and doubtful interpretations of the density distribution towards higher altitudes. We may hope that in the near future determinations from auroral bands may be extended to greater altitudes* . (* In a letter sent the President of the Association, Dr. S. Chapman, the same day, Vegard suggests the name "Coronosphere" for the region above about 80 km, which is the height of the luminous night clouds.)

(2) The denotations for the conductive layers F1 and F2 suggest a closer relation between the way of production and the properties of these two layers than borne out by observed facts, and Vegard proposes that the names of these layers should be changed accordingly.

Following this the meeting adjourned at 12:00.

Afternoon Session of August 23, 1951

President Chapman called the meeting to order at 14:10.

Since there were no more requests on the part of delegates to present National Reports, and since all those received by the Secretary will be published in full in the International Association of Terrestrial Magnetism and Electricity Transactions of the Brussels Meeting, this item was considered completed.

The following reports of Special Committees appointed at Oslo were read by title and were accepted by the Association. The first two were printed in full and had been distributed to the delegates prior to the meeting:

Committee on Selection of Sites of New Observatories for Terrestrial Magnetism and Electricity - J. A. Fleming, Chairman

Committee on Secular Variation Stations - E. H. Vestine, Chairman

Committee on Aurora - C. Störmer, Chairman

The following technical communications were then presented:

F. G. Lowes and S. K. Runcorn: A physical analysis of the geomagnetic secular change (presented by Mr. Runcorn)

R. D. Hutchison: Investigation of magnetic secular change in Canada (presented by Dr. C. S. Beals)

S. K. Pramanik: Secular variation of the magnetic field at Colaba and Alibag (by title)

E. Lahaye and E. Hoge: l'Etude de la variation séculaire en Belgique. Choix des stations et première campagne de mesures (presented by Mr. Hoge)

C. Gaibar-Puertas: Les déplacements isoporiques et leurs rapports avec les principaux accidents geotectoniques

Following this paper, the following proposal by Dr. L. Slaucitajs was presented:

"In view of the importance of following the movement of isoporic foci, the Association of Terrestrial Magnetism and Electricity recommends the establishment of additional magnetic repeat stations in regions of rapid changes, and further, recommends more frequent observations of the geomagnetic elements at all repeat stations in such areas".

This proposal was accepted and referred to the Resolutions Committee.

The report of the Committee on Methods of Observatory Publications was then given by its Chairman, Dr. Bartels. The report was accepted by the Association.

Sir Harold Spencer Jones then suggested that a Union resolution be sought to explore the possibilities of United Nations assistance in the completion of the non-magnetic ship "Research".

The proposal concerning "International Standards for Geomagnetic Operations and Publication of Results", based on action taken by the Fifth General Conference of the Pan-American Institute for Geography and History, and proposed by Captain

E. B. Roberts, United States Coast and Geodetic Survey, was referred to the following Special Committee:

Dr. N. Ambolt, Convener	(Sweden)
Dr. H. W. L. Absalom	(Great Britain)
Comdr. W. M. Gibson	(U.S.A.)
Dr. M. Hasegawa	(Japan)
Dr. E. Medi	(Italy)

The Committee was instructed to return their recommendations to the Association not later than Tuesday, August 28.

Mr. Egedal then commented as follows on National Reports:

"In the Danish National Report it has been mentioned that the directions of the axes of the magnets of the variometers at Rude Skov have been examined. It is very important that this is done for all observatories, because if the axes of these magnets are not oriented in the right direction, the magnetic components recorded will be in error.

"It would be valuable if the Committee on Observatory Technique could advise the magnetic observatories when assistance is necessary in order to get correct values. From the absolute value observations it is possible to state whether the recordings are correct or not."

Dr. Joyce reported that Mr. H. F. Baird of New Zealand had written him regarding checks made in July 1951 of the orientations of the Eschenhagen variometer magnets at Amberley in accordance with Association Resolutions 3 at Edinburgh and 4 and 10e at Washington. Only provisional results were available. These indicated correct positions to within 0.5° for the H variometer, about 0.9° for D, and 0.5° for Z.

Dr. Bartels requested that all magnetic observers read his "Hints to K-Scaling" and the report of the Committee on Magnetic Characterization, as preparation for the presentation of this report on Monday, August 27.

The President indicated Mr. Laursen would be the principal Association representative on the Third Polar Year Joint Committee, with Prof. Kaplan acting in a similar capacity in the Joint Committee considering upper atmosphere nomenclature.

The Association authorized the Secretary to pay $170 to the Journal of Geophysical Research to cover page charges of non-U. S. contributors in the last three volumes for 1950. This was in accord with earlier action taken at Oslo. This action concluded payment of subventions to the Journal of Geophysical Research.

President Chapman referred to the Committee on Observational Technique the recommendation contained in his Presidential Address that high latitude magnetic observatories consider the use of faster measuring absolute instruments.

The meeting adjourned at 17:00.

First Joint Session with Association of Meteorology on "Physics of the high atmosphere and the ionosphere", August 24, 1951

Chairman Kaplan called the meeting to order at 09:05. The following technical program was presented:

Fred L. Whipple: Results of rocket and meteor research. (Presented by Dr. H. E. Newell.) This paper was discussed by Dr. Hulburt and Dr. Pekeris.

F. E. Roach and Helen B. Pettit: Recent studies of the diurnal variations of the upper atmosphere emissions 5577 and 6300 (oxygen) and 5893 (sodium). (Presented by Dr. Roach.) This paper was discussed by Dr. Gunn, Dr. Pekeris, Dr. Bernard, Dr. Dieminger, Prof. Vegard, and Prof. Vassy.

S. Fred Singer, E. Maple, and W. A. Bowen, Jr.: Evidence for ionospheric currents from rocket experiments near the geomagnetic equator. (Presented by Dr. Singer.) This paper was discussed by Dr. Ferraro, Mr. Schonstedt, and Dr. Newell.

L. Vegard: Experimental results of auroral research. This paper was discussed by Mr. Garstang.

The meeting adjourned at 12:00.

Second Joint Session with Association of Meteorology on "Physics of the high atmosphere and the ionosphere", August 24, 1951

Chairman Kaplan called the meeting to order at 14:35 and the following technical program was presented:

S. Chapman: The aurora. This paper was discussed by Prof. Vegard, Prof. Clay, Prof. Bates, Dr. Bartels, and Dr. Hulburt.

D. R. Bates: Basic reactions in the upper atmosphere.

W. Dieminger: Über Echolotungen der Ionosphäre bei schrägem Einfall.

J. Clay: Ion balance in the atmosphere.

The meeting adjourned at 17:15.

Morning Session of August 27, 1951

President Chapman called the meeting to order at 10:00.

Following an announcement concerning the excursion to Dourbes on Thursday afternoon, August 30, the following technical papers were presented:

J. Kaplan: Laboratory studies related to the physics of the upper atmosphere.

M. H. Johnson: A relation between diffusion and electrical currents (read by title).

Next, reports of Special Committees of the Association appointed at Oslo were given as follows:

(1) Committee on Characterization of Magnetic Disturbances, by J. Bartels, Chairman

This report was discussed by Dr. Veldkamp, Rev. Father Cardus, Sir Harold Spencer Jones, and Mr. Selzer.

The President announced that an open meeting of this Committee would be held at 17:00 on August 27 to consider final recommendations to the Association, based on the Committee report. Final acceptance of this report was deferred until these recommendations could be formulated.

(2) Committee to Promote International Comparisons of Magnetic Standards, by V. Laursen, Chairman

The report, presented by Mr. Laursen, was accepted by the Association.

Mr. Laursen cautioned operators that the critical step in operating QHM's was in clamping the system after use, and he advised observers to be sure that the magnet system was properly positioned before securing the clamps, otherwise the quartz fiber may be broken. A common fault was to have the suspension stem displaced laterally so that it was not properly secured as the clamping mechanism was tightened.

Mr. Laursen also indicated that the program was to be extended to include more observatories and to repeat comparisons at given observatories at more frequent intervals. He extended the thanks of his Committee to the observatories which have cooperated in the program to date.

President Chapman suggested that any observatory interested in obtaining Association QHM's for comparisons could do so by communicating with Mr. Laursen at the Danish Meteorological Institute at Charlottenlund.

Dr. Ambolt also commented on the report.

(3) Committee on Giant Pulsations, J. Olsen, Chairman

This report was presented by Dr. Sucksdorff. The Association noted the Committee's recommendation for the loan of Association instruments to set up quick-run stations at Kiruna and Tromsø, and referred the question to the Executive Committee for action.

Following some additional comments by Dr. Sucksdorff, the report was accepted by the Association.

(4) Committee on Centralization and Standardization of Records, by Sir Harold Spencer Jones, Chairman

The report was presented by Sir Harold and in accordance with a recommendation contained therein, the Committee was discharged with thanks.

(5) Committee on Observational Technique, H. E. McComb, Chairman.

This report was presented by title since copies had been circulated and there were no questions raised concerning it.

(6) Committee to Promote Observations of Daily Variations in the Horizontal Force Between and Near the Geographic and Magnetic Equators, by J. Egedal, Chairman

The report was presented by Mr. Egedal and was accepted by the Association. It was discussed by Prof. Chapman and Dr. Price.

Next, the following technical communications were presented:

A. Romañá: Sur le caractère générale de la loi de classification des baies géomagnétiques pour les latitudes moyennes. Discussed by Dr. Bartels, Mr. Grenet, and Mr. Selzer.

M. Ota: Geomagnetic activity characterized by K-indices (given by title).

The meeting adjourned at 17:15.

Afternoon Session of August 27, 1951

The meeting was called to order by Prof. Chapman at 14:00.

It was announced that the number of Association representatives to the Mixed Commission on the Ionosphere was limited by statute to four. Since the Association appointed six members at the morning session on August 23rd, this number must be reduced to four. The matter was referred to the Nominations Committee for action.

Consideration was then given to the question of deciding what committees of the Association would be reappointed for the next period immediately following the Brussels Assembly. It was decided that all committees except No. 10 (Centralization and Standardization of Records) be continued and that two new ones be appointed, namely:

(1) A Committee on Upper Atmospheric Physics, and

(2) A Committee on Atmospheric Electricity.

The election of the members at large of the Executive Committee was the next order of business.

The Nominations Committee recommended the following names to the Association:

Dr. A. A. Giesecke, Jr.	(Peru)
Dr. M. Hasegawa	(Japan)
Prof. J. Kaplan	(U.S.A.)
Dr. S. L. Malurkar	(India)
Mr. J. M. Rayner	(Australia)

Since there were no further nominations the President declared these persons elected.

The following action was next taken on the various proposals that had been placed before the Association.

(1) The proposal by the French National Committee concerning the creation of an Association of Physics of the Earth's Interior.

Action: No action was taken by the Association as it was felt that the matter was being adequately dealt with in other associations of the Union.

(2) The proposal by the British National Committee concerning various topics:

Action: The Association agreed to the idea of part (2) concerning prompt preparation and disposition of proces-verbaux, and in limiting scientific communications therein to be published in appropriate journals.

The Association is already proceeding along the lines laid down in part (3), namely, distributing its publications through National Committees, except where special interests are concerned such as in the case of magnetic K and C indices.

The Association considers parts (1), (5) and (6) outside of its purview.

(3) The proposal by J. A. Fleming and H. F. Johnston concerning the appointment of a Special Committee to compile a thesaurus of magnetic observatory results, and the proposal by M. Hasegawa covering Association support to the publication of catalogues of disturbances, were referred to the Committee on Magnetic Characterization for action.

(4) All other proposals printed in the Preliminary Bulletin have already been or are being dealt with.

In addition, Professor Chapman introduced proposals on the following subjects:

(1) Encouragement of a resumption in the interchange of magnetic data by the U.S.S.R.

(2) An indication in National Reports of the degree of adherence to recommended operating procedures on the part of various observatories.

(3) The setting aside of definite funds from operating budgets for research in terrestrial magnetism.

(4) Encouragement to the responsible authorities to reestablish and reactivate the magnetic observatory at Hong Kong, with the subsequent renewal of magnetic work at that station.

The meeting then turned to a discussion of theories of the origin of the main magnetic field of the earth, led by Dr. S. K. Runcorn. Dr. Runcorn's remarks were followed by a discussion by Dr. Bullard.

The paper by M. Nicolet on "Interaction between solar radiation and earth's atmosphere" was then presented and it was discussed by Dr. Madwar and Prof. Vassy.

The meeting adjourned at 16:30.

Morning Session of August 28, 1951

President Chapman called the meeting to order at 10:10.

The proposed names of chairmen and members of Special Committees were presented to the Association by the Nominations Committee, and, in the absence of further nominations, all were declared elected. Since the financial support for the Committee on the Study of Lunar Variations in Meteorological, Magnetic, and Electric Elements was derived entirely from the Association of Terrestrial Magnetism and Electricity, it was decided that it would be designated as a Committee of the Association rather than a joint committee with Meteorology, although individual members primarily identified with Meteorology were to be continued. The Committee will continue to process magnetic, electric, and meteorological data. The Secretary will prepare a list of officers of the Association and chairmen and members of all committees for distribution to National Committees.

In the morning session of August 23, six members were designated by the Association as representatives on the Mixed Commission on the Ionosphere. Since only four are allowed by I.C.S.U., this list was reduced to the following:

Prof. S. Chapman	(Great Britain)
Dr. M. Hasegawa	(Japan)
Dr. D. F. Martyn	(Australia)
Prof. E. Thellier	(France)

Prof. Chapman is to act as coordinator of the group. Thus all contacts with the General Secretary, U.G.G.I., will be made through him.

The new Committee on Atmospheric Electricity was to take its place as Committee No. 10 in place of the disbanded Committee on Centralization and Standardization of Records. This new Committee will be established as a joint committee with the Association of Meteorology to arrange joint meetings on phases of atmospheric electricity of common interest to the two associations.

The question of active participation with the existing URSI Committee preparing for the Solar Eclipse of February 25, 1952, was discussed. No formal action was taken by the Association although it will cooperate through URSI members of the Committee who are also active in the affairs of IATME.

A final call was made for proposals. Sir Harold Spencer Jones submitted two, the first concerning the adoption of a 27-day numeration, and the second on the question of approaching one of the United Nations activities to see if they would complete and arrange for the operation of the R.R.S. Research. Both proposals were adopted and referred to the Resolutions Committee.

Mr. Kjaer asked if the International Hydrographic Bureau in Monaco had been approached regarding the Research. Sir Harold indicated it had not been officially, although Admiral Nares, the Director of the IHB, was aware of the problem.

Dr. Bartels presented a resolution on K and Kp. With its adoption by the Association, action on the report of the Committee on Magnetic Characterization was completed and the report was considered as accepted by the Association.

Dr. Fleming's report as Chairman of the Committee on Selection of Sites of New Observatories for Terrestrial Magnetism and Electricity proposed a resolution of encouragement to the Director of the National Meteorological Service of Portugal in the latter's efforts to increase activity in geomagnetism and related subjects. This proposal was accepted and referred to the Resolutions Committee.

Dr. Bartels then read a series of proposed instructions by the Association to the Committee on Magnetic Characterization. They were adopted by the Association, and are listed as follows:

The IATME instructs the CCMD:

(1) To continue the present scheme of magnetic characterization of days by the international character-figure, Ci, for three years;

(2) To introduce, for a trial period, a system of describing the level of magnetic activity for daily intervals by equivalent ranges, in particular by the planetary range Ap for the earth as a whole, and to derive a long series for Ap on the basis of older data;

(3) To broaden the possible basis of the Kp-index by calculating conversion tables to standardize K into Ks for as many observatories as possible;

(4) To invite the cooperation of observatories in lower latitudes in developing schemes to derive, from magnetic time-variations, current measures for solar wave-radiation, W, and for the intensity of the equatorial ring-current, ERC;

(5) To provide for the proper functioning of the K-scheme.

Prof. R. Bureau then presented a note on a comparison between Wulf's numbers and the number of solar flares over two sunspot cycles, based on data observed near Paris.

The report of the Committee on Magnetic Airborne Surveys was given by Dr. Joyce, Chairman. The report was accepted.

The following papers were then presented:

E. O. Schonstedt and H. R. Irons: Airborne magnetometer for determining all magnetic components.

A. Romañá and J. O. Cardús: Determination of the moon's influence on the earth currents by the Chapman-Miller method (presented by J. O. Cardús).

A. Romañá and J. O. Cardús: Note on a preliminary direct determination of the lunar phase effect in the magnetic declination at Tortosa (presented by J. O. Cardús).

The second of these papers was discussed by Prof. Chapman and Mr. Egedal.

The following papers were read by title:

Asger Lundbak: Aeromagnetic survey of vertical intensity over the Sound with apparatus of the BMZ type.

George Shaw: Aeromagnetic surveys.

Otto Schneider: Traces of residual lunar effects in geomagnetic K-indices.

The Association agreed to the following proposals for resolutions:

(1) On the importance of the observatory at Huancayo to geomagnetism and the ionosphere.

(2) An expression of appreciation for Belgian efforts in geophysics and a hope that the new installation at Dourbes may be completed as rapidly as possible.

These proposals were referred to the Resolutions Committee.

The meeting adjourned at 12:15.

Afternoon Session of August 28, 1951

The meeting was called to order by Acting Chairman Ferraro at 14:00. Mr. Laursen served as Secretary.

Dr. Ambolt presented the recommendations of the Special Committee appointed to consider the proposed guide for magnetic work, originated by the Fifth General Conference of the Pan-American Institute of Geography and History. The proposal was presented to the Association by Captain E. B. Roberts of the U. S. Coast and Geodetic Survey. A resolution on this question was referred to the Resolutions Committee.

The discussion on theories of the earth's main field was then continued, with Mr. Jarman, Dr. Price, Dr. Runcorn, and Prof. Ferraro participating.

The following technical communications were then presented:

Mme. A. Hee: Centres radioactifs dans des composés du fer.

T. Rikitake: The electrical state of the earth's interior as inferred from variations of geomagnetic field. (Presented by M. Hasegawa.) The paper was discussed by Dr. Price and Dr. Lowes.

N. Ambolt and E. Sucksdorff: Preliminary report on Swedish-Finnish geomagnetic measurements in the Bothnian Gulf from the surveying vessel "Kompass". (Presented by N. Ambolt.)

G. Kunetz: Corrélation et récurence de l'activité des courants telluriques et du champ magnétique.

Mme. O. Thellier: Résultats nouveaux dans la recherche du champ magnétique fossile; époque romaine et Moyen-âge. (Presented by E. Thellier.) The paper was discussed by Dr. Medi, Mr. Frankenberger, and Father Romañá.

E. Medi: Champ éléctrique de la terre. The paper was discussed by Father Romañá.

M. Bossolasco: Sur les perturbations magnétiques à Mogadiscio.

M. Bossolasco: Quelques résultats d'observations faites avec le céraunographe dans l'Italie du Nord.

The meeting adjourned at 16:30.

Morning Session of August 29, 1951

The meeting was called to order by Acting Chairman Sir Harold Spencer Jones at 10:00. Later, Prof. Bartels took over the chairmanship. Mr. Laursen acted as Secretary.

Dr. Rodriguez-Navarro commented upon the plans for a magnetic survey of Spain and Portugal.

The following technical communications were then presented:

J. Bricard and Ledoux: A propos de l'efficacité du paratonnerre. The paper was discussed by Prof. Norinder.

H. Israël: The diurnal variation of atmospheric electricity as a meteorological-aerological phenomenon. (Presented by H. Norinder.)

G. Grenet: Une année d'enregistrement des variations rapides du champ magnétique terrestre à Tamanrasset. The paper was discussed by Dr. Hasegawa, Father Romañá, and Prof. Bartels.

J. W. Graham and H. E. Tatel: Residual magnetic moment in clays and sedimentary rocks. (Presented by H. E. Tatel.) The paper was discussed by Prof. Thellier, Prof. Norinder, and Dr. Hasegawa.

H. Norinder: Thunderstorms--The electric-field variations as radiated from lightning discharges.

H. Norinder: Some recent results of investigations of the atmospheric electricity at the Institute of High-Tension Research of the University of Uppsala.

The meeting adjourned at 12:15.

Afternoon Session of August 29, 1951

Chairman Coulomb called the meeting to order at 14:00, with Mr. Laursen acting as Secretary.

The Chairman proposed that if an additional member can be elected by the Association to the Mixed Commission on the Ionosphere, this member should be Prof. Nicolet. If not, Prof. Thellier will be replaced by Prof. Nicolet. This was approved by the Association.

A resolution on the use of BMZ's and QHM's as observatory instruments in higher latitudes was adopted with an amendment that these instruments are relative and should be compared with absolute instruments. This resolution was referred to the Resolutions Committee.

A resolution concerning the proposed Third Polar Year was read and approved. Mr. Egedal and Father Romañá regretted that no mention was made in the resolution of the possibility of postponing the Polar Year until 1959-60 (sunspot maximum year).

The budget of the Association for the period January 1, 1951, through December 31, 1953, was presented by the Chairman and approved.

The report of the Special Committee on Nomenclature was presented by Prof. Kaplan and it was then referred to the Resolutions Committee.

The following technical communications were presented:

H. F. Johnston: Recent annual magnetic values at world-wide observatories.

In thanking Mr. Johnston for his paper, the Chairman proposed that Mr. Johnston be authorized to convey to Dr. Tuve the appreciation of the Association for the substantial assistance provided by the Department of Terrestrial Magnetism in order to make possible this important publication.

E. Hoge: La distribution du magnétisme terrestre dans l'Est de la Belgique.

N. Kumagai, N. Kawai, and T. Nagata: Recent progress in paleomagnetism in Japan (by title).

N. Kumagai, N. Kawai, and T. Nagata: Magnetic survey in Japan (by title).

K. Kato and S. Utashiro: Investigation of magnetic storm by the induction magnetograph (by title).

M. Hasegawa, M. Ota, and H. Maeda: Some results from the statistical investigations of diurnal variations of terrestrial magnetism on data of the II Polar Year (by title).

M. Hasegawa and H. Maeda: A suggestion for the electric conductivity of the upper atmosphere from an analysis of diurnal variations of terrestrial magnetism. (Presented by M. Hasegawa.)

M. Hasegawa: The daily magnetic variation in equatorial regions.

J. F. Clark: Daily variation in declination at Resolute Bay Magnetic Observatory. (Presented by C. S. Beals.) This paper was discussed by Prof. Coulomb.

At this point the report of the Special Committee on World Days was read by the Chairman and approved. The technical communications were then continued as follows:

Denisse, Steinberg, and Zisler: Contrôle de l'activité géomagnétique par les centres d'activité solaire distingués par leurs propriétés radio-électriques. (Presented by G. Kunetz.)

Asger Lundbak: Magnetic declination computed from vertical intensity (by title).

S. L. Malurkar and A. S. Chaubal: Quick-run magnetic records at Alibag during September 12, 1950, day of solar eclipse over North Pacific (by title).

S. L. Malurkar and A. S. Chaubal: Quick-run magnetic records during storms, January 1949, May 1949, and December 1950 (by title).

S. Matsushita: Circulatory motions in the ionospheric atmosphere and their relation to the S field of terrestrial magnetism, III (by title).

T. Nagata, N. Fukushima, and M. Sugiura: Electro-dynamical behavior of the ionosphere region viewed from geomagnetic variations (by title).

Y. Tamura: Distribution of electricity in thunder clouds (by title).

K. Maeda: On the electrical conductivity of the upper atmosphere (by title).

M. Misaki: A method of measuring the ion spectrum (by title).

G. Billaud: Relations entre l'agitation magnétique et l'ionisation des hautes couches de l'atmosphère (by title).

A. Dauvillier: Magnetographe enregistreur à répétition photo-électrique.

The meeting adjourned at 16:00.

Session of August 30, 1951

Chairman Coulomb called the meeting to order at 10:05.

The Resolutions Committee submitted resolutions on the following subjects for the consideration of the Association:

1. A guide for magnetic work.
2. Observational and instrumental standards.
3. Observatory instrumentation at high latitudes.
4. Expressions of thanks for special magnetic observations.
5. Magnetic observatories along the magnetic equator.
6. Measures for the intensity of magnetic disturbances.
7. Meteorological Service of Portugal.
8. Recognition of the importance of Dourbes.
9. "World Days"
10. 27-day numeration.
11. R.R.S. Research.
12. Magnetic observations in regions of isoporic foci.
13. Recognition of the importance of Huancayo.
14. Provisions for research funds.
15. Invitation to Union of Soviet Socialist Republics to collaborate.
16. "Upper atmosphere".

All resolutions, with the exception of No. 16, were approved without change by the Association. The Bureau of the Association (President and Secretary) were authorized to make editorial changes as required. The Bureau was also authorized to determine which of the resolutions would be recommended to the Union for adoption. (Resolutions Nos. 8, 11, 13, and 15 were subsequently chosen and were adopted as Union resolutions at the Final Plenary Session on September 1, 1951.)

In regard to proposed resolution No. 16 on "Upper atmosphere" the major portion of this document was approved as a general indication of policy (but not as a resolution) with the following changes and deletions:

1. Instead of making a definite recommendation for a new name for the Association to reflect its broadened scope, the term "an appropriate name" was substituted.

2. The last paragraph which referred to atmospheric electricity was deferred, to be considered at the next Assembly.

The following technical papers were then presented:

R. Bureau: A note on the use of light impulses to measure cloud heights in full daylight.

L. Koenigsfeld et Ph. Piraux: Un nouvel électromètre portatif et son application à la radiosonde. (Presented by Dr. Koenigsfeld.)

H. Hughes: The electrical conductivity of the earth's mantle.

Dr. Bock then presented a brief note on his Atlas of Magnetic Declination for Europe for the Epoch 1944.5, and he presented a copy of this volume to Prof. Lahaye for the Belgian Meteorological Institute.

Resolution No. 11 concerning the R.R.S. Research was supplemented to link it to the proposed Third Polar Year if the latter becomes a reality.

The printed minutes of the two sessions of August 23 were approved without change.

The meeting adjourned at 12:05.

NOTE: The members of the Association visited the Geophysical Center at Dourbes on the afternoon of August 30, 1951.

Session of August 31, 1951

President Chapman called the meeting to order at 10:05.

The printed minutes of all meetings through August 27 were approved without change. Minutes of the morning meeting of August 28 were approved as read. A committee consisting of Prof. Chapman, Prof. Coulomb, Mr. Laursen, and Dr. Joyce was authorized by the Association to approve the balance of the minutes.

The President invited written comment on the paper given by H. Hughes on "The electrical conductivity of the earth's mantle".

Prof. Lahaye expressed thanks on behalf of the Royal Meteorological Institute for the Atlas of Magnetic Maps of Europe presented at yesterday's meeting by Dr. Bock.

The President recommended that the proposal on the upper atmosphere be considered as a policy paper and not as a resolution. He further pointed out that a change in the name of the Association merits serious consideration, and, furthermore, that it affects the By-Laws of the Union (UGGI By-Law II, 1947). It was therefore suggested that this decision be postponed until the next General Assembly and that in the meantime the Executive Committee of the Association of Terrestrial Magnetism and Electricity consult with the Executive Committee of the Association of Meteorology and arrive at a mutually agreeable proposed new name for IATME. This would then be sent to the General Secretary of UGGI for circulation to the National Committees in advance of the 1954 General Assembly, where action would be taken. The Association approved of this plan.

The Secretary suggested that he be authorized to prepare for immediate distribution to National Committees and interested individuals a brief pamphlet containing:

(a) The minutes of the Brussels meetings of the IATME.

(b) The approved resolutions of the IATME, including those referred to and approved by the Union.

(c) List of officers of the IATME for the period 1951-1954.

(d) List of Special Committees appointed for the period 1951-1954.

It was indicated that the cost of this publication might be $200. This suggestion was approved.

The Budget Committee approved the Secretary's financial statement for the period 1 January 1948 through 31 December 1950.

Prof. Bartels suggested that, in accordance with proposal submitted by J. A. Fleming and H. F. Johnston, a Committee on a Thesaurus of Annual Observatory Values be appointed, with the following membership:

Mr. H. F. Johnston (U.S.A.), Chairman
Dr. E. Selzer (France)
Mr. J. W. Beagley (New Zealand)
Mr. O. Lützow-Holm (Argentina)

The Association approved the appointment of this Committee but specified that it must operate without financial support, and, further, that a place on the Committee was to be reserved for a member from the U.S.S.R. if that country would cooperate in supplying annual values and other magnetic data from observatories under its control.

Mr. Wilkes then presented the Report of the Committee on Lunar Variations in Meteorological, Magnetic, and Electric Elements. Following discussion of the report by Prof. Chapman, it was approved by the Association. The Committee then invited any observatory wishing to have its data examined for lunar variations to write and discuss the matter with the Committee. Mr. Davies reported that there are two continuing ionospheric experiments now going on in Canada to determine lunar tide effects, and he indicated that, although there have been no published results as yet, positive evidence has been obtained in support of Mr. Wilkes' work at Cambridge.

Prof. Coulomb reported that the Service de Prévision Ionosphérique Militaire (SPIM) has installed punch-card machines and that it proposes to determine ionospheric tides at the stations at Freiburg i. Breisgau and Marcoussis (France). Prof. Coulomb suggested that the Committee discuss this subject with M. Gallet of SPIM.

Prof. Chapman proposed that the name of M. Gallet be added to the list of members of the Committee on Lunar Variations. This was agreed to by the Association.

The report of the Committee on Magnetic Charts, presented at an earlier session, was approved.

The following papers were read by title:

Y. Sikido and S. Yoshida: On the diurnal variation of cosmic rays: Part II, Annual change of cosmic-ray diurnal variation.

H. Hatakeyama and K. Uchikawa: On the disturbance of the atmospheric potential gradient caused by the eruption smoke of the Volcano Aso.

The prices of the Auroral Atlas and Supplement were discussed. On the recommendation of the Committee on Aurora, the price of the Atlas was increased from \$3.50 to \$5.00. The Supplement remained at \$2.00. It was left to Prof. Störmer or members of the Committee on Aurora to decide who shall be entitled to free copies of these publications, since normally the Committee makes the distribution of these two publications.

The following resolutions were then presented and approved by the Association:

(1) A resolution urging the renewal of magnetic work at the Hong Kong Observatory.

(2) A resolution urging the renewal of magnetic work at the Zi-Ka-Wei Observatory.

(3) A resolution recommending the taking of magnetic observations in Spanish Guinea during the solar eclipse in February 1952.

(4) An invitation to any magnetic observatory experiencing instrumental difficulties to communicate with the Secretary of the Committee on Observational Techniques (Mr. J. Olsen, Det Danske Meteorologiske Institut, Charlottenlund, Denmark) for advice and guidance.

The Association expressed thanks to the retiring Secretary for his services during the past four years.

Thanks were also expressed to the Belgian Organizing Committee through Prof. Lahaye for the excellent arrangements and facilities provided for the Association. (Note: Union resolutions adopted at the Final Plenary Session expressed thanks to the Belgian Organizing Committee and all other organizations and individuals who contributed to the success of the Ninth General Assembly.)

This final meeting of the Association at the Ninth General Assembly of the UGGI adjourned at 11:15.

GEOMAGNETICIANS WHOSE DEATHS HAVE BEEN REPORTED SINCE THE ASSEMBLY OF 1948

James Peter Rowland (Great Britain)--The former Director of Stonyhurst Observatory, Blackburn, England, from 1932 until its discontinuance at the end of 1946, died on December 26, 1946, at the age of 73 years.

Elizabeth Sternberg Mulders (U.S.A.)--Mrs. Mulders died suddenly at her home in Glendale, California, on December 18, 1948, at the age of 41. She was engaged for nearly 19 years in solar research at the Mount Wilson Observatory, until her resignation in 1947. For many years she prepared, in collaboration with Dr. Seth B. Nicholson, the solar and magnetic data from Mount Wilson Observatory.

C. K. Edmunds (U.S.A.)--From 1903-1924, Dr. Edmunds was Professor of Physics and Electrical Engineering at Canton Christian College. During this period he also carried out extensive magnetic-survey work in China for the Department of Terrestrial Magnetism in various of the Provinces. After later service as Provost of the Johns Hopkins University, he became Professor Emeritus of Pomona College. He died January 9, 1949, after an automobile accident. He was 72 years of age.

Antonio Lo Surdo (Italy)--Professor Antonio Lo Surdo, one of the notable leaders of Italian geophysics, died on June 7, 1949, at the age of 69. His first research work was done at Messina, whence he went in 1919 to Rome, where he held the chair of physics in the University until his death. In later years he gave increasing attention to geophysics. When the Italian National Research Council was initiated at the close of the First World War, he secured the establishment under its auspices of the National Institute of Geophysics. He founded the excellent journal "Annali di Geofisica".

William Joseph Rooney (U.S.A.)--William Joseph Rooney died on August 31, 1949, as he was returning from a field trip in the western United States. Born April 20, 1890, he received the degree of Bachelor of Arts from Boston College in 1912 and that of Bachelor of Science from Massachusetts Institute of Technology in 1915. The greater part of his professional life was with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, whose staff he joined in 1924. There he did notable research dealing with earth-currents and resistivity measurements and was an authority in this field. His observational work had ranged through Australia and the mountains of Peru, Guatemala, Spain, and all parts of North America.

Sven Åslund (Sweden)--Dr. Sven Åslund, connected for many years with the Magnetic Section of the Hydrographic Service of Sweden, and with Lovö Observatory, died suddenly on October 17, 1949. He was devoted and self-sacrificing to magnetic work, striving always to obtain the highest standards.

Harry Durward Harradon (U.S.A.)--Following some 37 years of service in geophysical fields, Harry Durward Harradon died suddenly on December 8, 1949, shortly after his 66th birthday. He had retired with honor on September 30, 1949, from his post as Librarian, Translator, and Editor with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Following several years of pedagogical work he joined the Department's staff in 1912. No small part of Harradon's service to the natural sciences was the part he took in the activities of the International Union of Geodesy and Geophysics whose triennial assemblies he attended, as an official delegate of the National Research Council and of the National Academy of Sciences of the United States, at Madrid in 1924, Stockholm in 1930, Lisbon in 1933, Edinburgh in 1936, and Washington in 1939.

V. H. Ryd (Denmark)--Dr. V. H. Ryd, formerly of the Danish Meteorological Institute and during the period 1923-31 Chief of its Geophysical Section, died at the age of 85 on January 10, 1950. His earlier research had to do with meteorology. Later, as Chief of the Geophysical Section and of the Rude Skov Observatory, he turned his attention to geomagnetic research on problems such as theory of magnetic variometers and their construction.

Albert K. Ludy (U.S.A.)--Albert K. Ludy, nationally known geophysical authority, died on June 10, 1950, at the age of 68. He retired from the United States Coast and Geodetic Survey in December 1944, after 25 years in Government service, the last three years as Chief of the Geomagnetism Section. Previously, he had been in charge of magnetic observatories at Sitka, Tucson, and Cheltenham.

William N. McFarland (U.S.A.)--William N. McFarland died on August 11, 1950, at the age of 64. He was a retired statistician of the United States Coast and Geodetic Survey.

Leland Bradley Snoddy (U.S.A.)--Dr. Leland Bradley Snoddy of the Rouss Physical Laboratory of the University of Virginia, died November 12, 1950, at the age of 52. While most of his research related to physics, he gave some study to improvements in auroral observations using methods suitable for physical interpretation.

H. Nagaoka (Japan)--Prof. H. Nagaoka died on December 11, 1950, at the age of 84. He was one of the outstanding leaders in physical sciences in Japan since the beginning of this century. The field of his interest covers terrestrial magnetism, the ionosphere, seismology, and the physics of the earth's crust, as well as various branches of the pure physics. He retired from the presidency of Imperial Academy of Japan in 1948, but he continued his work and published many papers mostly concerning terrestrial magnetism and the ionosphere until the day of his death.

Hans Gerdien (Germany)--Prof. Hans Gerdien died on February 2, 1951, in his 74th year. He was well known for his work in atmospheric electricity. He designed the equipment now almost universally used in measuring the conductivity of the atmosphere.

Vilhelm F. K. Bjerknes (Norway)--Prof. Vilhelm F. K. Bjerknes died in Bergen, Norway, on April 9, 1951, at the age of 89 years. He was Professor of Geophysics for many years at Oslo and Leipzig universities. In late years he was associated with the Astrophysical Institute in Blindern, Norway.

Ch. Combier (France)--Rev. Father Ch. Combier died on June 8, 1951. He was mainly interested in meteorological problems, such as sand-winds, but also in border problems between meteorology and magnetism. He photographed the crepuscular arch and obtained great differences between orthochromatic and panchromatic plates, what has been recently explained by its peculiar spectrum. Last, as Director of the Ksara Observatory, Lebanon, he maintained at a good level this important station, notwithstanding many financial and political difficulties.

APPENDICES TO THE MINUTES

PRESIDENTIAL ADDRESS

By Prof. S. Chapman

Introduction

In common with the other Associations in the International Union of Geodesy and Geophysics, we have now completed the first post-war triennium of our activities since the Oslo meeting in 1948 ended the break caused by the second World War. In the three years there has been much successful work done within our Association. It will be reported by our Secretary and the Chairmen of our various Committees, and I will briefly mention some of it in Part II of this address. But first I wish to speak of our Association itself, and the branches of science served by it.

Part I

Geomagnetism and atmospheric physics

At Oslo, some of those who attended our meetings, but who were not chiefly interested in terrestrial magnetism and electricity, urged the formation within our Association of a Commission on the Upper Atmosphere. At the present Assembly the matter has been formally raised by our French colleagues. In considering the question, it seemed to me desirable that we should have in our minds a reasonably clear picture of the Association as it is, and of its past history; and that it would be helpful to many present, including those whose acquaintance with the Association is slight or only recent, if I were to try to outline such a picture.

The long history of our subject

Magnetism and electricity are parts of the ancient and universal science of physics, and among their own branches is terrestrial magnetism and electricity. Geomagnetism can itself claim an honorable place among the sciences, and a history of several centuries. In a sense it began when the directive property of the magnetic needle was discovered, more than 750 years ago. Later landmarks in its progress were the discovery and discussion of the magnetic dip by Robert Norman, 1576-1581; the experiments by William Gilbert that led to the statement in his great book de Magnete, 1600, that the earth itself is a great magnet; the discovery of the secular magnetic variation by Gellibrand in 1634; the first ocean magnetic survey by Halley, and his world magnetic map, 1698-1701; the measurement of the magnetic intensity by Gauss, his institution and equipment of a magnetic observatory, and his spherical harmonic analysis of the magnetic field at the earth's surface, 1830-1840; the nineteenth century discovery of the remarkable connections between the geomagnetic variations and changes on the sun; and the recognition by Balfour Stewart that some of the surface magnetic variations are caused by electric currents in the upper atmosphere.

Terrestrial electricity has been studied for a shorter period, which, however, is more than a century. It includes the measurement and interpretation of electric currents and potentials within the earth, and of electric potential gradients and ionization in the atmosphere. It was the study of atmospheric electricity that led to the discovery of cosmic rays, the most energetic particles known to us, which have contributed so much to the advance of nuclear physics and to our knowledge of the fundamental particles.

International collaboration in our subject

International collaboration in our science goes back to at least the 18th century, when Graham, who discovered the transient magnetic variations, and Celsius at Upsala, in mutual correspondence, found that when the earth's magnetism is disturbed, auroral displays are specially intense. Gauss, after he had stimulated by example and precept the institution of many magnetic observatories in Europe and other continents, set up the Magnetic Union, which organized simultaneous observations at certain times. Later the first International Polar Year of 1882-83 was instituted, a great enterprise of cooperative magnetic and meteorological observation in the polar regions and elsewhere - an enterprise repeated 50 years later in the second International Polar Year of 1932-33 (a proposal that there shall be another repetition in 1957-58 is to be discussed at this Assembly).

For some years before and after the first World War, many international aspects of our science were dealt with by a Commission appointed by the Conference of Meteorological Directors. The Commission continued to exist after our Association was founded, and was dissolved only after the second World War, when it had become clear that our Association, if adequately supported financially, could effectively meet the international needs of our branch of science.

Our Association was an original Section of the International Union of Geodesy and Geophysics, itself instituted with other international scientific unions at Brussels in 1919, at the inaugural meeting of their parent body, the International Research Council. This was formed to renew and reorganize the international relations of science, after their interruption by the first World War; it was later transformed into the present International Council of Scientific Unions (ICSU), which has since become formally linked with the United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO gives valuable financial support through annual grants-in-aid, to the ICSU and its Unions, in which our Association has been happy to share.

The scope of our Association

The main magnetic observations which underlie the work of our Association are of two kinds. Owing to the secular magnetic variation the whole earth has to be magnetically re-surveyed at moderate intervals of time; and the world magnetic survey is partly dependent on the wok of the magnetic observatories, of which about seventy are now distributed over the globe. They keep a continuous record of the changes in the earth's magnetic field, and many of them also measure the changes of terrestrial electricity. This work of survey and continuous registration represents a great and perpetual task of observation and measurement; it raises many questions that need international discussion and agreement. The range and activity of our committees show how extensive and fruitful is the work of our Association. They are such as to demonstrate that the scope and importance of our branch of science fully merit and require the existence of an independent Association within the International Union of Geodesy and Geophysics.

Our links with the other Associations

We cannot, however, be a self-sufficient body, working wholly apart from our scientific colleagues in other Associations of the Union, or even in other Unions.

Geomagnetism is first and foremost a phenomenon originating within the earth, mainly deep down, though the magnetism of the crust is of great economic importance and much purely scientific interest. The secular magnetic variation, when adequately interpreted, will give precious information, probably obtainable in no other way, as to the motions within the earth's liquid core. Geo-electricity, as distinct from atmospheric electricity, is also a branch of interior geophysics, and leads the theorists of our subject to an interest in the electric currents within the core, as well as in the overlying solid layers and the rocky crust: and likewise to an interest in the electric currents and potentials in the oceans, which have recently been applied by the Woods Hole Oceanographic Institution to the measurements from ships of the oceanic currents themselves. These aspects of our subject link us with our fellow Associations that deal with interior geophysics, and also with the Association of Oceanography.

Atmospheric electricity, as measured at the ground and from small balloons, has obvious links with meteorology, being much affected by thunder clouds and lightning strokes. One of its outstanding features is the observed maintenance of the earth's negative charge, as shown by the atmospheric potential gradient, despite the continual leaking away of the charge through the slightly ionized air near the ground. For a time some physicists saw in this feature a possible indication of an unknown charged radiation of a fundamental kind, impinging on the earth through the atmosphere. But this idea now seems unnecessary, and the charge is supposed to be renewed mainly at one or two centers of specially intense thunderstorm activity, which results in a daily variation of potential gradient depending on universal, not local, time, as discovered by Mauchly. Thus the science of the electricity of the lower atmosphere is a part of meteorology; its inclusion in our Association was doubtless mainly due to the electrical techniques involved in its measurements, techniques formerly unfamiliar to most meteorologists. Nowadays the Association of Meteorology might well claim the subject as falling within its range rather than ours.

With this exception, our sphere of work and interests is well distinguished from that of our meteorological colleagues, though both Associations have an interest in ozone research, which has been generously supported by the Association of Meteorology. Our observational work is concerned with the continuing task of the magnetic survey, and the continuous recording of magnetic and electric data over the globe; it is linked with the properties and motions at all levels within the earth, and in the oceans. But on account of the transient magnetic variations, solar and lunar daily, and irregular, we have also a strong interest in the atmosphere, from the troposphere up to and throughout the ionosphere; these transient magnetic variations are linked with electric currents in and outside the atmosphere, and with ionized gas clouds and streams outside the earth's atmosphere, which come from the sun and are much modified by the geomagnetic field, and with the ultraviolet wave radiations from the sun.

Provision for upper atmospheric physics

Clearly, therefore, our Association has an interest in upper atmospheric physics, relating to levels above those with which our colleagues in the Association of Meteorology are mainly concerned, apart from our common interest in the ozone layer. But the upper atmospheric physicists, who are certainly to be classed as geophysicists, find no specific provision made for their needs in the structure of the International Union of Geodesy and Geophysics - a structure little changed, except for the institution of an Association of Hydrology, since the Union was established in 1919.

Other branches of geophysics are in the same position. Those belonging to interior geophysics, and not falling specifically within the range of the Associations of Geodesy, Seismology and Volcanology, were for some years entrusted to a Special Committee on Continental and Oceanic Structure; at Oslo the provision of a more settled place for them within the Union was discussed, but not decided, and it is being further considered at this Assembly.

On another level, the International Council of Scientific Unions is faced with problems of the same kind, through proposals for the creation of new scientific Unions under its auspices.

There is a natural reluctance to increase the number of new Unions, and of new Associations within our Union, partly because of the added complexity of organization, and still more because of the new claims involved on the exiguous funds available, whether through directly subscribing nations, or at second remove through UNESCO.

The objects of international association among scientists differ from one branch of science to another. The growth of formally constituted international scientific bodies began in the nineteenth century, and their inception was usually due to some urgent practical need, such as for a cooperative scheme of observation or standards, as in Gauss' Magnetic Union; or the astronomical conference on world time reckoning, which established the Greenwich meridian as the basis, or the Astrographic Congress to organize the photography of the whole celestial sphere on a common plan.

Subsequently such cooperating groups of scientists formed permanent international bodies meeting periodically, knowing that old schemes and problems would need re-discussion, and that new ones would arise. Important incidental advantages were also gained from the personal meetings and general diffusion of knowledge involved in such assemblies. Later on, other Unions were formed in universal branches of science like chemistry, mathematics and physics; in these Unions the personal meetings and interchanges of knowledge were the main objects rather than an incidental advantage as in astronomy and geophysics. The upper atmospheric physicists, being geophysicists, feel both needs - to be able to organize cooperative schemes of observational coverage, and to have a forum for meeting and interchange of ideas.

They might seek to satisfy these needs by joining with this Association, or with URSI, the International Union of Scientific Radio, which also deals with a branch of geophysics, and might conceivably have been established as an Association within our Union, instead of as a separate Union. The choice of URSI as the providing body for the upper atmospheric physicists would seem the more natural, as its original scope was almost wholly concerned with the earth's atmosphere, though lately it has been broadened by the inclusion of the new border-line science of radioastronomy. The scope of our Association, as I have shown, includes parts of interior geophysics far removed from the interests of upper atmospheric physicists.

Another point in favor of upper atmospheric physics being linked with URSI is that there is more scope for a considerable degree of autonomy within an independent Union than in an Association like ours, which is only a seventh part of a Union, though admittedly our Union is a larger body than URSI, and has been classed by ICSU as a general Union instead of, like URSI, a specialized one.

Speaking as President of the Association of Terrestrial Magnetism and Electricity, formed to meet the very considerable needs of our extensive branch of science, for whose international needs our Association is the only provider, I should hesitate to support a step equivalent to a division of our body into two co-equal and loosely bound parts, each having independent officers and roughly similar claims on our small funds, which just about meet our needs. Unless new funds can be found, any considerable increase in the volume of our publications would involve a decrease in the money available for our schemes of cooperative work. Any substantial division of our Association between geomagnetism and electricity, on the one hand, and upper atmospheric physics, on the other, would seem scarcely distinguishable from the formation of another Association within the Union, but it would be one the financial burden of which would fall entirely upon our particular branch of geophysics, instead of being met by a redistribution of the funds of the whole Union.

Speaking, however, both as President of this Association and as one who is also an upper atmospheric physicist, I would welcome an extension of the scope of our Association to cover both geomagnetism and upper atmospheric physics, provided that the Association remained one united body, with one set of officers as now. Its committees would be charged not only, as now, with geomagnetic and electric problems, but also with upper atmospheric problems; and the financial aspects of the extension of our scope would have to be dealt with in the light of all the needs. Such a step would seem to be a useful one, indicating formally, in our title and statutes, our already present interest in upper atmospheric physics - an interest shown in the past by holding joint meetings with the Association of Meteorology, as also at this Assembly. These meetings might well continue under the suggested new conditions. The upper atmospheric physicists among us would still wish also to meet as heretofore with our astronomical and radio colleagues, and a forum for such meetings is provided partly by our Union, and partly by the Mixed Commission on the Ionosphere, of which URSI is the parent Union, with our Association and that of Meteorology, and the International Astronomical Union, as participating bodies.

Though I personally should welcome the inclusion of upper atmospheric physics within the scope of our Association, on a united basis but not by way of a division into two parts, it would seem to me best not to try to take any formal step of the kind at this Assembly. I would suggest that a small representative group of upper atmospheric physicists be formed from among those here present, to examine and report on the best means of providing for the subject internationally, whether in connection with our Association or with URSI or both. It should consult by correspondence with the Executive Committees of URSI and of the Association of Meteorology, and with other upper atmospheric physicists. The solution recommended could then be proposed at the next Assembly by one of the National Committees. Meanwhile I think we should renew as a regular Committee of the Association the group which, under Dr. Kaplan as Chairman, has arranged the joint symposia on upper atmospheric physics for this Assembly.

Part II

Inter-Assembly activities

I now turn to comment, with discursions, on the work of our Association during the past triennium - because it is part of our regular practice to continue our activity between Assemblies, and to make the planning of future corporate work an important part of our proceedings at these Assemblies. This work is entrusted to our Committees, of which fourteen were appointed at Oslo. As I have just mentioned, one of these has arranged joint discussions on upper atmospheric physics at this Assembly, and we have every reason to expect that these will be valuable to us and our 'non-magnetic' colleagues in that field, and increase the interest of others in it.

Naturally our Committees are not all equally productive and successful; circumstances, as well as the devotion and ability of the chairman and members, may favor the work of some Committees more than others. Lack or brevity of reference to a particular Committee in the following remarks implies no reflection on it or its work - the reports of all Committees will of course be brought before the Association.

The world magnetic survey

The earth's main field must be our continual concern, owing to its secular variation. Several of our Committees deal in one way or another with the problems that arise in this connection; among them are our Committees on magnetic secular variation stations, on magnetic charts, and on airborne magnetic surveys - a subject in which there is much progress to report since our last Assembly. The present stage reached in the technique of the airborne survey still seems, however, to be one of promise rather than of full achievement, and even after the technical problems of measurement are solved there will remain problems of operation and, alas, of world politics that will hamper and retard the full use of the method.

Meanwhile the time has too much lengthened since the last extensive work on the world survey, although since Oslo many countries have shown very commendable activity in their land magnetic surveys - as the National Reports show. But the ocean magnetic survey, comprising far the greater part of the earth, remains unfulfilled, although the British Government has constructed a ship to replace the famous but ill-fated non-magnetic vessel the Carnegie, lost by fire in 1929. It is to be earnestly hoped that some way may be found to overcome the financial difficulties that have thus far prevented its use for this important international task; one possible way may be that our Association and Union should seek to induce one or more of the United Nations Specialized Agencies, such as those for maritime matters and aviation, to sponsor the work, by arrangement with the owners of the vessel, and with advisory assistance from our Association.

Magnetic observatories

The world magnetic survey and the charts that result from it must be based on the fundamental framework supplied by the magnetic observatories, whose continuous registration of the three magnetic elements is important also in connection with radio and telegraphic communications, as well as for its purely scientific interest. We have four Committees concerned with the observatories. One of them organizes the very desirable task of international comparison of magnetic standards; this Committee has been decidedly active during the past three years, mainly in comparing the measurements of the horizontal magnetic intensity H at numerous observatories. For this purpose the quartz horizontal magnetometer (QHM) has been used, devised by our former President Dr. la Cour [Dr. la Cour, Commun. Mag. Nos. 15, 16 (with E. Sucksdorff), Copenhagen, Danish Meteorological Office, 1936]. The instrument is extremely accurate and safely portable; it is sent by post in sets of three, between the issuing office at Copenhagen and the different observatories. It is not an absolute instrument, and its results depend on the calibration made at the issuing office, which has been the Copenhagen Meteorological Institute. Thus the instrument gives a comparison between the magnetic standard of H at Copenhagen with that at the observatories concerned. By intercomparison between observatories with the best absolute standards, the whole work can be based on a mean between those observatories, though it is desirable also to investigate the small differences revealed between those standards.

Observations with the QHM are quickly made, even in high geomagnetic latitudes, as I know from personal experience during a visit paid with Dr. la Cour in 1936 to the Sodankyla magnetic observatory in Finland, then under the direction of Dr. Sucksdorff; their joint observations revealed an error in the setting of the H variometer, despite the great care exercised in the conduct of that excellent observatory, now happily restored to usefulness after its war destruction.

This prompts me to some general reflections on magnetic observatories, at one of which, namely Greenwich, I have personally worked. I have also had the privilege of visiting such observatories in many other parts of the world. This has strongly impressed me with the differences existing between the equipment, methods, and quality of work at different observatories. At some, despite isolation, hard climate and slender finance, the equipment is excellent and most carefully and skillfully used; at others where the conditions might seem more favorable, the results are less good. It is much to be desired that there should be a levelling upward in the equipment and techniques of the observatories.

The first step to this end is the recognition that improvement is needed; at many observatories the directors and staffs are well aware of this; at some it may be less clearly felt. But there are few, if any, where there is indifference; the deficiencies, where they exist, are probably due to lack of knowledge on the part of the administrators who control the finance, and lack of good equipment and of training and experience at the observatories themselves.

How can the situation be improved? The recent work of our Magnetic Standards Committee is likely to contribute to improvement by disclosing discrepancies; but it goes only a little way towards ensuring high quality in observatory work, which in any case must depend on whether the available equipment is suitable.

Let us first consider the measurement of horizontal intensity H. The method devised by Gauss marked an epoch in physical measurement, and its direct dependence on the units of length, mass and time should ensure it a permanent place in magnetic practice. But it has the serious drawback of being slow, and where quiet periods may be few, as in the higher geomagnetic latitudes, from perhaps 50°, the result may be that after about an hour spent on a Gaussian determination of H, only an unreliable base-line value is obtained. Hence I would suggest, as an objective to be attained before our next Assembly, that in such latitudes the base-line values for H be determined by quicker methods, and more often than once a week - using, for example, an absolute or calibrated coil instrument or a calibrated QHM. Similarly, I would urge the use in such latitudes of frequent direct determinations of the base-line values for the vertical intensity Z, using, for example, an absolute coil instrument, or a calibrated coil magnetometer such as that designed by la Cour for use at Godhavn [D. la Cour, see pp. 259, 260 of Bulletin 9 of our Association, Copenhagen, 1934].

The dip inductor should continue in use as a check on the measurements of H and Z.

Such a re-equipment and change of methods should produce a valuable improvement in the accuracy of the observatory results in the latitudes mentioned. There and elsewhere, however, in many cases room would remain for improvement in the use of these instruments and in the general operation of the magnetographs and the reduction of their data. If magnetic observatories were profit-making institutions in the direct financial sense, one can imagine their administrative heads calling in efficiency experts to examine, report and advise on their equipment and operation; as things are, the administrative heads might find it difficult to obtain funds and authorization for such a course, but the efficiency experts exist (not under that name), and can be found by those who go about and ascertain which observatories are of the highest quality. The temporary detachment of such men from their normal work might likewise be somewhat difficult to arrange, but both sets of difficulties could doubtless be overcome to some extent, which would result in a gradual improvement in the conduct and equipment of observatories, in so far as the recommendations were adopted and applied. Another way of promoting the same end would be by interchanges of staff between magnetic observatories, or the sending of newly appointed observatory staff members to first-class observatories for training, before entry upon their duties. The staffs of magnetic observatories should have the opportunity of seeing what is done elsewhere, so that useful interchanges of ideas may be achieved, and their too customary isolation mitigated.

In these remarks I am trenching on the province of our Committee on Observational Techniques, many of whose members have a much more intimate knowledge of the subject than I can claim. It is a Committee which seems to me to have very great scope for usefulness to our science. Another of our Committees deals with sites for new observatories, still much needed in some areas of the globe.

The purpose of magnetic observatories is in the first place to produce magnetic data; the publication of these data, on which also we have a Committee, is a highly important part of their work, which has fallen much into arrears as a result of war. Some of the National Reports show there has been progress in overtaking arrears, but a great deal more remains to be done.

The object of publication is to enable the science of geomagnetism to be advanced by discussion and research on the observatory data. This requires adequate distribution of the observatory publications, and would be further facilitated by centers for the collection of all available magnetic publications, and also of much material not published, such as copies of the magnetograms themselves - except in cases where these too are reproduced, a useful practice adopted in recent years by the U. S. Coast and Geodetic Survey, and one well worthy of being followed elsewhere. The difficult questions involved in the establishment of central depositories of data are the concern of another of our Committees; the present time seems unpropitious for such projects; they are among the many that could probably easily be achieved if the United Nations Organization was in fact what its name indicates, so that the money and effort now devoted to military needs could be applied to constructive purposes.

Research on geomagnetic data

Discussion and research on the observatory data is carried on by the directors and staffs of some observatories, and also by workers in universities and research institutions. There is much value still unexploited in the long series of data now accumulated at many observatories, and too little effort is devoted to research on these and current data. It seems to me that the budget of every observatory should include an item for research, even if it were only one or two per cent of the whole: and that such research funds should be usable by the director or administrator in whatever way was found most effective for the purpose, whether within or outside the institution and its staff. Thus, arrangements might be made for particular researches involving the data of an observatory to be conducted at universities or elsewhere. An example is afforded by the work of our Committee on lunar geophysical variations, which during the past three years has begun to organize such studies on magnetic and other data from several observatories; this work has been supported either by Association or UNESCO funds, or by funds supplied by national bodies for the lunar discussion of data falling within their province. There is good scope for a considerable extension of this practice.

Magnetic characterization

One of our important tasks as an Association has long been the magnetic characterization of time intervals, originally for each Greenwich day, and since 1939 for each period of three hours. This work evolved gradually, and after being somewhat interrupted by the war was re-organized at Oslo, under the auspices of our Committee headed by Dr. Bartels. The Association is greatly indebted to him for his skilled guidance of the work, and to Dr. J. Veldkamp who, in association with him, has successfully maintained and enhanced the work long executed at the de Bilt observatory, in organizing the collection of observatory data and preparing the Bulletins of magnetic characteristics, C and K. We may look forward to valuable debates on the subject at this Assembly, when proposals for new developments in this field come to be discussed.

The auroral atlas

Another useful Association accomplishment since our last Assembly is the re-issue of the Auroral Atlas, under the auspices of the Committee of which Professor Størmer is chairman. This Atlas contains a fine collection of photographic prints of auroras, made, as in the original edition, direct from the negatives, so that it is in no way inferior to the first issue, as it might have been had the reproductions been from blocks or plates. It is certain to continue to be useful in aiding auroral observers, steadily growing in number, to classify the forms they see.

The equatorial electrojet

The last of our Committees whose work I shall refer to is that proposed at Oslo by Dr. J. Egedal, who as Chairman has ably guided its activities. These have consisted in observations of the daily magnetic variations, mainly of horizontal intensity, at places in low latitudes, along or near the meridians in America, Africa, India and the Philippines, where evidence has been found of an abnormally large daily variation of H, first recognized as an outstanding feature at the observatory of Huancayo in Peru.

The results obtained, especially at the long line of stations occupied by Dr. A. A. Giesecke, Director of that observatory, and his assistants, are of great interest and value. They show that in certain longitudes, not yet properly delimited, there occurs in the ionosphere, during the day hours, a local concentration of the eastward electric current flow in the current system that produces the daily magnetic variations at the earth's surface. I have ventured to call such a local concentration of current an electrojet, by analogy with the meteorological jet streams. The present evidence suggests that the latitudinal breadth of this equatorial electrojet is only a very few degrees, comparable with the breadth of the electrojets flowing along the auroral zones.

The success of this observing program calls for its extension to the other magnetic elements, vertical force and declination, in the same regions, and also in other longitudes. In this way we may hope to ascertain the height and intensity of the electrojet, and to delimit its cross section, and the range of longitude over which it occurs.

The cause of this remarkable phenomenon is a mystery on which it will be more profitable to speculate later, when the facts concerning it are more fully known. But it is difficult to refrain from supposing that it may be in some way associated with the surprising decrease in F2 noon electron density along the magnetic equator, as compared with the values at latitudes only a few degrees further north and south.

Part III

I now turn to speak briefly on some of the general advances made in our subject since the Oslo meeting; and of some future needs of our science.

The past decade has seen a very welcome revival of activity directed to explain the interior physics of geomagnetism. Elsasser was one of the pioneers in the revival, and he and Bullard have contributed greatly to our present degree of understanding as to why the earth has a somewhat oblique and irregular dipole field, and why the field undergoes a secular variation. The problem is not yet solved, and new ideas for its solution have been broached by Dr. Runcorn and his colleagues, and will be discussed at this Assembly. But it now seems that the earth's field is most likely to be explicable by classical physics, and due to electric currents circulating in its liquid metallic core; and that relatively minor sub-systems of current near the surface of the core are responsible for the anomalies of the field. These sub-systems are probably associated with the turbulence in the internal motion of the core, which will change with time, and lead to the secular magnetic variation. The cause of the main dipole system of electric currents in the core is not yet clearly established.

It appears to be established, by magnetic measurements in mines, made by Dr. Runcorn and his colleagues in association with Professor Blackett, that the non-magnetic outer layers of the earth do not contribute to the geomagnetic field, as has been proposed in many fundamental theories of geomagnetism; one of these theories was revived by Professor Blackett a few years ago, and has now been abandoned by him.

Workers on geomagnetism cannot but be interested in the problems of magnetism on a still grander scale, in sunspots, in the general field of the sun - a subject on which the facts remain obscure - and in the stars. Dr. H. W. Babcock of Mount Wilson Observatory has continued his brilliant observational researches in this field, and his work has prompted renewed interest and speculation in cosmical magnetism.

The United States of America has continued to be active in making high altitude rockets available for fundamental scientific research; and our science has been among those that have benefited thereby. As suggested by Dr. Vestine, the magnetic airborne detector developed by the Naval Ordnance Laboratory and Development Company has been twice carried up to a height of more than 100 kilometers, and provided a record of the earth's magnetic intensity during the ascent and descent. The results, which are to be described at this Assembly by Dr. Singer, are of interest in throwing light on the situation of the electric currents responsible for the daily magnetic variation. There is much scope for further exploration of the ionospheric electric currents by means of rockets, particularly in high latitudes.

Ionospheric radio research offers an alternative and less expensive, but also (at present) less clear and direct, means of investigating the geomagnetic field at high altitudes.

Lastly I may mention the success achieved by Meinel, following Vegard and Gartlein, in detecting the entry into the earth's atmosphere, along auroral arcs, of hydrogen atoms traveling with speeds of several thousand kilometers per second. This is the most direct evidence yet obtained in favor of the corpuscular theory of magnetic storms and auroras.

Future work

At this Assembly a proposal for a third International Polar Year is to be discussed. The advances in radio technique since the second Polar Year in 1932-33 in themselves constitute a strong argument for a repetition, and the proposed interval of 25 years, bringing the date to 1957-58, has the merit of giving a year expected to be of high sunspot number. Since 1933 the North American nations, Canada and the United States, have increased the number of their geophysical stations in their belt of the polar regions to a degree that justifies one in regarding every year as being, for them, equivalent to a Polar Year. Thus, in seeking their cooperation along with that of other nations in a new International Polar Year, their enhanced regular program must be taken into account. The world situation is no more propitious for the scheme than the one that preceded the Second Polar Year, but that great enterprise was carried through to success by the energy, enthusiasm and skill of many nations, led by Dr. la Cour, and it seems to be faithless to shrink back from a renewed attempt.

International collaboration

In conclusion, as President of an Association devoted to a science of the earth in which political boundaries have no relevance, I should like to express satisfaction at the enlargement in the number of our member nations that marks this Assembly; and also to express regret that we still lack the cooperation of some nations. Our late President la Cour in 1936, by correspondence and personal visits, earnestly sought the entry of Russia as a member of our Union, and at Oslo, in token of the desire of our Association for such cooperation, a leading Russian scientist in our field was nominated to one of our Committees. Unfortunately our Secretary was unable to obtain any response to his communications in respect to this matter. The activity and interest of Russia in geophysics in general, and of our branch in particular, are fully evident, and we should welcome their scientific collaboration in the manner in which it is accorded to the World Meteorological Organization of the United Nations Organization.

REPORT OF THE SECRETARY AND DIRECTOR OF THE CENTRAL BUREAU FOR THE PERIOD 1948-1951

General

The intervening period between the 8th and 9th General Assemblies of the International Union of Geodesy and Geophysics has been characterized by a stimulating renewal of activities on a world wide basis on the part of the Association of Terrestrial Magnetism and Electricity. Aided by UNESCO grants-in-aid, a well conceived series of projects has been activated, with gratifying results.

Details of the various programs are contained in the reports of the Chairmen of the several special committees appointed at the Oslo meeting of the Association. Those that are of particular interest because of their scope and accomplishments include: (a) A series of intercomparison observations of horizontal intensity, covering many magnetic observatories throughout the world, using QHM's belonging to the Association; (b) a comprehensive series of measurements of daily variation in horizontal intensity in regions between and near the geographic and magnetic equators; (c) the publication of geomagnetic activity indices, K and C, through 1950, as well as for extended series of earlier years for certain observatories; (d) the development of additional concepts regarding the significance and use of K indices; (e) continued studies of lunar variations in geophysical phenomena.

The Executive Committee

There were no changes in the Executive Committee during the period of this report.

Publications

The Transactions of the Oslo Meeting, IATME Bulletin No. 13, were printed in the spring of 1950. Distribution was made primarily through the National Committees, and in many cases the Washington diplomatic posts of the various countries very kindly arranged for the transmission of the bulletins through their respective pouch services. This resulted in a welcome savings of Association funds, as well as providing more expeditious delivery of the Transactions. In addition to distribution to National Committees, individual copies were forwarded to officers of the Union, Presidents and Secretaries of all Associations, and Chairmen and members of all IATME special committees. Finally, a limited number of copies went to various non-member countries, including several that are now applying for membership in the Union. Of the total edition of 1430 copies, approximate distribution figures are as follows:

Member countries (includes officers of Union, Associations and special committees)	1050
UNESCO	15
Non-member countries	65
Held in stock	300
	1430

The compilation of a list of addresses of institutions and individuals interested in the fields of terrestrial magnetism and electricity was a feature of the Oslo Transactions. This resumed a practice last followed in Bulletin No. 8, Comptes Rendus de l'Assemblée de Stockholm, 1930.

The Central Bureau has carried out arrangements for the printing and distribution of the following additional IATME Bulletins:

	Edition
Bulletin 12b, Geomagnetic Indices, C and K, 1948	350
Bulletin 12c, Geomagnetic Indices, K and C, 1949	500
Bulletin 12e, Geomagnetic Indices, K and C, 1950	600

(Note: Bulletin 12d was printed in and distributed from Germany)

Oslo Resolutions

The Resolutions adopted by the Association at Oslo were transmitted to the various National Committees of the Union.

Correspondence

During the period between the Oslo and Brussels meetings the Central Bureau received over 600 letters and sent out more than 675, in addition to several hundred copies each of a number of circular letters

Finances

The budget adopted by the Association at Oslo for the period 1 January 1948 to 31 December 1950 follows:

Management expenses. . . . . $	900.00
Oslo programs, printing	71.00*
Oslo reprints, including shipping charges.	537.00*
Oslo Transactions (UNESCO $600.00 in 1948)	3,000.00
Oslo miscellaneous costs	150.00
Preparation for 1951 Assembly:	
Agenda notices	200.00
Postage	100.00
Subventions:	
Bulletins 12 and 12a	1,588.00*
Thesaurus, Vol. VIII.	331.00*
Danish deficit	465.00
Intercomparisons (UNESCO $1,200 in 1948)	1,500.00
Journal T. M. and A. E. (Provisional, subject to approval by assembly of ATME)	1,500.00
Lunar tide studies	2,000.00
Magnetic characterization (grant-in-aid)	2,000.00
	$14,342.00

* Items so marked represent expenditures made after 1 January 1948 but prior to the Oslo Assembly.

In addition to the above, a sum of £350 ($1,400.00) allocated at the Edinburgh Assembly for study of giant pulsations is still available.

Actual receipts and payments for the period are listed in the appended and audited Statement of Accounts. In explanation of these accounts, the following remarks are submitted: (1) The allocation for the cost of preparing and printing the Oslo Transactions was $3,000.00, not including UNESCO aid. Actual cost was $2,964.92 plus a UNESCO grant of $600.00, total $3,564.92, or approximately $2.50

per copy. (2) Exchange rate fluctuations increased the actual dollar amount repaid to the Temporary Commission on Liquidation of the Polar Year 1932-33 for funds advanced to the Association from an estimated $465.00 to $538.05. (3) The item for management expenses went over the budgeted amount by almost $600.00. This was due in part to the fact that postage items included well over $200.00 for distribution of various publications, such as Bulletins 12b, 12c, 13 and certain URSI and other documents which were sent out by the Central Bureau. There was also included an item of $74.63 to cover transportation of a stock of IATME publications from Edinburgh to Washington. (4) Of the various subventions approved at Oslo, none were exceeded, and in many cases balances remain. With the approval of the Executive Committee, $300.00 of the $1,500.00 allocated for intercomparison observations was diverted to the Committee to Promote Daily Observations of Horizontal Force between and near the Geographic and Magnetic Equators. The remaining balance of $1,200.00 for intercomparisons has not been touched, thanks to UNESCO grants for this purpose. In this case, the Association contribution has consisted of making its QHM's available for the intercomparison program. (5) Of the $1,500.00 set aside for the Journal of Geophysical Research for the payment of page charges for articles on terrestrial magnetism and electricity by authors outside the U. S. a balance of over $900.00 remains, although there will be some additional charges for the period 1 January to 31 July 1951 if the Association agrees these are to be honored. (6) The lunar tide study subvention has been used with the exception of a small balance of about $150.00. (7) The sum of £350 set aside by the Edinburgh Assembly for giant pulsation studies remains unused. (8) Finally, the Association balance as of 31 December 1950 was $10,530.93 as compared with $12,314.20 at the start of the period on 1 January 1948, a reduction of $1,783.27.

UNESCO Grants-in-Aid

A far larger deficit would have occurred, or the Association's programs would have had to be correspondingly curtailed, had it not been for the UNESCO grants-in-aid which totaled $5,340.00 during the three-year period 1948-1950. Of this total, $856.00 was returned to UNESCO because it could not be committed within authorized time limits. This included approximately $113.00 for travel of young scientists to Oslo and $743.00 for magnetic intercomparisons. In the latter case, the Association did not have enough QHM's to use the total amount authorized, which had included over $500.00 held over from a previous year. The principal use of UNESCO funds in the intercomparison program is for the payment of air transportation and the relatively minor repairs to the QHM's that are required from time to time. In supporting publications of the Association, UNESCO grants have been most helpful. As already reported, $600.00 was appropriated to assist in the production of Bulletin 13, the Association's Oslo Transactions. In addition, a total of $940.00 has been made available over the three-year period 1948-1950 to aid in publishing geomagnetic K and C indices.

A listing of UNESCO grants-in-aid allocations and the corresponding expenditures will be found in the appended Statement of Accounts.

Future Expenditures

Unless funds are drawn from its reserve the Association's activities during the coming triennium face almost certain curtailment because of the decreased dollar value of Union contributions and the fact that UNESCO grants-in-aid are more than likely to be reduced. Added to these factors are the increasing costs of materials and services. All of these influences must be taken into account in planning realistic financial support of the Association's program for the period 1950-1952.

Preparations for the Brussels Meeting

The first circular letter announcing the Association's plans and a provisional agenda for the Brussels meeting were sent to National Committees and officers of the Union and its Associations in September and October 1950. The agenda, in greater detail, was mailed to this same group in June 1951.

Finally, a preliminary bulletin for distribution at the Assembly was prepared and printed in July. This contained the agenda, proposals, abstracts of national and special reports and technical communications which were received in time for inclusion.

REPORT OF THE BUDGET COMMITTEE

The Budget Committee of the International Association of Terrestrial Magnetism and Electricity recommends that the financial report submitted by the Secretary, Dr. Joyce, be accepted as it stands, on the basis of the technical report of the Public Accountant.

Brussels, 31 August, 1951

/s/ Nils Ambolt
/s/ Gaston Grenet
/s/ E. C. Bullard

[The Statement of Accounts appear on pages 62 and 63.]

APPROVED BUDGET FOR INTERNATIONAL ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY FOR THE PERIOD JANUARY 1, 1951, TO DECEMBER 31, 1953

Estimated Receipts

Cash on hand 1/1/51.	$10,530
From Union for period 1/1/51 - 12/31/53, based on guaranteed minimum of £900 per year	7,560
Total. . .	$18,090
Estimated payments.	16,170
Estimated balance 12/31/53	$ 1,920

Note: Estimated expenditures are $8610 in excess of estimated income. No account has been taken of UNESCO grants. These, if received, will reduce the amount of deficit spending.

Estimated Payments

Management expenses (including expenses since 1/1/51)	$ 1,200
Brussels Transactions	3,500
Preparation for Brussels (1/1/51 to Assembly)	600
Preparation for 1954 meeting. .	700
Subventions:	
Outstanding to Journal of Geophysical Research . .	170
Magnetic intercomparisons	1,000
Equatorial observations. . .	500
Magnetic activity indices. .	1,250
Lunar studies	1,000
Giant pulsations.	250
Instrumental program. . . .	6,000
	$16,170

INTERNATIONAL ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

Statement of Accounts from 1st January 1948 to 31st December 1951

Receipts

		USA Dollars	USA Dollars	Danish Crowns
Cash in hand 1/1/48		125.51		
Cash in bank 1/1/48 (L3164-05-03.5 transferred from England to U.S.)		12,188.69	12,314.20	
Allocations to the Union:				
1948		3,143.00		
1949		3,143.40		
1950		2,184.00	8,470.40	
Grants-in-aid from UNESCO:				
1948				
International comparison of geomagnetic standards	$1,200.00			
Aid in publications of geomagnetic indices	300.00			
Aid in publication of IATME Oslo Transactions	600.00			
Transportation of IATME officers to Oslo	350.00			
Transportation of young scientists to Oslo	250.00	2,700.00		
1949				
International comparison of geomagnetic standards	$1,000.00			
Aid in publication of geomagnetic indices	300.00	1,300.00		
1950				
International comparison of geomagnetic standards; special magnetic observations; lunar tide studies	$1,000.00			
Aid in publication of geomagnetic indices	340.00	1,340.00	5,340.00	
Interest on U.S. Savings Accounts			64.69	
Interest on Danish sub-account, international comparisons of geomagnetic standards				
1949				7.61
1950				53.41
Miscellaneous			.01	
Totals			26,189.30	61.02

Payments

	USA Dollars	USA Dollars	
Subventions to:			
Preparation and publication of Thesaurus of Observatory Values	331.00		
Preparation and publication of geomagnetic indices (less UNESCO grants)	1,848.44		
Special observations of daily H variations	300.00		
Studies of lunar tides	1,850.87		
Journal of Geophysical Research - page charges for communications by authors outside U.S.	226.55		
Repayment to Temporary Commission for Liquidation of Polar Year 1932-33 of loan made to IATME for photographic reproduction of magnetic records	538.05	5,094.91	
Oslo Assembly			
Preparation, publication, and transmittal from Washington to Oslo of reprints and copies of special reports for Oslo Assembly	536.82		
Oslo Agenda and program	71.00		
Preparation and publication of IATME Oslo Transactions (less UNESCO grant)	2,964.92		
Reprints of Oslo summary from Journal of Geophysical Research	3.14		
Office and miscellaneous services at Oslo Assembly	137.83	3,713.71	
Brussels Assembly			
Circular letter to National Committees		19.25	
Management expenses			
Stationery	104.18		
Postage	565.52		
Clerical	696.78		
Bank charges	6.00		
Audits	31.84		
Transportation of IATME Bulletins, Scotland to U.S.	74.63		
Western Union - cables and registration of cable address	11.55	1,490.50	
1948 UNESCO			
International comparisons of geomagnetic standards	628.50		
Aid in publishing geomagnetic indices (IATME Bulletins 12 and 12a)	300.00		
Aid in publishing IATME Transactions of Oslo Meeting	34.50		
Travelling expenses of IATME officers to Oslo Meeting	320.47		
Travelling expenses of young scientists to Oslo Meeting	166.80		
Repaid to UNESCO (unspent balance for travelling expenses of officers of IATME and young scientists to Oslo Meeting)	112.73	1,563.00	
1949 UNESCO			
International comparisons of geomagnetic standards ($571.50 obligated in 1948)	915.13		
Aid in publishing geomagnetic indices (IATME Bulletin 12b)	300.00		
Aid in publishing IATME Transactions of Oslo Meeting (funds obligated in 1948)	565.50		
Repaid to UNESCO (unspent 1949 balance)	743.00	2,523.63	
1950 UNESCO			
International comparisons of geomagnetic standards	362.32		
Special observations of daily H variations	101.92		
Lunar tide studies	449.13		
Aid in publishing geomagnetic indices (IATME Bulletin 12c)	340.00	1,253.37	
International comparisons of geomagnetic standards			61.02
Totals		15,658.37	61.02
Balance			
Cash in hand 12/31/50		None	
Cash in bank 12/31/50		10,530.93	
Totals		26,189.30	

Washington, D.C., U.S.A.,
12 February 1951

J. W. Joyce, Secretary and
Director of Central Bureau

The above accounts have been audited and are certified correct.
s/Helen E. Russell
Accountant, Department of Terrestrial Magnetism

MEETINGS OF THE EXECUTIVE COMMITTEE OF THE ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY

Minutes of the First Meeting

The first meeting of the Executive Committee was held at 11:00 on August 20, 1951. Present were: Prof. Chapman, Prof. Coulomb, Mr. Laursen, and Dr. Joyce.

The principal business was the preparation of suggested slates of nominations for the various special committees required during the course of the Brussels Meeting. These included committees on Nominations, Budget, and Resolutions. In addition, the following three joint committees with other Associations of the Union were to be required:

1. A Committee on the Third Polar Year 1957-58 (subsequently changed to the International Geophysical Year, 1957-58), with the Associations of Meteorology, Hydrology, and Physical Oceanography. The coordinating Association was Terrestrial Magnetism and Electricity.

2. A Committee on Upper Atmosphere Nomenclature, with the Associations of Meteorology, Hydrology, and Physical Oceanography. The coordinating Association was Terrestrial Magnetism and Electricity.

3. A Committee on "World Days", with the Associations of Meteorology and Physical Oceanography. The coordinating Association was Meteorology.

All proposals were to be submitted to the first meeting of the Association of Terrestrial Magnetism and Electricity on August 21, 1951 for consideration.

The meeting adjourned at 12:00.

Minutes of the Second Meeting

The second meeting of the Executive Committee was held at 09:30 on August 23, 1951. Present were: Prof. Chapman, Prof. Coulomb, Mr. Laursen, and Dr. Joyce.

Consideration was given to the question of including the World Meteorological Organization in the forthcoming International Geophysical Year. Discussions were also held concerning the best manner in which to assure adequate and proper coverage of the upper atmosphere.

The meeting adjourned at 09:55.

Minutes of the Third Meeting

The third meeting of the Executive Committee was held at 09:30 on August 29, 1951. Present were: Prof. Chapman, Prof. Coulomb, and Mr. Laursen. Members of the new Executive Committee elected on August 23 had also been invited to attend. They included: Prof. Bartels, Mr. Giesecke, and Dr. Hasegawa. The Chairman of the Special Budget Committee, Dr. Ambolt, was also present by invitation. In the absence of Dr. Joyce, Mr. Laursen acted as Secretary.

The proposed budget for the period January 1, 1951 through December 31, 1953 was discussed and amended. A proposal that the Association should try to acquire a portable magnetometer equipment to be used at temporary magnetic stations was strongly recommended, and a sum was set aside in the budget for this purpose, to be presented to the Association for consideration and action.

The meeting adjourned at 09:50.

Minutes of the Fourth Meeting

The fourth meeting of the Executive Committee was held at 16:15 on August 29, 1951. Present were: Prof. Chapman, Prof. Coulomb, Mr. Laursen, Prof. Bartels, Mr. Giesecke, Dr. Hasegawa, and Mr. Rayner. Dr. Nicolet of the Joint Committee on the Upper Atmosphere was also present by invitation. In the absence of Dr. Joyce, Mr. Laursen acted as Secretary.

The President presented a proposal as to the procedure to be followed in the future with regard to papers bearing on Upper Atmosphere research. The proposal was approved by those present and will be submitted to the Association of Terrestrial Magnetism and Electricity for its consideration. The proposal will also be submitted to the Association of Meteorology.

The meeting adjourned at 17:00.

PART II

STATUTES

STATUTS DE L'ASSOCIATION DE MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES DE L'UNION GÉODÉSIQUE ET GÉOPHYSIQUE INTERNATIONALE

I. -- Objets de l'Association

1. L'Association a pour objets:
   (1) d'étudier des questions qui concernent le magnétisme et l'électricité terrestres en tant que ces questions exigent la coopération internationale pour en assurer l'étude effective;
   (2) d'encourager l'étude de ces sujets par les différents pays, institutions, ou les particuliers.

II. -- Membres de l'Association

2. Les pays qui adhèrent à l'Union Géodésique et Géophysique Internationale auront le droit de s'inscrire comme membres de l'Association et de nommer des délégués pour se faire représenter aux réunions de l'Association.

III. -- Comités Nationaux

3. Avec l'approbation de son Comité National de l'Union Géodésique et Géophysique Internationale, chacun des pays, en devenant membre de l'Association, peut créer un Comité National pour faire progresser les objets de l'Association dans son propre territoire. Ces Comités Nationaux auront le droit de déterminer leur propre constitution et de régler leurs affaires en accord avec ces statuts et ceux de l'Union Géodésique et Géophysique Internationale. Ils auront aussi le droit de nommer des délégués à chaque réunion de l'Association et de soumettre à ces réunions des questions à discuter pourvu que ces questions soient parvenues au Secrétaire de l'Association au moins quatre mois avant la réunion de l'Assemblée où elles sont à discuter.

4. La correspondance entre un Comité National de l'Association et le Comité Exécutif de l'Association sera conduite par le Comité National local de l'Union Géodésique et Géophysique Internationale.

IV. -- Administration de l'Association

5. Les travaux de l'Association seront dirigés par l'assemblée générale des délégués choisis par les Comités Nationaux de l'Association.

6. L'Association aura un Comité Exécutif élu par l'Assemblée Générale.

7. L'intervalle entre la clôture d'une Assemblée Générale et la clôture de la suivante sera appelé, pour les buts de ces statuts, une période. Le Comité

Exécutif comprend le Président, deux Vice-présidents, le Secrétaire qui est en même temps directeur du Bureau Central de l'Association, cinq autres membres, enfin le président sortant s'il y en a un.

8. Le président et les vice-présidents sont élus pour une période et rééligibles une seule fois. Le Secrétaire est élu pour deux périodes et rééligible par périodes successives. Les cinq membres additionnels sont élus pour une période et rééligibles par périodes successives. Le président sortant est membre de droit pour une période seulement.

9. Le Comité Exécutif aura le droit de pourvoir aux vacances qui surviendraient dans son sein pendant l'intervalle entre deux assemblées générales. Toute personne désignée dans ces conditions restera en fonctions jusqu'à l'assemblée générale suivante et sa rééligibilité par conséquent ne sera pas affectée. Si la vacance est celle du Président, le Comité Exécutif nommera un des Vice-Présidents pour le remplacer jusqu'à l'assemblée générale suivante.

10. Le Président présidera toutes les assemblées générales et les séances du Comité Exécutif et, en conférence avec le Secrétaire, réglera les affaires de l'Association entre les assemblées générales.

11. Les Vice-Présidents, l'un ou l'autre, conformément aux dispositions que prendra le Comité Exécutif, présideront les assemblées générales en l'absence du Président.

12. Les fonctions du Secrétaire seront les suivantes: (1) D'expédier toute correspondance relative aux affaires de l'Association; (2) de recevoir et de gérer les sommes qui peuvent être allouées par l'Union Géodésique et Géophysique Internationale ou d'autre provenance; (3) de débourser telles sommes conformément aux décisions de l'assemblée générale ou aux instructions du Comité Exécutif; (4) de tenir le compte de tout l'argent reçu et dépensé et de soumettre ce compte, certifié par un comptable qualifié, à l'examen d'un comité financier nommé à cet effet par l'assemblée générale; (5) de rédiger et publier les comptes-rendus de l'Association et de procéder à leur distribution selon les directives de l'assemblée générale.

13. Soumis aux directives générales et spéciales de l'assemblée générale, le Comité Exécutif aura le droit: (1) de fixer l'ordre du jour de chaque assemblée générale; (2) de confier à des commissions spéciales ou à des particuliers la préparation de rapports sur des sujets rentrant dans la compétence de l'Association; (3) de choisir et de consulter des personnes et des institutions représentatives des pays qui n'adhèrent pas à l'Association, ces personnes ou institutions étant considérées comme membres correspondants de l'Association.

14. Si, pour un motif qui semblerait bon et suffisant, le Comité Exécutif considère nécessaire ou désirable de s'écarter de la décision ou des instructions de l'assemblée générale ou bien de l'interprétation formelle de ces statuts, il en aura le droit pourvu qu'un exposé de l'action réalisée ou non réalisée, appuyé des motifs, soit présenté à l'assemblée générale suivante.

V. -- Assemblées de l'Association

15. Une assemblée générale ordinaire se tiendra à l'occasion de l'assemblée générale ordinaire de l'Union Géodésique et Géophysique Internationale.

16. Le Président peut, avec l'approbation du Comité Exécutif, convoquer une assemblée générale extraordinaire de l'Association. Il sera tenu de le faire à la demande d'au moins la moitié des voix des pays adhérents à l'Association, exprimée par leurs Comités Nationaux.

17. Avec le consentement du Comité Exécutif, le Président peut inviter comme hôtes des représentants d'institutions ou d'autres personnes intéressées à assister aux séances d'une assemblée générale.

18. Sauf dans le cas de modification de ces statuts ou de questions financières, toutes les questions présentées à une assemblée générale seront décidées à la majorité des voix des délégués. Sur les questions relatives à la modification de ces statuts, chaque pays représenté dans l'assemblée générale aura une voix, laquelle sera donnée par un représentant choisi par les délégués du pays considéré. En ce qui concerne les questions financières, le scrutin se fera selon les statuts de l'Union Géodésique et Géophysique Internationale. Dans tout cas ne concernant pas une modification aux statuts, s'il y a égalité de voix, celle du Président sera prépondérante.

19. L'ordre du jour d'une assemblée générale sera préparé par le Secrétaire et communiqué aux membres de l'assemblée générale au moins trois mois avant l'ouverture de la session. Il y figurera toutes les questions qui auront été soumises par les Comités Nationaux pour être discutées à l'assemblée générale, avec d'autres questions qui peuvent être mises à l'ordre du jour par le Comité Exécutif. Toute question qui n'a pas été ainsi communiquée ne peut être prise en considération qu'avec l'assentiment de l'assemblée générale.

VI. -- Budget

20. Le Secrétaire préparera un budget de prévision de recettes et dépenses pour la période comprise entre deux assemblées générales ordinaires successives. Il présentera ce budget au Comité Exécutif au cours des sessions de l'assemblée générale qui précède immédiatement cette période et, après en avoir reçu l'approbation, il peut procéder au déboursement des fonds conformément à cette approbation.

21. A chaque assemblée générale ordinaire, un Comité sera institué pour examiner les comptes et présenter à l'Association un rapport sur les résultats de cet examen.

VII. -- Interprétation et modification des statuts

22. Le présent texte français servira exclusivement pour l'interprétation à donner à ces statuts.

23. Aucun changement ne pourra y être apporté sauf dans le cas où:

(1) Un pays, par l'intermédiaire de son Comité National, fait savoir son intention de proposer une modification--cette intention ayant été communiquée au Secrétaire au moins six mois avant l'assemblée générale à laquelle la question doit être étudiée.

(2) Le changement reçoit l'approbation d'au moins deux tiers du nombre des pays appartenant à l'Association.

STATUTES OF THE ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY OF THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

I. -- Objects of the Association

1. The objects of the Association are:
   (1) The study of questions relating to terrestrial magnetism and electricity in so far as these questions require international cooperation for their effective investigation.
   (2) The encouragement of research in the above subjects by individual countries, institutions, or persons.

II. -- Members of the Association

2. The countries which adhere to the International Union of Geodesy and Geophysics shall be eligible as members of the Association, and may appoint delegates to represent them at meetings of the Association.

III. -- National Committees

3. With the approval of its National Committee of the International Union of Geodesy and Geophysics, any country becoming a member of the Association may constitute a National Committee for the purpose of furthering the aims of the Association within its territory. Such National Committees shall have power to determine their own constitution and to regulate their own procedure in accordance with these Statutes and the Statutes of the International Union of Geodesy and Geophysics. They have also the right to appoint delegates to each meeting of the Association and to submit subjects for discussion at these meetings, provided that notice of such subjects is received by the Secretary of the Association not less than four months before the meeting of the Assembly at which they are to be discussed.

4. Correspondence between a National Committee of the Association and the Executive Committee of the Association shall be carried on through the local National Committee of the International Union of Geodesy and Geophysics.

IV. -- Administration of the Association

5. The work of the Association shall be transacted by the general assembly of the delegates appointed by the National Committees of the Association.

6. The Association shall have an Executive Committee elected by the General Assembly.

7. The interval elapsing between the end of one general assembly and the end of the next one, will, for the purposes of the Statutes, be termed one period. The Executive Committee shall consist of the President, two Vice-Presidents, the Secretary who is simultaneously Director of the Central Bureau of the Association, five other members, and the retiring President if there is one.

8. The President and the Vice-Presidents shall be elected for one period and may be reelected once. The Secretary shall be elected for two periods and may be

reelected for successive single periods. The five additional members shall be elected for one period and reelected for successive single periods. The retiring President is member ex-officio for only one period.

9. In the event of any vacancy in the Executive Committee occurring in its membership during the interval between two general assemblies, the Executive Committee shall have power to fill the vacancy, such election being valid until the next general assembly, and the eligibility for reelection of the person so elected shall not be affected by such election. Provided that if the vacancy be that of the office of President, the Executive Committee shall appoint one of the Vice-Presidents to act until the next general assembly.

10. The duties of the President are to preside at all general assemblies of the Association and at meetings of the Executive Committee, and, in consultation with the Secretary, to regulate the current business of the Association between general assemblies.

11. It is the duty of the Vice-Presidents, one or other as may be determined by the Executive Committee, to preside at general assemblies in the absence of the President.

12. The duties of the Secretary shall comprise the following: (1) To carry on all correspondence relating to the affairs of the Association; (2) to receive and keep charge of such funds as may be allotted by the International Union of Geodesy and Geophysics to the Association, or as may be received from any other source; (3) to disburse such funds in accordance with the decisions of the general assembly or with the instructions of the Executive Committee; (4) to keep the account of all receipts and disbursements and to submit such account, audited by a qualified accountant, for examination by any financial committee appointed for the purpose by the general assembly; (5) to prepare and publish the transactions of the Association, and to arrange for their distribution in accordance with the directions of the general assembly.

13. Subject to the general or special directions of the general assembly, the Executive Committee shall have power: (1) To arrange the agenda of each general assembly; (2) to entrust to special commissions or to particular individuals the preparation of reports on subjects within the province of the Association; (3) to select and consult with persons or representative institutions belonging to countries which are not within the Association, such persons or institutions being deemed corresponding members of the Association.

14. If, for any reasons that may appear to it to be good and sufficient, the Executive Committee considers it necessary or desirable to depart either from the decision or the instructions of the general assembly or from the strict interpretation of these Statutes, it shall have power to do so, provided that a statement of the action taken or not taken, with reasons for the same, shall be laid before the next general assembly.

V. -- Assemblies of the Association

15. An ordinary general assembly of the Association shall be held in connection with the ordinary general assembly of the International Union of Geodesy and Geophysics.

16. The President may, with the approval of the Executive Committee, call an extraordinary general assembly of the Association. He shall be obliged to do so on the request of not less than one-half of the votes of the countries adhering to the Association, as expressed by their National Committees.

17. With the consent of the Executive Committee, the President may invite as guests representatives of institutions or other interested persons to be present at meetings of a general assembly.

18. Except in questions relating to the alteration of these Statutes or to financial questions, all questions before a general assembly shall be decided by the majority of votes of those delegates then present. In questions relating to the alteration of these Statutes, each country represented at a general assembly shall have one vote, to be given by a representative chosen by the delegates from the respective country. In all financial questions, the voting shall be in accordance with the Statutes of the International Union of Geodesy and Geophysics. In all questions not relating to the alteration of these Statutes, if there be an equality of votes, the President has a casting vote in addition to his own deliberative vote.

19. The agenda of a general assembly shall be prepared by the Secretary and circulated to members of the general assembly not less than three months before the opening of the general assembly. It shall include all questions which have been submitted by National Committees for discussion at the general assembly, together with any other questions placed on the agenda by the Executive Committee. Any questions of which notice has not thus been given may only be discussed with the consent of the general assembly.

VI. -- Budget

20. The Secretary shall prepare, for each period intervening between two successive ordinary general assemblies, a budget estimate of receipts and expenditures during that period. He shall lay this before the Executive Committee during the meetings of the general assembly immediately preceding that period, and, having received its approval, he may proceed with the disbursement of funds in accordance with that approval.

21. At each ordinary general assembly a committee shall be appointed to examine the accounts and to report the results of their examination to the Association.

VII. -- Interpretation and Alteration of Statutes

22. The French text shall serve exclusively for interpretation of these Statutes.

23. No change may be made in the present Statutes except:

(1) By notice being given by any country, through its National Committee, of its intention to move an alteration, such notice being given to the Secretary not less than six months before the general assembly at which it is intended to be discussed.

(2) By the approval of at least two-thirds of the number of countries included in the Association.

[Editor's Nóte: No changes were made in the Statutes of the Association of Terrestrial Magnetism and Electricity at the Brussels Meeting. They are therefore reprinted from IATME Bulletin No. 13, "Transactions of the Oslo Meeting".]

PART III

NATIONAL REPORTS

ARGENTINA

INFORME DE ACTIVIDADES GEOMAGNETICAS DESARROLLADAS EN LA DIVISION GEOFISICA DEL SERVICIO METEOROLOGICO NACIONAL

(Período comprendido entre el 1° de enero de 1948
y el 1° de marzo de 1951)

1. Observatorios--Los tres Observatorios, La Quiaca, Pilar y Orcadas, del Sur continuaron funcionando normalmente, sin interrupción alguna, con registros permanentes de D, H, y Z, y observaciones obsolutas de D, H é I, en intervalos aproximados de 6 días. Se hallan tabulados los valores medios horariosde los tres elementos registrados hasta fines del año 1950 para Pilar, y hasta fines del año 1949 para Las Orcadas, hallándose en ejecución la tabulación de los mismos valores de La Quiaca para los años 1948, 1949 y 1950.

Copias de dichas tabulaciones podrán ser facilitadas a las instituciones e investigadores interesados, en la medida de lo posible; por el momento, el Servicio Meteorológico Nacional se halla imposibilitado de publicar este material, por falta de fondos, pero se proyecta editarboletines provisorios, en mimeógrafo, mensuales y trimestrales, que contendrán los valores medios horarios de los tres elementos del Observatorio de Pilar, para los cinco días tranquilos y perturbados internacionales de cada mes, como también los datos sobre perturbaciones y actividad geomagnética que regularmente se remiten a la Comisión respectiva de la IATME.

En cooperación con el Comité n° 7 de la IATME (para la intercomparación de patrones magnéticos), se efectuaron intercomparaciones entre los instrumentos absolutos de lostres observatorios con magnetómetros QHM, facilitados por el mencionado Comité. Estos trabajos se realizaron en lasiguiente forma:

1949: Pilar - La Quiaca - Pilar
(tres intercomparaciones QHM)
1950: Pilar - Orcadas - Pilar
La Quiaca - Pilar
(dos instrumentos QHM).

Los resultados obtenidos fueron muy satisfactorios y de gran beneficio para el control de nuestros patrones.

2. Campañas de relevamiento--Durante el período de referencia se continuaron normalmente las tareas de levantamiento magnético de la República, con un equipo tipo Carnegie; fueron ocupadas:

en 1948,	20 estaciones;	de ellas: 14	reocupaciones;
" 1949,	34 " ;	" " : 31	" ;
" 1950,	4 " ;	todas ellas	" .

3. Cartas Magnéticas--Sehalla terminada, para su publicación, la carta isógona de la Rep. Argentina para la época 1950.0. A propósito de este trabajo se estudió y elaboró un procedimiento para reducir las observaciones de campaña, eligiendo como nivel de referencia el que resulta de los valores de las horas nocturnas. Las bases de este procedimiento se hallan descriptas en la publicación (1).

4. Perturbaciones y actividad geomagnética--Se determinaron corrientemente desde 1940 hasta el presente, los índices k para Pilar, que son remitidos mensualmente al Comité respectivo de la IATME. El procedimiento para hallar los índices k fué sometido a un examen detallado en lo que se refiere a la necesidad de eliminar la influencia de la variación lunar (2); se comprobó que en Pilar (y en los k_W mundiales) existe una pequeña onda lunar residual, cuya semi-amplitud semimensual en Pilar no alcanza valores críticos, siendo de unas 0,4 unidades de k en días muy tranquilos del solsticio del sur.

Con miras a una posterior investigación de la perturbación residual (postperturbación) y su posible relación con las variaciones diarias, solar y lunar, se estudió analíticamente el efecto de curvatura que la recuperación asintótica de los valores medios pueda ejercer en la amplitud diaria (3). Se llegó a la conclusión de que este efecto puede llegar a ser del orden de magnitud de 1γ en H, de manera que convendrá tomarlo en cuenta en ciertos estudios de la variación lunar.

Para este trabajo se empleó, en parte, material del antiguo observatorio de la Isla Año Nuevo, datos que fueron puestos a la disposición del Servicio Meteorológico Nacional por gentileza del Ministerio de Marina.

Los estudios de las perturbaciones se extendieron también por primera vez en esta parte del mundo, al fenómeno de las micropulsaciones. A este efecto, se comenzó un recuento provisional de las mismas en los registros del Observatorio de las Islas Orcadas, con el fin de hallar un criterio racional para su clasificación. Se prestó especial atención a la posible interferencia de las micropulsaciones con perturbaciones de otra naturaleza; en este sentido, es de interés anotar la desaparición temporaria del fenómeno durante la fase ascendente de un "efecto de destello solar" (s.f.e.), comprobada en forma simultánea en Las Orcadas y en La Quiaca (4). En general, se observaron varios casos de micropulsaciones registradas paralelamente en ambos observatorios (distancia aproximada: 4000 Km).

5. Año Polar--Se tabularon valores medios horarios de D y H para La Quiaca, correspondientes al Segundo Año Polar Internacional, y con destino a la Comisión Liquidadora del Año Polar. Para el mismo período, se determinaron índices k de Pilar, La Quiaca y Orcadas.

6. Tabulación mecánica--Con la ayuda de un equipo de máquinas IBM, de tarjetas perforadas, fueron tabulados los valores horarios de los tres elementos geomagnéticos D, H y Z para el antiguo observatorio de la Isla Año Nuevo, de un período de 15 años. El procedimiento adoptado permite obtener, con una sola operación de la máquina tabuladora las marchas medias diarias de cada mes que por lo común se publican en los anuarios o sea: de todos los días del mes, de los cinco días tranquilos y los cinco días perturbados. En forma análoga se ha comenzado a elaborar el material del observatorio de Pilar, disponiéndose en estos momentos de una colección de 12 años de datos en forma de tarjetas ya perforadas.

7. Observaciones solares--Además de las tareas geofísicas generales, y en particular geomagnéticas, el Observatorio de Pilar viene desarrollando observaci-

ones de manchas y fáculas solares, desde hace una veintena de años. Estas observaciones se realizan en todos los días en que las condiciones atmosféricas lo permiten. El procedimiento empleado, y especialmente el método correcto para hallar un valor provisorio del número relativo de manchas, fueron objeto de consultas con el Observatorio Astronómico Federal de Zürich, Suiza, con el cual se estableció un convenio de colaboración.

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(4) Archiv für Meteorologie, Geophysik und Bioklimatologie, 1951; trabajo a publicarse en el número conmemorativo que se editará en otoño.

Servicio Meteorológico Nacional
Buenos Aires, Argentina

Supplemental Report

Magnetismo Terrestre. Los trabajos de que se da cuenta en este informe, han sido realizados por el Departamento de Magnetismo Terrestre y Electricidad Atmosférica, a cargo del profesor doctor Leónidas Slaucitajs, utilizando los instrumentos que se detallan a continuación: 1 teodolito magnético Schulze; 1 magnétometro horizontal de cuarzo QHM; 1 balanza magnética vertical Schmidt; 1 balanza magnética vertical BMZ; 2 juegos completos de variómetros registradores Ruska.

En los años 1949-1950 se realizó una campaña de mediciones magnéticas en la Provincia de Buenos Aires, midiéndose la declinación magnética (D) en 10 puntos; la intensidad horizontal (H) en 17 puntos; y la intensidad vertical (Z) en 211 puntos.

El objeto de estas mediciones, además de los fines generales, fué: (1) La investigación más detallada sobre el carácter del campo de Z y sus probables anomalís; (2) Los estudios sobre variación secular de H, cerca de un foco isoporico muy característico en las proximidades de la costa atlántica argentina; empleándose especialmente, en esta tarea, el magnetómetro de cuarzo (QHM); (3) Obtención de los registros de D, H, Z en una estación magnética temporaria en la Provincia de Buenos Aires (Escuela Inchausti, $\phi = 35°.6S$, $\lambda = 60°.50W$). Junto con las observaciones visuales sobre las variaciones diurnas cerca de La Plata, estos registros tienen importancia como material sobre amplitudes y curso de la variación diurna y perturbaciones en la región mencionada.

En el futuro, se proyecta efectuar con esa estación transportable, los registros en otras regiones, dedicando otro juego de registradores para el observatorio magnético fijo que habrá de instalarse en el Territorio Nacional de Santa Cruz, en Paso del Río La Leona, entre los Lagos Viedma y Argentino, donde se está construyendo actualmente la Estación Astronómica Austral "Félix Aguilar".

En el año 1951, el personal del Departamento efectuó una comisión especial a la Antártida Argentina, midiendo en 5 puntos los elementos D, H, I(Z) y en 26 puntos la intensidad vertical (Z), observando también las variaciones.

Publicaciones. "Estudios geomagnéticos de la Provincia de Buenos Aires" (en preparación), y "La observación del campo geomagnético" (en prensa), ambas obras del profesor doctor Leónidas Slaucitajs. Además, este mismo profesor está preparando el manuscrito con los resultados de la campaña en la Antártida; habiendo dedicado también atención a cuestiones teóricas entre las cuales podemos mencionar las investigaciones sobre la variación secular geomagnética en América del Sud y también en escala global. Parte de este trabajo, titulado: "Investigaciones sobre variación secular geomagnética", fué presentado por el doctor Slaucitajs en el Primer Congreso Interobservatorios realizado en La Plata en el mes de noviembre de 1950, cuyos resultados están en prensa.

En todos los trabajos del Departamento, el profesor doctor Slaucitajs ha sido secundado por los señores J. C. Harriague y O. Sidoti.

Universidad Nacional de La Plata
La Plata, Argentina

AUSTRALIA

SUMMARY STATEMENT ON THE MAGNETIC SURVEY OF AUSTRALIA DURING THE YEARS 1948-51

By J. M. RAYNER

The official magnetic survey of Australia, the operation of the magnetic observatories and related activities are carried out by the Geophysical Section of the Bureau of Mineral Resources, Geology and Geophysics, in the Ministry of National Development of which the writer is Chief Geophysicist. This report deals primarily with the work of this organization, but reference will be made to the work of others in Australia.

(1) Magnetic Observatories

Watheroo Magnetic Observatory--Magnetic, ionospheric and related observations have been carried out continuously. The observatory is also equipped for earth-current and atmospheric electrical investigations. K-index values and other data have been regularly distributed. During the period a second ionospheric recorder has been installed. Annual mean values of the magnetic elements are as follow:

Date	D	H	V	Remarks
1948	2°51!2W	24816γ	51913γ	Provisional values
1949	2 49.9W	24825γ	51966γ	Provisional values
1950	2 49.2W	24838γ	52029γ	Provisional values

Toolangi Magnetic Observatory--Magnetic observations have been carried out continuously and K-index values have been regularly distributed. Annual mean values of the magnetic elements are as follow:

Date	D	H	I	Remarks
1948	9°23!9E	22894γ	67°54!8	Absolute observations reduced to mean of day
1949	9 29.2E	22872γ	67 55.9	
1950	9 34.1E	22853γ	67 57.5	

Macquarie Island Observatory--This is a new observatory for magnetic, seismological and other geophysical investigations. Its position is latitude 54°30!0S, longitude 158°57!0E and buildings have been erected. Since April, 1950, absolute values of all magnetic elements have been regularly observed and changes in horizontal intensity have been continuously recorded in connection with ionospheric work.

Additional equipment consisting of La Cour magnetograph, QHM and BMZ, which has been on order for a long time, has recently arrived in Melbourne. This will be installed when the next relief expedition visits Macquarie Island in May, 1951, and continuous recording of three elements will commence shortly thereafter.

Heard Island Observatory--This is a new observatory for magnetic, seismological and other geophysical investigations. Its position is latitude 53°01!9S, longitude 73°21!9E, and buildings have been erected. Since January, 1951, absolute observations have been regularly made of all elements and changes in horizontal intensity have been continuously recorded for ionospheric purposes.

Additional equipment consisting of La Cour magnetograph, QHM and BMZ, recently arrived in Melbourne. Unfortunately, this just missed the annual relief expedition which left Melbourne for Heard Island in January, 1951. Arrangements have now been made, however, for the "Discovery" to land the equipment on Heard Island in August, 1951, and continuous recording will commence shortly thereafter.

Proposed Port Moresby Observatory in Papua--It is proposed to erect a major geophysical observatory near Port Moresby to carry out magnetic, seismological and other investigations, and to act as a base for field geophysical projects in New Guinea. Unfortunately, there have been many delays in this project. So far field magnetic surveys have been made to test sites and the buildings have been designed.

Proposed Antarctic Observatory--Plans have been made to establish an observatory on the Antarctic Continent for magnetic and seismological investigations and to act as a base for geophysical field work. It is likely that this observatory will be established in December, 1952.

(2) Absolute Field Observations

Because of other urgent projects this work has been in abeyance during the period but the observations, set out in the attached table, have been made.

(3) Secular Variation

In the latter part of 1951 it is proposed to commence a magnetic re-occupation campaign. Those parts of the Australasian zone most in need of re-occupation are New Guinea, Papua, Northern Queensland, Tasmania, and the northwest portion of Western Australia.

(4) Magnetic Maps

A preliminary Isogonic Map of Australia has been prepared appropriate for the mean of the year 1950. Work is proceeding on a new set of maps showing all components.

(5) Aeromagnetic Surveys

During 1950 a decision was taken to carry out aeromagnetic surveys widely over Australia, New Guinea and neighboring areas. So far two sets of aeromagnetic equipment, aircraft and much auxiliary equipment have been purchased and the nucleus of a staff established. Trial flights have been carried out and it is expected that regular surveys will commence during May, 1951. In the first instance, changes in the total magnetic force will be recorded in connection with subsurface investigations. At a later stage it is planned to measure three magnetic components in the aircraft.

(6) Diurnal Variation of Horizontal Intensity in Equatorial Regions

A request was received to carry out observations for the above on Jarvis, Christmas and Fanning Islands in the Pacific Ocean. This project was put on our program but considerable difficulties have so far been encountered in organizing the substantial expedition which is required to visit this remote area.

(7) Vertical Force Surveys

Many surveys have been made with vertical force variometers in Australia and New Guinea to explore the subsurface. Some of these surveys have covered extensive areas, and it is proposed to connect their datum stations to the absolute magnetic stations in order to build up a vertical force map of Australia showing close detail.

(8) Surveys by other Organizations

The major companies engaged in the search for minerals have magnetically surveyed a number of areas using vertical force balances. The Departments of Mines in the States of South Australia and New South Wales have carried out a limited amount of work along similar lines. The Department of Geology in the University of Sydney is planning to make some magnetic surveys for subsurface exploration. Aeromagnetic surveys recording changes in the total magnetic force have been carried out over several areas for mineral exploration by mining companies.

(9) General

During the year a set of QHM instruments from Copenhagen was used for comparisons at the Australian magnetic observatories. A start was made with a program to improve instrumentation in the various field and observatory magnetic groups within the Geophysical Section and to establish first-class magnetic standards within the country.

Melbourne
27 April 1951

REPORT OF RESEARCHES ON MAGNETIC VARIATIONS AND THE IONOSPHERE (1948-50)*

There are now reasons for believing that the solar and lunar atmospheric tides are much larger in the ionosphere than at the ground. It is also likely that the solar tide in the F2 region is sufficiently great to distort it notably, so producing anomalous variations in its temporal and geographical distribution. Such variations are most easily studied for the lunar tide, which has a period sensibly different from 12 hours, so that the solar harmonics due to ion production can be eliminated.

The lunar tide in the principal ionospheric parameters has been studied at more than a dozen locations[1] scattered representatively over the globe. Lunar semi-diurnal variations have been found in the heights of the F1 and F2 regions, as well as in the E region; also found are marked semi-diurnal lunar variations in the critical penetration frequencies of the F2 region. At Huancayo, near the magnetic equator, the variations become very large. A theory of the lunar variations has been developed[2], according to which they are due to vertical ionic drifts associated with the "dynamo" fields caused by the horizontal component of the earth's magnetic field. This leads to changes in sign of the variations at about 35°, an effect which is detected observationally[3] for the E region. The phases of the F1 and F2 variations are sensibly the same all over the globe, save at the magnetic equator. It has been suggested[1] that this is due to domination of F region drifts by the polarization field developed near the E region; in the latter region the <u>air</u> movements appear to be larger than in the F region.

A beginning has also been made[4] on the analysis of the solar tidal harmonics. This has thrown some light on the nature of the anomalous F2 variations.

The results obtained from both the above studies, of lunar and solar iono spheric variations, throw some light on the location of the currents producing the (quiet) magnetic variations. It appears likely that the main solar currents flow be low the E region, with smaller in-phase currents in upper regions. The main lunar currents appear to flow also below the E region, but the smaller currents in and above this region appear to have the opposite phase; this may explain the peculiar seasonal and solar cycle changes in the lunar variations.

Considerable work has been done on the nature[5] and origin[6] of the anomalous magnetic variations near the equators. A successful conclusion to this work would almost certainly explain the corresponding ionospheric anomalies in these regions. The dynamo theory of Balfour Stewart and Schuster has been modified to take account of the anisotropy in conductivity due to the earth's magnetic field. It is found that this modification does not explain the anomalies. In a later development of this work two conducting shells are considered, one of which is highly conducting while the other has large tidal motions. The regions are linked by high conductivity along the lines of magnetic force. This creates an anomalous isolated region in the inner shell near the magnetic equator. It is found that large meridional current systems occur in this zone, and these appear likely to be the cause of the anomalous magnetic variations. The rather laborious computations are still incomplete.

Much attention has been given to traveling disturbances in the F2 region of the ionosphere. A network[7] of radio echo sounders (P'-f and P'-t) has been set up

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* This portion of the report prepared by the Council for Scientific and Industrial Research, Radio Research Board.

MAGNETIC OBSERVA-

Name of station	Lat.	Long.	Date	Declination		Horizontal Intensity	
				LMT	Value	LMT	Value
				h m	° ′	h m	γ
Ararat B, Vic.	37 17 S	142 56 E	1949, Dec. 8	10 02	8 36.7 E	10 35	22800
				11 51	8 42.7 E	11 24	22811
				13 36	8 49.5 E	14 00	22851
				15 05	8 49.7 E	14 54	22857
Portland, Vic.	38 21 S	141 36 E	1949, Dec. 5	9 36	7 45.9 E	10 07	21818
				11 26	7 49.1 E	10 58	21834
				14 06	7 59.0 E	14 33	21848
				15 48	7 58.7 E	15 21	21853
			1949, Dec. 6	10 07	7 47.9 E	10 37	21796
				12 33	7 51.6 E	11 57	21825
				14 43	7 57.9 E	15 21	21850
Port Jeanne d'Arc, Kerguelen Island	49 33 S	69 49 E	1947, Dec. 31	-	-	-	-
			1948, Jan. 1	11 34	47 40.6 W	-	-
				11 47	47 40.0 W	-	-
			1950, Feb. 28 to Mar. 1	12 30 to 11 30	48 07.9 W	-	-
			1950, Feb. 28	-	-	0 05	18156
Heard Island	53 02 S	73 22 E	1947, Dec. 23	-	-	14 52	18360
			1947, Dec. 24	0 00 to 18 00	48 43.5 W	-	-
			1950, Feb. 20	-	-	15 24	18414
			1950, Feb. 22 to Feb. 23	10 27 to 11 09	49 22.4 W	-	-
Macquarie Island	54 30 S	158 57 E	1948, Mar. 18	-	-	13 34	13451
			Mar. 19	Mean of day	23 26.7 E	-	-
			1949, Mar. 30	14 59	24 09.9 E	-	-
			Apr. 1	12 28	24 07.7 E	-	-
			1950, Apr. 15	-	-	2 40	13434
			Apr. 18 to Apr. 19	13 24 to 12 35	23 58.0 E	-	-

TIONS, 1948 - 1950

Vertical Intensity		Inclination		Remarks
LMT	Value	LMT	Value	
h m	γ	h m	° ′	
-	-	9 30	69 59.7	New station, approximately 160 feet south of CIW station of 1923 which could not be accurately located.
-	-	12 24	69 59.8	
-	-	12 54	69 58.9	
-	-	15 31	69 57.1	
-	-	9 01	69 15.5	Exact re-occupation of CIW station of April 9, 1936, and of CIW station of 1912.
-	-	12 08	69 15.5	
-	-	13 47	69 15.8	
-	-	16 22	69 15.0	
-	-	9 36	69 15.0	
-	-	14 06	69 14.2	
-	-	-	-	
14 40	43300	10 34	67 19.4	Exact re-occupation of BANZARE dip station (1930).
-	-	-	-	
-	-	-	-	
-	-	-	-	Exact re-occupation of station of January 1, 1948.
-	-	1 17	67 23.4	
-	-	17 08	68 36.9	New station.
-	-			
-	-	12 24	68 37.5	Exact re-occupation of station of December 1947.
-	-	-	-	
-	-	12 40	78 14.9	Exact re-occupation of BANZARE station (1930).
-	-	-	-	
-	-	-	-	Observations with compass declinometer, and are of inferior accuracy.
-	-	-	-	
-	-	3 13	78 14.3	Exact re-occupation of station of March 1948.
-	-	-	-	

to track these disturbances across the eastern states of Australia. Over two years of observation marked seasonal changes[8] have been observed in the directions of movement, with sudden changes occurring near the equinoxes. A theory of these disturbances has been developed[9] according to which they are caused by cellular atmospheric waves about 200 km long. The inclination of the earth's magnetic field causes the F2 electron disturbance to appear to change phase with height; this gives the disturbances the appearance of having a vertical component of motion, although the true motion is entirely horizontal.

Other subjects investigated include the propagation of moon echoes through the ionosphere[10], the refraction of solar noise by the ionosphere[11], and the causes of errors in ionospheric forecasting services[12].

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Canberra
12 March 1951

BELGIQUE

RAPPORT SUR L'ACTIVITE SCIENTIFIQUE EN MAGNETISME ET ELECTRICITE TERRESTRES PENDANT LA PERIODE 1949-1951

Par EDMOND LAHAYE

Les enregistrements continus du champ magnétique terrestre

La station magnétique de l'Institut Royal Météorologique de Belgique, située à Uccle, a continué à enregistrer la déclinaison magnétique et la composante horizontale. Les enregistrements obtenus ont été satisfaisants, malgré le voisinage des lignes de tramways électriques et ce, grâce à des amortisseurs électromagnétiques.

La station magnétique de Manhay, dépendant de l'Université de Liège, a continué à enregistrer les 3 éléments: D, H, Z. Les résultats des observations ont été publiés régulièrement. En juin 1951, un nouvel enregistreur à marche rapide a été mis en fonction.

Des comparaisons pour la mesure de H ont été effectuées à l'aide de QHM entre les observatoires de Manhay, Cape Town, Elisabethville et Copenhague. Les calculs sont en cours. Les différences semblent être de l'ordre du gamma.

Levés magnétiques et stations de variation séculaire

Pour préparer l'exécution du prochain levé magnétique qui sera entre pris par le département du magnétisme terrestre et de l'électricité de l'Institut Royal Météorologique à partir de 1952, onze stations de variation séculaire ont été repérées en Belgique. Elles ont été choisies de manière à ne pas être influencées par les perturbations artificielles dues à l'électrification actuelle ou future des lignes de transports. Des mesures de H et de Z y ont été effectuées et les différences ont été calculées par rapport à la station de Dourbes, où doit être installé le nouvel observatoire magnétique destiné à remplacer la station d'Uccle. Le travail de réduction est en cours et les résultats seront bientôt publiés.

Des comparaisons entre la carte magnétique de la Belgique et d'autres cartes se rapportant à la géologie et à la géophysique (gravimétrie et séismologie) ont été abordées par E. Hoge qui étudie spécialement les anomalies magnétiques décelées dans l'est du pays.

Relations entre les phénomènes solaires et terrestres. Recherches sur l'ionosphere

Des études théoriques sur l'ionosphère ont été entreprises par M. Nicolet et L. Bossy et ont porté sur la théorie de la formation d'une couche ionisée avec une application à l'absorption des ondes courtes dans l'ionosphère. Une étude détaillée des mécanismes de photo-ionisation dans l'ionosphère a été publiée par M. Nicolet, en même temps que des considérations sur les recherches spectrales en relation avec l'ionosphère.

Dans l'étude des relations entre les phénomènes solaires et terrestres, M. Nicolet a fait une analyse très développée de l'émission des ondes radioélectriques du Soleil. Il a examiné les effets de l'activité solaire en fonction de la propagation des ondes courtes.

L'émission du rayonnement du ciel nocturne a été étudiée expérimentalement par P. Swings et M. Nicolet dans le cas du ciel crépusculaire. En collaboration avec D. R. Bates, M. Nicolet a effectué une recherche très développée sur la photochimie de la vapeur d'eau. Cette recherche est à la base de l'interprétation de mécanisme d'émission du rayonnement infra-rouge de la molécule OH (D. R. Bates, J. Hunaerts et M. Nicolet). D'autres recherches théoriques ont été effectuées sur le sodium et l'hydrogène atmosphérique par D. R. Bates et M. Nicolet. Enfin, ce dernier a proposé une nomenclature française pour la haute atmosphère.

Electricité atmosphérique

Un enregistreur de potentiel électrique de Benndorf a été installé à l'Institut Royal Météorologique d'Uccle. Il a été transformé en enregistreur photographique avec amortissement magnétique.

Une étude du potentiel électrique en fonction des masses d'air a été abordée par L. Koenigsfeld. En outre, un nouvel électromètre portatif avec son application à la radiosonde a été mis au point par L. Koenigsfeld et Ph. Piraux. Des mesures continues du potentiel effectuées en altitude et au sol permettent actuellement de vérifier leur relation avec les masses d'air, tant au sol qu'en altitude.

Des appareils de mesure des conductibilités électriques de l'air ont été réalisés par le Département de Magnétisme terrestre et Electricité de l'Institut Royal Météorologique.

Réalisation du Centre de Physique du Globe à Dourbes

Le Centre de Physique du Globe dont la création avait été annoncée au cours de la précédente Assemblée, est en bonne voie de réalisation. Le pavillon des mesures absolues du champ magnétique terrestre et la cave destinée aux enregistreurs seront terminés au cours de cet été et les appareils pourront donc être installés incessamment. La station sera en ordre de marche pour la fin de 1951.

Un enregistreur ionosphérique automatique à multifréquences sera également installé au cours de cet été.

La construction des pavillons destinés aux mesures d'électricité atmosphérique, d'électricité tellurique, du rayonnement solaire, à l'étude du ciel nocturne, etc. sera bientôt entreprise.

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CANADA

PROGRESS REPORT OF THE DIVISION OF TERRESTRIAL MAGNETISM, DOMINION OBSERVATORY, 1948-1950

By R. G. MADILL

Magnetic Surveys

One hundred and sixty-two Dominion Observatory magnetic stations, including fifty-one repeat, were occupied in the area between latitudes 45° and 83° N and longitudes 52° and 129° W. The stations were distributed as follows: Newfoundland, two repeat, seven new; Quebec, three repeat, fourteen new; Ontario, ten tepeat, fourteen new; Manitoba, nine repeat, three new; Saskatchewan, eight repeat, two new; Alberta, twelve repeat, twenty-five new; and Northwest Territories, seven repeat, forty-six new. Declination observations were made for the Division by officers of the Surveys and Mapping and Geographical Branches of the Department of Mines and Technical Surveys, at two hundred stations in Northern Canada as well as at many stations in Southern Canada. Officers of Provincial Governments and land surveyors contributed numerous declination data for many areas throughout Canada.

It is of interest to note that magnetic stations were established at Pasley Bay, Boothia Peninsula (lat. 70°.7 N, long. 95°.9 W) within fifty miles of the position of Ross's north magnetic pole of 1831; Pell Inlet, Bathurst Island (lat. 75°.9 N, long. 102°.2 W) within eight miles of the position of the magnetic pole as computed by foreign scientists for 1945; and on Ommanney Bay, Prince of Wales Island (lat. 73°.3 N, long. 100°.3 W) in the vicinity of the position of the magnetic pole computed from recent Canadian observations and analyses.

The mean magnetic results from these three stations, based on from twenty to fifty observations for each element over a period from twenty-six to forty-eight hours, are as follows:

Station	Lat.	Long.	Date	D	I	H	Z	F
Pasley Bay	70°42′	95°53′	Aug. 5- 6, 1948	25°40′W	88°59′N	1046	59081	59090
Pell Inlet	75 54	102 15	Aug. 8- 9, 1948	164 40 E	89 44 N	276	58457	58457
Ommanney Bay	73 16	100 21	Aug. 19-21, 1949	46 27 E	89 46 N	238	58461	58461

Magnetic Maps

The work of compilation, construction, and revision of magnetic maps and charts, formerly done by the Surveys and Mapping Branch, was transferred to the Dominion Observatory in November 1948. Since that time a declination map of Canada showing isogonic and isoporic lines for the epoch 1948.5 has been published. The construction of two isodynamic maps of Canada depicting vertical and total force and accompanying isopors for the epoch 1950.5 has been completed and publication of these two maps may be expected in 1951. Magnetic data applying to topographical map sheets and air and marine navigation charts have been supplied for 2050 items.

Magnetic Observatories

The magnetic observatories at Agincourt, Ontario, and Meanook, Alberta, were in continuous operation throughout the period. Photographic registration was made of the changes in the three magnetic elements, declination, horizontal, and vertical force. At Agincourt, one set of la Cour and one set of Kew type variometers were in operation. At Meanook, the Kew type for declination and horizontal force and two sets of la Cour variometers were employed. Abstracts from magnetograms were kept up to date and the schedules of absolute observations maintained. K-indices were supplied regularly each month to four scientific centers and photostats of both Agincourt and Meanook magnetograms were made available at regular intervals to Government Departments and commercial geophysical operators.

The establishment at Meanook was enlarged in 1948 by the construction of a modern office building and a power house. Plans and specifications have been prepared for the construction of a non-magnetic observatory building to replace that erected in 1916. It is expected that the construction will be finished in 1951 when the absolute and recording variometers will be moved from the old absolute building and attached basements to the new observatory where all instruments will be above ground. An office building similar to that at Meanook was constructed at Agincourt during 1950, and the Toronto office transferred to the site of the observatory.

A temporary magnetic observatory was established at Resolute Bay, Northwest Territories (latitude 74°42′ N, longitude 94°55′ W) in 1948. A prefabricated non-magnetic building was erected and one set of electrical recording variometers and one photographic recording la Cour declinometer installed. A photographic recording vertical force magnetometer was installed in 1950. The results from this observatory have been so encouraging that it is quite probable it will be continued on a more permanent basis. The temporary magnetic observatory established at Baker Lake, Northwest Territories (latitude 64°19′ N, longitude 96°02′ W) in 1947 was enabled to function more satisfactorily after a non-magnetic building was constructed in 1949. A set of la Cour photographic recording variometers was installed in 1950 to supplement the set of electrical recording instruments previously in use.

Instrument Design and Construction

The work of constructing absolute electrical magnetometers for survey and observatory use continued. Refinements were made in the circuits which resulted in better performance under adverse conditions encountered on magnetic surveys, simplicity in design, and a reduction in weight. These absolute instruments are now used at the northern observatories and on all magnetic survey operations. One valuable result of the use of this type of magnetometer arises from the fact that a set of observations comprises measurements of declination, inclination, and total force whereby sufficient data may be gathered at each station to determine daily variation in inclination and force which hitherto had not been possible unless several days were available for work at each station.

The development and construction of the universal airborne magnetometer continued. Satisfactory progress was made on the gyro-stabilization equipment and a device for determining the absolute vertical. Those parts of the apparatus tested during several flights gave encouraging performance and test flights of the entire experimental model have been arranged.

Research

Progress was made in mathematical analysis of the magnetic field in Canada with special reference to daily variations and disturbances in the Canadian Arctic. A comprehensive analysis of the main magnetic field in Canada was practically completed. Special attention was given to an analysis of secular change in all elements with the result that predictions for a few years ahead may be made with a considerable degree of certainty.

Publications

The magnetic survey results for the years 1938 to 1943, inclusive, are in manuscript form. No magnetic observatory publications were issued during the period but a resumption of these reports will begin in 1951.

Declination Results at Canadian Stations North of Latitude 60°N 1938-47, which is Vol. XI, No. 9, of the Publications of the Dominion Observatory, was issued in 1949.

PROGRESS REPORT ON ATMOSPHERIC IONIZATION IN CANADA, 1948-1951

By B. W. CURRIE

This report covers primarily activities in Canada that come to the attention of the Sub-committee on Atmospheric Ionization of the Associate Committee of the National Research Council of Canada on Geodesy and Geophysics. As such, it concerns itself with researches in atmospheric electricity, aurora and geomagnetic phenomena in so far as they indicate the ionic conditions of the atmosphere, ionospheric reflections of radio waves and meteor ionization. It does not concern itself with such matters as tropospheric propagation of radar waves, reflection of radar waves by precipitation, ozone content of the atmosphere and cosmic rays, each one of these fields of investigation falling more properly under the jurisdiction of other existing committees of the National Research Council.

Atmospheric Electricity

Little work is in progress in this field. Investigations by Currie and Pearce on the electrification of snow during blizzards showed that it is due largely to fracture of snow particles, a resultant negative charge appearing on the heavier particles and a corresponding positive charge on either very small ice particles or ions; and that the charge producing mechanism is most effective at high air velocities and at low temperatures.

Aurora

Auroral investigations in Canada are concentrated largely at the University of Saskatchewan, Saskatoon, and are supported mostly by grants and loans of equipment from the National Research Council and the Defense Research Board of Canada, and the Air Force Cambridge Research Laboratories (U.S.A.). Direction of these investigations is by Professors Petrie and Currie.

(a) Spectroscopic

Two spectrographs, one a grating instrument with a first-order dispersion of about 40 A/mm and the other a single-prism instrument with interchangeable glass and quartz optics, and with a dispersion of about 40 A/mm at 3600 A are in use. The former has been used largely in the spectral region from 7000 to 9600 A; and the latter in the visible and ultraviolet regions. The infra-red spectra include features due to low energy level atomic oxygen and nitrogen lines. The relative intensities of the oxygen lines indicate high excitation conditions; and of nitrogen that atomic nitrogen is present in considerable quantities during an auroral display. Nitrogen band intensities in the visible region have been determined showing that vibrational temperatures are high and emphasizing the discrepancy between rotational and vibrational temperatures. The band intensity studies are being extended into the ultra-violet, good spectra down to 3126 A having been secured.

Three high light-gathering power spectrographs are under construction. Each instrument will use a plane grating and a flat-field Schmidt camera, the gratings being ruled by the Bausch and Lomb Company, and the cameras being made by Dr. Meinel of Yerkes Observatory. These will be used to determine changes in the auroral spectrum with altitude and latitude; and to obtain reliable wave-lengths and intensities of the fainter spectral features.

Equipment has been constructed for measuring relative changes of intensity of selected auroral radiations. A rotating shutter pulses the light falling on either a photomultiplier cell or a caesium oxide or a lead sulphide cell; and the signal is recorded autographically after being amplified by a high-gain amplifier and rectified. At present filters are in use to isolate the radiations, but it is anticipated that a spectrograph will be used shortly for this purpose.

(b) Radar Studies

Two radar units, operating on frequencies of 3000 and 106.5 megacycles, respectively, have been used to search for radar reflections from aurora. No reflections were observed with the high-frequency set, but short-lived pulses of 10-cm radiation were picked up on the receiver. These came from the direction of the aurora, arrived in a random manner, and were more numerous with bright active displays. Each pulse appeared to be of one to five microseconds duration. Reflections were observed regularly with the low-frequency set when the aurora was in a direction corresponding to the primary lobe of the aerial array. This was at an angle of about 4° to the horizontal - corresponding to auroras at distances of 600 to 1000 km. Comparison of the photographs of the echoes taken on plan-position and intensity-range displays with simultaneous photographs of the aurora leaves little doubt the echoes originate either from the bright, lower edge of the aurora or from an ionized layer at a level close to the lower edge. Further investigations, involving the modification of the aerial array to get more energy into the higher lobes and the construction of an aerial to give a fan-shaped beam lying in the geomagnetic meridian and covering an angle of about 150°, symmetrical about the perpendicular to the zenith, failed to yield echoes. This suggests that the reflections are specular and take place from cylindrical columns of ionization with their axes in the direction of the magnetic field. However, a radar set with a frequency of about 56 megacycles will be used shortly in a further search for echoes from aurora. From the observations with the two sets, it may be possible to deduce the conditions and processes responsible for the echoes. At present, studies are proceeding on the development and fading of the echoes and on the changes in distance of reflections as picked up on the 106.5-megacycle set.

Auroral echoes have also been observed at Ottawa by McKinley and Millman using a 30 to 36-megacycle set in their studies of meteor ionization. Many of their echoes come from higher altitudes and shorter ranges than the ones observed at Saskatoon.

(c) Auroral Recorder

An auroral recorder (reported to the Oslo Meetings of I.U.G.G.), designed to indicate the occurrence and intensity of zenithal aurora, was operated at Saskatoon for two years. It has now been replaced by a recorder designed to scan the sky from horizon to horizon along a geomagnetic meridian. Light from the sky is reflected from a rotating mirror to a photomultiplier cell, the rotation pulsing the illumination. A cylindrical shield with an aperture of such a size that 4° of sky is scanned at any instant rotates about the same axis as the mirror so that the sky along the meridian is swept over once each five minutes. The signal, after suitable amplification, is recorded on a moving-paper recorder and also displayed on an oscilloscope. The display on the oscilloscope shows intensity and altitude. On occasion, this display is photographed on a moving sheet of photographic paper. The oscilloscope is used particularly for detailed studies of auroral displays, while the recorder is used as a patrol instrument designed to give the occurrence of aurora ranging from about 1000 km north of Saskatoon, to 1000 km south. Alternate sweeps with a filter transmitting a narrow band of wave-lengths centered on 5577 A and another centered on 5200 A serves to distinguish between auroral light and moonlight.

The zenithal recorder indicated a much greater auroral frequency at Saskatoon than is indicated by the published isochasms, aurora occurring on 148 out of 222 clear nights in 1949. The records for 1948 and 1949 show pronounced spring and autumn maxima in both frequency and intensity of aurora. However, they fail to show a consistent diurnal variation. Actually a particular pattern of diurnal variation may persist for a number of successive days with aurora, and then be replaced by a completely different pattern.

(d) Night Sky Brightness at Latitude 52°

Numerous measurements of the brightness of the night sky at Saskatoon, as part of a project initiated by E. O. Hulbert, Naval Research Laboratory, Washington, D. C., show that the brightness on clear nights without visible polar aurora is appreciably higher than at lower latitudes. A seasonal variation corresponding approximately to the seasonal occurrence of polar aurora and observations of sky luminosities when polar aurora is present suggest that the increase in brightness is due to light of polar auroral origin, which is probably always present.

(e) Statistical Studies

Measurements of all usable double-station parallactic photographs, taken at Chesterfield during the Second International Polar Year, 1932-33, and analyses of the visual records from Coppermine, Chesterfield and Cape Hopes Advance, made at the same time, are now complete. Preparation of this material in a form suitable for publication is still required.

Studies are under way of the diurnal and latitudinal variations in the orientation of auroral displays, using the large number of single-station photographs taken at Saskatoon in recent years in connection with other auroral projects. An investigation is also being made of the reliability of estimates of the maximum height of an auroral form by using single-station photographs and assuming that the lower edge is at the average height for the form in question and that the vertical extension of the form is parallel to the magnetic field.

(f) Investigations on Aurora at Other Places than Saskatoon

Analysis of visual auroral observations at points between Portage la Prairie (49.9° N., 98.3° W.) and Baker Lake (64.3° N., 96.1° W.), by J. H. Meek, Radio Physics Laboratory, Defense Research Board, indicate the presence of two zones of maximum occurrence of auroral light, one near Churchill (58.8° N., 94.2° W.) and the other about 3° of latitude farther south. Correlation of auroral light intensity with magnetic variations indicates that the latter is not as localized as the auroral light. During periods of increased ionospheric and magnetic activity, aurora increased in occurrence and in the width of the zone - particularly toward the south.

Studies have been initiated by Dr. G. M. Shrum, University of British Columbia, to correlate auroral observations in the Northern and Southern Hemispheres.

Ionospheric Ionization*

The network of ionospheric stations, operated in Northern Canada, was increased by three during the report period. These are located at Fort Chimo (58.2° N., 67.8° W.), Baker Lake (64.3° N., 96.1° W.), and Resolute Bay (74.7° N., 94.9° W.). A mobile ionospheric observatory was operated along the railway lines between Portage la Prairie and Churchill during the year from August, 1948, to August, 1949. Airborne measurements of the D level height and reflection coefficient were made on 540 kc as a function of position, and measurements of ionization and absorption in the high frequency range were begun with an airborne pulse recorder. Particular investigations by the Radio Physics Laboratory include magneto-ionic theory of an inhomogeneous medium, low and medium frequency investigations of the D and E levels, sporadic E ionization, attenuation of echoes from the ionosphere, ionospheric winds and tides and magnetic fields at ionospheric levels.

(a) Mobile Ionospheric Observatory

This consisted of a railway coach, equipped with a 10 kw manually operated ionospheric unit, an auroral intensity recorder, electrical magnetometers recording D and H or Z, a standard Loran receiver, a standard communication receiver with signal strength recording attachment and a 500 watt high frequency communications transmitter. Sporadic E ionization was found to increase northward to a maximum about 150 miles south of Churchill, to be chiefly a night-time phenomenon, to show no seasonal changes other than those due to the change of night duration, and not to be correlated with general ionospheric disturbance. Amplitude of echoes from the ionosphere at points north of Portage la Prairie showed far greater momentary fluctuations than at more southerly stations. During quiet days, attenuation appeared to be due to the normal solar effect without evidence of additional auroral zone effects, other than the occurrence of a minimum value well before midnight. At night, greater attenuation was observed on echoes from the E region than from the F region. Attenuation increased markedly during ionospherically disturbed days. There was no indication of two maximum zones of attenuation.

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* Prepared in part from notes submitted by J. C. W. Scott and J. H. Meek, Radio Physics Laboratory, Defense Research Board of Canada.

(b) Sporadic Ionization at High Latitudes

Ionospheric records, showing rapid or erratic variations in frequency or vertical height as compared with the normal region traces, are quite common at northern Canadian stations. Four distinct types of F-region sporadic ionization and five of E-region sporadic ionization are recognized. Estimates of the speeds of some of the sporadic "ionized clouds" over Baker Lake range from 400 km per hour for clouds at 100 km virtual height to 1200 km per hour for clouds at 300 km virtual height.

(c) Magnetic Fields at Ionospheric Levels

Simultaneous measurements of the ordinary and extraordinary critical frequencies have been made at a number of ionospheric stations for both the E and F levels over several years. From these measurements the gyro-frequency of the magnetic field of the earth at these levels is calculated. The results show very large (over 20 per cent) diurnal, seasonal, and long-term variations in the apparent magnetic field at levels of 100 and 300 km. When compared with the field measured at ground level and extrapolated to ionospheric heights the apparent field is usually too high in the F layer and too low in the E layer. An explanation for the results in the F layer has been found in the lateral deviation and separation of the ordinary and extraordinary rays together with the variation of ionization with latitude. These effects in the E layer are small and in the wrong direction to explain the measured variations. Calculations of the effect of negative ions on the measured gyro-frequency have been made, which indicate that the E layer variations may be due to a variable concentration of these ions, giving a ratio of negative ions to free electrons which rises to over 4000. At Resolute Bay (74.7° N., 94.9° W.) in the summer polar day, a large semi-diurnal variation in the apparent field (or the ion-electron ratio) is found with the maxima in the apparent field occurring at 06 and 18 hours local time and a minimum at noon.

(d) Propagation in an Inhomogeneous Anisotropic Medium

The propagation of waves through non-absorbing inhomogeneous media has been investigated. It was shown that results usually obtained by approximate methods for such propagation may break down under certain circumstances. Exact solutions of the propagation equation are available for artificially constructed media; these media can be made very similar to any naturally occurring medium. It was shown that waves can completely pass through certain distributions of ionization which, on the classical ray theory, would be totally reflecting.

(e) Ionospheric Winds

The signals from a single pulse transmitter are received after reflection from the ionosphere, on three receiving systems situated at the corners of a right-angle triangle of about 100 meters side. On some occurrences the fading records obtained in this way show excellent correlation and on others there is no correlation. A time displacement between any pair of similar records is assumed to indicate a wind at or below the level of reflection, and the speed and direction of the wind may be deduced from the three records. Winds with velocities of about 80 meters/sec were commonly observed. On some occasions wind of much higher velocities (300 meters/sec) were observed, and there is some evidence to show that these were associated with ionospheric storms. This work is continuing and experiments are proceeding to obtain information regarding the meaning of the fading phenomenon.

Ionization by Meteors*

(a) Technique

In August, 1947, the Dominion Observatory and the National Research Council, Ottawa, commenced a point program of meteoric observations, using visual, photographic, and radio techniques. During an observing period a group of trained observers scan the sky and plot visual meteors, marking the time of their appearance on the radar record by means of a hand-operated visual marker light. Several direct and spectrographic cameras are also employed. These are usually mounted behind rotating shutters which divide the photographed meteor trail into segments, from which the meteor velocity can be measured, and certain properties of the persistent train luminosity determined. Three radar stations operating in the band 30-36 mc/sec with peak pulse powers from 50 to 400 kw, and located at Ottawa, Arnprior and Carleton Place, are used to produce range-time records of meteor echoes. The positions and heights of the clouds of meteoric ionization are found by triangulation. A continuous-wave transmitter (2 kw on 30 mc/sec) at Ottawa with a receiving station at South Glocester produce amplitude-time radio records of meteors from which the meteor velocities can be found, and by which other phenomena associated with the diffusion, recombination and wind motion of the ionized cloud left after the passage of the meteor can be studied. Photoelectric methods of observing meteors are under development.

(b) Conclusions

Some contributions to the astronomical knowledge of meteors have been made with the new radio frequency techniques but these will not be discussed here. A new phenomenological theory has been evolved to explain the various types of radar and radio echoes. It is suggested that there exists in the upper atmosphere an M-region in which most meteor echoes occur with a maximum between heights of 90 and 100 km. Diurnal and annual fluctuations in height, thickness and ionizing ability are recognized, and the presence of fine structure within the region in the form of striae, patches or layers is postulated to account for some of the complex meteor echoes observed. Analysis of the continuous-wave amplitude-time records indicates that for the majority of meteors the received echo is a summation of the echoes scattered from all parts of the long thin column of dense ionization formed behind the meteor by collision processes. For some of the brighter meteors a moving radar echo appears to accompany the meteor and its presence is not well understood but has been tentatively explained by ultra-violet light from the meteor momentarily ionizing a large volume around the meteroid. In a few special cases the deceleration of the meteor has been measured from the geometry of the radar range-time echo record. Taking the strength of the initial radar echo, and using Lovell's scattering formula to compute the electron density along the meteor path, it is indicated that between 10^{-6} and 10^{-8} of the kinetic energy of the meteor is converted to ionization, assuming standard values of air density. The long durations of echoes associated with the brighter meteors, however, would suggest that a much larger fraction of the total energy is eventually channeled into producing or maintaining ionization. It has been found that the mean height of radio echoes from shower meteors increases with the shower velocity. Detailed examination of a few selected bright meteors together with a statistical analysis of a large number of fainter meteors suggests

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* By Dr. P. M. Millman, Dominion Observatory, Ottawa, and Dr. D. W. R. McKinley, National Research Council of Canada, Ottawa.

strongly that the amount of ionization produced by the meteor is a function of the velocity, though the law is not yet known. Long-enduring echoes, of the order of a few minutes to a few hours, are now under study, including echoes from meteors, echoes from the aurora, and a faint wide echo that is seen occasionally at a range of 80-100 km. Moderate success has been achieved in preliminary tests of the photoelectric meteor detector. Accurate relative timing between radar echoes and photocell signals available by this technique may be of aid in understanding ionization-luminosity processes.

Spectrographic studies of shower meteors have confirmed a previous conclusion that lines of the ionized atoms appear generally in the spectra of meteors with geocentric velocities greater than 40 km/sec, and are absent in the spectra of meteors with velocities less than 30 km/sec. Some photographic evidence as to the physical nature of the persistent trains of meteors has been secured. It is indicated that the luminosity of the persistent train is a recombination spectrum involving atoms common in the light of the associated meteor. The average duration of the persistent train is related to the geocentric velocity and the mean visual magnitude of the meteors. This relation is similar to that found for the duration of the radar echoes from bright meteors.

(c) Future Plans

Radar and continuous-wave systems are under construction with higher power and better resolution than existing apparatus. Additional spectrographic observations are planned, particularly in the infra-red. A card index of radar-visual meteors is being compiled which will furnish statistical data for a number of problems now under consideration. Correlations among meteor luminosities, heights, velocities, path lengths, echo durations, echo types and other physical characteristics will be studied.

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University of Saskatchewan
Saskatoon, Saskatchewan
November 15, 1950

DENMARK

REPORT ON MAGNETIC WORK IN THE YEARS 1948-1950

Part I

By J. EGEDAL

The magnetic observatory at Rude Skov has functioned without interruptions during the period from 1948-1950. Records of normal speed from sensitive and insensitive variometers, as well as records from a la Cour quick-run recorder, were obtained. The orientation of the magnetic axes of the magnets of the variometers was closely examined in 1948, and since then controlled (Resolution 3, Edinburgh 1936, and Resolutions 4a and 10e, Washington 1939). The absolute measurements have been carried out as in former years. For the determination of magnetic declination and inclination zero-corrected instruments have been used (cfr. Trans. p. 532-534, and Resolution 4b, Washington Meeting 1939). A great number of measurements have been made in order to determine the constants of the different la Cour magnetic instruments delivered abroad by the Danish Meteorological Institute, and of the constants of QHM's belonging to the Association to be used for international comparisons and for measurements of the range of the daily variation of H in the equatorial region.

The modified type of the Godhavn Balance, TZ, (Terr. Mag., 50, 241, 1945) has functioned so well that it is now used as the main Z-variometer for direct readings at the observatory.

In 1950 measurements have been made at all Danish secular variation stations.

Field observations have been made in the years 1948 and 1949 in order to make the magnetic survey of Denmark more complete. The distance between the stations for horizontal and for vertical force was about 4 km, and between stations for declination about 8 km. Using older determinations, corrected by means of the secular variations found from the measurements in 1950, a magnetic chart for declination 1951.5 has been worked out.

The instruments constructed for magnetic measurements to be carried out from the ship "Galathea" of the Danish Deep Sea Expedition have been examined and controlled at the Rude Skov observatory.

The magnetic observations from the observatory at Rude Skov and from the secular variation stations have been published in Annuaire Magnétique, 1ére Partie, Le Danemark. The Annuaire Magnétique has been issued regularly, the observations from one year being published in the succeeding year.

Part II

By J. EGEDAL and V. LAURSEN

The magnetic observatory at Godhavn has been functioning without interruption during the period under review. Mr. K. Lassen has been in charge of the station, replaced during his vacation in Denmark in the summer of 1949 by Mr. M. N. Skottfelt.

The instrumental equipment is unchanged. Sensitive and insensitive normal records of D, H and Z, as well as quick-run records (180 mm/h) of the same elements, are available.

Every year a QHM and a BMZ have been sent from Denmark to Greenland to insure that the results obtained at Godhavn were in accordance with the values of the Rude Skov observatory.

The cosmic-ray observatory at Godhavn, established in 1938, has continued in operation. The records are sent to the Carnegie Institution of Washington for examination. A radiation of exceptional intensity and persistence was recorded on November 19, 1949.

The results of the magnetic observations made at Godhavn are being published in the Annuaire Magnétique II, le Groenland, of which the volumes covering 1931, 1939, 1940 and 1941 have been completed and published during the period.

Also the magnetic observatory at Thule, established in 1947, has been in continuous operation. Observers in charge have been Mr. F. P. Dahlkild 1948-1949, Mr. L. Jensen 1949-1950, and Mr. V. Jensen 1950- . The magnetic records are currently compared with the records of a cosmic-ray equipment set up at Thule by Mr. Singer from the Johns Hopkins University.

As a part of the program of the Danish Pearyland-expedition, conducted by Mr. Eigil Knuth, magnetic observations have been made at a station in Pearyland (82°.2N, 31°.3W) between December 1948 and July 1950. The observations comprising about 100 single determinations of D, H and Z, have been made by Dr. J. Troelsen and Mr. Th. Nielsen; the results will be published in "Meddelelser om Grønland".

Part III

REPORT ON THE MAGNETIC MEASUREMENTS IN CONNECTION WITH THE DANISH DEEP SEA EXPEDITION ROUND THE WORLD 1950-52

By NIELS ARLEY

The Danish Deep Sea Expedition Round The World 1950-52 is primarily a zoological expedition organized by the Zoological Museum of the University of Copenhagen in cooperation with the Danish Navy. Its task is to investigate the animal life of the great depths of the oceans below, say, 4000 m and especially in the Indian and Pacific oceans. For this purpose the ship of the expedition, "Galathea", is equipped with a longer wire and more powerful winch than previous deep sea expeditions. Due to this fact and the fact that the construction of magnetometers of high precision has been especially developed in Denmark through the work of the late D. la Cour, it was thought a natural task to take up on the "Galathea" expedition also the problem of measuring the variation of the magnetic field of the earth with depth below sea level. The problem of the origin of terrestrial magnetism being still an open question, such measurements may further elucidate this problem which has become of special interest through the recent works of Bullard, Blackett and Elsasser. Through cooperation between the Institute for Theoretical Physics, University of Copenhagen, The Danish Meteorological Institute, and The Laboratory for Telegraphy and Telephony, Denmarks Institute of Technology, and by means of a grant from The Carlsberg Foundation, the following work has been done since this project was started in 1949.

Mr. J. Egedal, Danish Meteorological Institute, has been responsible for the construction of (a) a self-recording H-balance-magnetometer, and (b) a self-recording H-coil-magnetometer. Mr. Johannes Olsen, Danish Meteorological Institute, has been responsible for the construction of (c) a self-recording Z-balance-magnetometer. The principle of (a) and (c) is that the deflection of a magnetic needle of the la Cour monad type from respectively a vertical and a horizontal position is measured optically on a moving photographic film. The principle of (b) is that the alternating current induced in a coil rotating about a vertical axis is amplified by an electronic amplifier, the amplification of which is inversely proportional to the frequency with which the coil rotates. The amplified current is then recorded by means of a magnetic recorder. Mr. G. Bruun, Laboratory for Telegraphy and Telephony, has directed the construction of this amplifier. In all three instruments most of the field to be measured is compensated by suitable magnets so that only a small fraction is actually measured.

Finally, Dr. N. Arley, Institute for Theoretical Physics, has been responsible for the organization of the project and the construction of the non-magnetic spheres containing the instruments and protecting them against the pressure of the water, being at the greatest measured ocean depths about 1000 atmospheres. For this purpose a quite new bronze alloy has been produced by Mr. B. Lunn of Messrs. Paul Bergsøe and Son, Copenhagen, being at the same time non-magnetic and sufficiently strong, having an elastic limit of about 28 kg/mm^2 and a tensile strength of 70-80 kg/mm^2 at an elongation of 10-20 per cent. Of this material Messrs. Burmeister and Wain, Copenhagen, have constructed a single sphere, internal diameter 50 cm, wall thickness 10 cm, weight 1100 kg, to contain successively the instruments (a) and (c), as well as a double sphere consisting of two single spheres, of about the same dimensions as those of the first one, connected by a tube about 100 cm long. The total height of the double sphere is 2.5 m and the total weight 1700 kg. The lower sphere contains the rotating coil, the upper one the motor driving the coil and its batteries, the amplifier and the recorder.

"Galathea" left Copenhagen on October 15, 1950, and from November 8 to December 19 the following work has been done. First of all both spheres have been tested for water-tightness on various depths down to 4500 m. The double sphere was completely water-tight at once and the single one was made so after some experimentation. Next all three instruments were tested on various depths down to 2500 m.. The results of these tests showed that various alterations had to be made on the instruments. As soon as this work has been completed, the instruments will be tested again.

Apart from this project we plan to take up bottom cores by means of Dr. Kullenberg's core-sampling device and, in cooperation with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, to have these cores analyzed for residual magnetism. Hereby we hope to throw some light on the terrestrial magnetism in previous geological periods.

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FINLAND

REPORT OF THE FINNISH NATIONAL COMMITTEE, 1948-1951

By E. Sucksdorff

A. Geophysical Observatory, Sodankylä

The reconstruction, following the destruction of the Observatory of the Finnish Academy of Science has advanced so far that the main building, consisting of living quarters for the observer-in-charge and his assistant, office room, laboratory, fireproof archives, etc., was completed in 1950. At the same time, a meteorological-aerological observatory (owned by the Meteorological Office) was completed in the immediate neighborhood of the Geophysical Observatory. Meteorological observation work, which since 1914 had belonged to the Geophysical Observatory, was transferred in its entirety to this new Observatory.

The inauguration ceremonies of both these observatories were held on September 2, 1950, in Sodankylä. In connection with these ceremonies, a five-day Nordic Geophysical Conference was held, with participants from Denmark, Norway, and Sweden, at which questions of common interest were discussed. At this time, also comparisons of the magnetic field instruments of the Nordic countries were carried out.

The Observatory, however, still functions on a comparatively modest basis. A normal la Cour magnetograph has been running since 1946. It is planned to have also a quick-run recorder and a low-sensitivity recording set in operation in the autumn of 1951.

Mr. T. Hilpelä, M. A., acted as observer-in-charge until the end of October, 1950, and from then on, Mr. E. Kataja, M. A.

B. Geophysical work of the Meteorological Office, Helsinki

During the summer of 1948, 12 magnetic secular stations were reoccupied and, in the summer of 1949, 24 stations. During the summer of 1950, 31 points on the Gulf of Bothnia were measured in cooperation with the Swedish Hydrographic Office (Kungliga Sjökarteverket) on board the Swedish surveying ship "Kompass". This being done, the magnetic exploration of the Gulf of Bothnia, begun in 1939, was completed. Dr. N. Ambolt acted as the Swedish magnetician, and Dr. E. Sucksdorff as the Finnish magnetician.

Magnetic theodolite Chasselon No. 82, QHM's Nos. 84, 85, and 86, and BMZ's Nos. 25 and 31, have been used for making land surveys. These instruments have been compared with Swedish instruments at Lovö in 1948, and at Sodankylä in 1949, with Danish, Norwegian, and Swedish instruments at Lovö and Sodankylä in 1950.

The planned new geophysical observatory of South Finland is now about to materialize. The observatory is located in Nurmijärvi, about 50 km north of Helsinki, at $\phi = 60°30'.5$ N, $\lambda = 24°39'.3$ E. The Meteorological Office has obtained for the observatory an area in the State Park of approximately 8 hectares; the area is fairly homogeneous magnetically; on two sides it borders on a lake, and it is likely to remain undisturbed for a long time to come. The magnetic variation house and the absolute house have just been completed, and it is expected that the installation of instruments can be made during the autumn of 1951. The variation house has been built on a hill side, and is half way sunk into it. It will have both normal, quick run and low sensitivity magnetic recording sets.

Of other geomagnetic work performed in the Meteorological Office, the following are worth mentioning: statistical investigations of bay disturbances at Sodankylä during 30 years, from 1914 to 1943; investigations of magnetic activity in Sodankylä, on the basis of hourly ranges, for the years 1935-1944; orientation investigations on the quick run records taken during the Polar Year for the following observatories - Thule, Godhavn, Sveagruvan, Julianehaab, Reykjavik, Tromsö, Abisko, Petsamo, Sodankylä, Lycksele, Kajaani, Lovö, and Rude Skov. This latter work was performed at the request of the Temporary Commission of the Liquidation of the Polar Year of 1932-33. In addition, sudden commencements are being investigated from the records of the following observatories - Björnöya, Matotchkin Char, College Fairbanks, Fort Rae, Sitka, Eskdalemuir, Meanook, Niemegk, Abinger, Ebro, Alibag, Mogadiscio, Elisabethville, Cape Town, Christchurch, and Magallanes. This work is as yet not fully accomplished.

Visual observations have been made on the aurora at Sodankylä and at the climatological stations of our country.

C. Publications

Ergebnisse der magnetischen Beobachtungen des Observatoriums zu Sodankylä im Jahre 1939.

Ergebnisse der magnetischen Beobachtungen des Observatoriums zu Sodankylä im Jahre 1940 (in print).

E. Sucksdorff: Ergänzende Daten betreffs der erdmagnetischen Aktivität in Sodankylä in den Jahren 1914-1934.

J. Keränen: Maamagnetismi Suomessa (Earth magnetism in Finland). Suomen Maantieteen käsikirja (Geographic handbook of Finland). The paper contains a short review with magnetic charts for D, H, and Z for 1948.5.

Meteorological Office, Helsinki
August 1951

FRANCE

RAPPORT DE LA SECTION DE MAGNÉTISME ET ÉLECTRICITÉ TERRESTRES SUR LES TRAVAUX DE 1948 À 1951

Par le Secrétaire E. THELLIER

I. Magnétisme Terrestre

A. Mesures géomagnétiques

Appareils. G. Grenet a proposé et réalisé un dispositif nouveau pour l'étude des variations rapides du champ terrestre, qui utilise les courants induits dans une bobine fixe, par les déplacements d'un gros aimant de variomètre. Il a développé les calculs relatifs à l'ensemble de l'appareil (aimant, bobine et galvanomètre) qui présentent des analogies étroites avec ceux relatifs aux séismographes électro-magnétiques (69, 70). J. Castet en a fait une première réalisation (23).

Observatoires. Les observatoires de Chambon-la-Forêt et Nantes, en France métropolitaine, de Tamanrasset au Sahara et ceux de Tananarive (Madagascar), Ksara (Liban) et Zo-Sé (Chine) dirigés par les RR. PP. Jésuites, ont poursuivi régulièrement leurs observations. Les résultats de ces observations sont publiés ou résumés dans les Annales de l'Institut de Physique du Globe de Paris, sauf en ce qui concerne l'observatoire de Zo-Sé qui les publie directement.

L'observatoire nouveau de M'Bour, au Sénégal (16°57'35'' W, 14°22'58'' N) est maintenant sommairement équipé et il doit entrer en fonctionnement régulier à partir du 1er Mars 1951.

L'expédition polaire française installée en Terre Adélie (continent antarctique) a établi une station magnétique (Port Martin, 66°50' S, 141°25' E) qui doit fonctionner au moins pendant l'année 1951.

Réseaux magnétiques généraux. Un certain nombre de mesures de déclinaison on été effectuées par le Service hydrographique de la Marine, sur les côtes de France, d'A.O.F., du Maroc, de Tunisie et sur des îles du Pacifique. J. Dubief a effectué des mesures magnétiques complètes (D, I, H) en 104 stations dispersées sur toute l'Afrique française (40).

A. Lasserre et Melle Malbos ont rassemblé les résultats des mesures de la composante horizontale effectuées en Algérie Tunisie à différentes époques. Après discussion de la variation séculaire et calcul de valeurs approchées (ramenées à 1938.0), ils ont pu tracer une carte de H s'étendant assez loin vers les territoires du Sud (88).

Réseaux magnétiques locaux. Des études magnétiques locales conduites en vue de recherches volcanologiques on apporté d'intéressantes données sur les anomalies magnétiques inversées: L. Godard a prospecté des coulées volcaniques d'Auvergne (64); A. Roche, combinant la prospection magnétique et la détermination de l'aimantation d'échantillons de roche à orientation repérée, a étudié les venues volcaniques de plateau de Gergovie (109) et des massifs péperitiques en Limagne

(110). E. Le Borgne a fait une étude approfondie des anomalies magnétiques (composante Z) sur une grande surface en Bretagne centrale (89).

D'importantes campagnes de prospection magnétique industrielle ont été effectuées par la Compagnie générale de Géophysique (C.G.G.) qui a établi des cartes magnétiques de Z sur de grandes surfaces, au Maroc et au Gabon en particulier.

B. Etudes sur les variations du champ terrestre

Variations régulières. P. Rougerie, poursuivant son étude de la variation diurne lunaire du champ terrestre, a conduit, sur la composante verticale, un travail analogue à celui qu'il avait présenté antérieurement sur la Déclinaison (117). Ré-emment, il a rassemblé l'ensemble de ses résultats en les discutant et les comparant aux résultats antérieurs (118).

Répondant aux recommandations du "Committee to promote daily observations of horizontal force between and near the geographic and magnetic equators", L. Pontier, géophysicien de l'O.R.S.O.M. (Office de la Recherche scientifique d'Outre-mer) a effectué au Togo des mesures au Q.H.M. étendues sur toute la journée. Il a fait ainsi plusieurs jours d'observations en 5 stations situées de 0°55 au Nord de l'Equateur magnétique à 3°20 au Sud (107).

Variations irrégulières. P. Bernard compare, pendant le cycle solaire 1936-1947, les variations d'année en année de phénomènes solaires et de divers phénomènes de l'agitation magnétique: nombre de perturbations et leurs amplitudes, nombre de débuts brusques et leurs amplitudes (10). M. Burgaud a rassemblé les résultats de ses études antérieures sur les relations entre les éruptions chromosphériques et les orages magnétiques, en s'aidant surtout des crochets magnétiques (20). A. K. Das et R. Anantkakrishnan recherchent (4 cas, 1949), s'il existe une corrélation entre les disparitions brusques des protubérances solaires et les perturbations magnétiques (34).

P. Giacomo a étudié au moyen d'un cadre, constitué par une simple boucle de 250 m de diamètre, les oscillations rapides du champ terrestre; il observe une agitation complexe correspondant généralement à des baies et des oscillations plus ou moins régulières (59).

Perturbations industrielles. G. Dupouy a effectué une étude fouillée des perturbations magnétiques et telluriques dues au chemin de fer électrifié de Paris à Orléans; c'est, de beaucoup, le travail le plus important publié sur cette question des perturbations ferroviaires intéressante à divers points de vue (52).

C. Géomagnétisme fossile et aimantation des roches

Melle J. Roquet a poursuivi l'étude des aimantations rémanente isotherme et thermorémanente du sesquioxyde de fer, de terres cuites et de magnétite en grains fins dilués; elle a, en particulier, exploré le domaine des champs intenses et approfondi l'étude de la désaimantation par recuit (111, 112, 113, 114). E. Thellier et Mme Thellier ont déterminé les aimantations rémanentes et les susceptibilités d'une collection de roches volcaniques pyrénéennes de A. Lacroix (123).

Rassemblant l'ensemble des propriétés expérimentales des aimantations rémanente isotherme (A.R.I.) et thermorémanente (A.T.R.) des terres cuites et des roches (viscosité magnétique, saturation, indépendance des aimantations thermo-rémanentes acquises par un objet dans différents intervalles de température), L. Néel en a proposé une théorie étendue (101). Observant d'abord que ces propriétés appartiennent à des minéraux variés, il admet qu'il faut les attribuer à une propriété physique commune à tous ces corps: la division en particules si fines qu'elles constituent chacune un domaine élémentaire. Développant des calculs relatifs aux propriétés d'un ensemble de tels grains monodomaines, en tenant compte de l'agitation thermique, L. Néel dégage les idées de temps de relaxation et de température de relaxation et il arrive ainsi à expliquer tous les faits expérimentaux. Les travaux de Ch. Guillaud sur le champ coercitif des poudres ferromagnétiques fournissent le point de départ et la base solide de ces déductions (71, 72).

Au Colloque du Centre national de la Recherche scientifique sur le "Ferromagnétisme et l'antiferromagnétisme", E. Thellier a présenté un rapport étendu sur l'état actuel des études sur les propriétés magnétiques des terres cuites et des roches (122). Sous le titre "Problèmes de Géomagnétisme" ont été publiées par A. Dauvillier des conférences-rapports faites au Congrès de l'A.F.A.S. (Genève, 1948) par lui-même, J. Rothé, R. Jouaust et E. Thellier sur des sujets variés de magnétisme terrestre (37).

D. Théories sur l'origine du champ moyen

C. Sălceanu propose une explication de la théorie gyromagnétique de Blackett par l'existence d'une charge électrique spatiale de la Terre (119). S. Chapman calcule la variation des composantes du champ terrestre, en fonction de la profondeur, à l'intérieur du globe, dans l'hypothèse de Blackett et dans l'hypothèse d'une sphère intérieure uniformément aimantée, afin de tenter une discrimination entre les deux théories, à partir des mesures faites dans des mines profondes (24). A. Giâo s'est intéressé au même problème en déduisant la variation du champ en profondeur de sa théorie unitaire de la gravitation et de l'électromagnétisme (60, 61); puis il a développé sa théorie pour expliquer le champ terrestre régulier et ce qu'on croit connaître du champ magnétique général du soleil et des étoiles (62, 63). A. Dauvillier et P. Henry, partant d'une observation de Sucksdorff sur la réduction de l'activité magnétique lorsque la lune, Vénus ou Mercure, se trouvent entre la Terre et le Soleil, l'interprètent en admettant un effet d'écran par l'ensemble du champ magnétique de l'astre; la théorie de Blackett prévoyant pour ces corps un champ beaucoup trop faible pour expliquer un tel effet, ils voient là un argument nouveau contre elle (36).

II. Courants Telluriques

L. Cagniard a fait une étude théorique détaillée de la propagation de courants électriques dans un sous-sol qu'il complique progressivement, en insistant sur l'importance des phénomènes de réfraction des lignes de courant et d'anisotropie (22).

Melle Y. Beaufils a recherché, par analyse harmonique, des corrélations entre des variations telluriques rapides en des stations très éloignées les unes des autres et entre variations telluriques et magnétiques (8, 9).

L'activité des équipes de prospection tellurique de la C.G.G. (Directeur général: L. Migaux) a été très importante pendant les années 1949 et 1950. De grandes surfaces ont été prospectées par ce procédé: en France, en Italie, au Maroc, en Algérie, en A.E.F., à Madagascar, en Assam. Plus de 20.000 mesures ont été effectuées durant ces deux années.

III. Électricité Atmosphérique (troposphère)

A. Appareils

Pour mesurer le taux de production d'ions dans l'air, P. Pluvinage et R. Utzmann ont construit une chambre d'ionisation dont la paroi est réduite à un treillis métallique entouré extérieurement d'une enveloppe à paroi mince dont la distance au treillis est supérieure au parcours des rayons α dans l'air. On peut ainsi, avec une chambre de petites dimensions, éliminer l'erreur provenant de l'arrêt des particules α dans la paroi de la chambre (106).

A. Godefroy a perfectionné des appareils antérieurs et réalisé un électromètre électronique enregistreur qu'il a équipé pour la mesure des conductibilités positive et négative de l'air et pour la détermination de la charge spatiale totale ou, avec adjonction d'un séparateur, des charges spatiales positive et négative. Son dispositif le plus récent permet la mesure simultanée des conductibilités et des charges sur un enregistreur à deux directions (12).

P. Molard et J. Jolivet, à l'observatoire du Morne des Cadets (Martinique), ont installé, avec du matériel radio ordinaire, un appareil mesurant à intervalles réguliers la charge acquise par une électrode isolée; ils ont appliqué ce procédé à l'étude de la charge électrique de la pluie et à la mesure de la conductibilité électrique de l'air (99).

L. Godard et C. Lafargue ont mis au point (observatoire du Puy de Dôme) une méthode, du type Millikan, pour la mesure absolue des charges électriques portées par de fines particules naturelles (brouillard) ou artificielles; une nouveauté de leur dispositif est l'emploi de silicones comme liquide de captation, ces corps ayant l'avantage d'être des isolants et des hydrofuges excellents (65).

Durant le séjour forcé qu'il fit à Troyes pendant l'occupation, P. Langevin s'était livré à l'étude théorique très fouillée d'un analyseur de mobilités d'ions gazeux. Son travail a été publié après sa mort (87) et récemment l'appareil qu'il avait ainsi conçu et calculé a été réalisé (100). Bien que le dispositif ne se prête pas directement à l'étude des ions atmosphériques, les géophysiciens trouveront dans l'ensemble de ce travail des indications et des leçons précieuses.

B. Mesures sur le champ électrique et l'ionisation

Au cours de l'expédition française au Groënland pendant l'été 1948, P. Pluvinage a effectué des mesures de champ électrique, de conductibilité et de taux de production des ions de part et d'autre de la bordure de l'inlandsis sur la côte ouest (104). De nouvelles mesures ont été effectuées, sur l'inlandsis, jusqu'à la station centrale, pendant les nouvelles campagnes de 1949, par P. Pluvinage et G. Taylor (105) et 1950 par G. Taylor et P. Stahl.

J. Rouch a effectué des mesures de champ électrique au Musée océanographique de Monaco (115, 116).

G. Vassails a fait une étude étendue des ions de l'air, portant principalement sur la "nucléation" ou formation de noyaux par action sur l'air pur de rayonnements U.V. ou X (124).

H. Gondet a étudié le problème, d'intérêt théorique et pratique, de l'électrisation des avions en vol: mesure des charges, mécanisme de leur formation, déperditeurs (66).

C. Etudes sur l'équilibre électrique dans la basse atmosphère

J. Bricard étudie la captation des petits ions par les noyaux de condensation en admettant l'existence de gros ions à charges multiples. Appliquant les relations qu'il obtient ainsi à des résultats de mesures faites avant la guerre à Chambon-la-Forêt, il trouve un accord très satisfaisant (13, 14).

D'importantes études de H. Israël (79) et de H. Israël et H. W. Kasemir (80) sur l'équilibre électrique de tout l'ensemble de l'atmosphère située au-dessous de l'ionosphère ont été publiées dans les "Annales de Géophysique".

D. Electricité des nuages et foudre

R. Lecolazet a poursuivi ses mesures de champ électrique, en planeur, au voisinage et à l'intérieur des cumulus de beau temps, et il a interprété ses résultats en considérant l'existence de trois milieux schématiques: air pur, couche de brume et nuage (90, 91, 92, 93). Avec P. Pluvinage, il a calculé la répartition du champ dans quelques cas schématisés et montré que les prévisions faites ainsi étaient en bon accord avec l'expérience (94).

M. Sourdillon qui effectue des enregistrements d'éclairs à la chambre de Boys a publié quelques résultats (120).

G. Grenet a proposé une explication nouvelle du mécanisme de la charge des nuages orageux (68).

Une étude étendue du spectre des éclairs a été effectuée par J. Dufay et Tcheng Mao-Lin à partir d'observations faites avec des spectrographes à fente, dans le visible (45, 46) et par M. Dufay et J. Dufay avec des observations faites au prisme objectif (48).

IV. Géoradioactivité

Mme A. Hée a poursuivi l'étude de la radioactivité des roches par la méthode électrométrique (74), mais elle a inauguré d'autre part l'emploi de la méthode photographique (73) qu'elle a utilisée avec ses élèves, soit directement par contact d'une lame de roche sur la plaque, soit par activation, activation de la plaque ou activation de disques mis ensuite en contact avec la plaque (75, 76, 77, 85). R. Coppens a aussi utilisé la méthode photographique dans un grand nombre d'études sur les inclusions radioactives des roches (25, 26, 27, 28, 29, 30, 31, 32). D'autres essais sur le même sujet ont été effectués par E. Picciotto (103) et A. Demay (38, 39).

L'étude de la radioactivité de l'air a été poursuivie par H. Garrigue qui a effectué de nombreuses mesures dans la plaine de Clermont-Ferrand, au sommet du Puy de Dôme et dans un avion spécialement équipé pour ces mesures (53, 54, 55, 56, 57, 58).

V. Physique de l'ionosphère

Les travaux français relatifs à l'ionosphère ont été analysés chaque année dans les comptes-rendus, largement diffusés, du Comité français de Géodésie et Géophysique. Un rapport général sur ces travaux ferait double emploi avec les rapports de l'U.R.S.I., surtout en ce qui concerne les questions relatives aux appareils, aux mesures et aux problèmes de la propagation. Nous ne citerons ici que les travaux relatifs à la physico-chimie de l'ionosphère et aux relations entre les phénomènes ionosphériques et d'autres phénomènes géophysiques ou solaires.

R. Bureau a comparé les nombres des P.I.D.B. et les nombres de Wolf observés pendant deux cycles undécennaux (18). P. Lejay, A. Haubert et Melle J. Durand ont entrepris une étude des corrélations entre les fréquences critiques et l'agitation magnétique (95). A partir des observations du centre de réception de Villecresnes, J. Maire définit un indice journalier d'agitation ionosphérique et il étudie la variation de cet indice et ses relations avec l'agitation magnétique (97). R. Bureau et A. Dauvillier ont analysé les conséquences géophysiques de l'éruption chromosphérique du 19 novembre 1949 (phénomènes radioélectriques, magnétiques et rayonnement cosmique), en insistant particulièrement sur le phénomène intéressant, et rare, du renforcement anormal de l'intensité du rayonnement cosmique (19). A. Dauvillier s'était, antérieurement, intéressé aux émissions cosmiques solaires exceptionnelles (35). M. Laffineur et Melle Durand ont fait, pour deux courtes périodes, une comparaison des phénomènes solaires et terrestres (radioélectricité et magnétisme) (86).

Le regretté R. Jouaust a fait un exposé méthodique des travaux théoriques sur l'ionosphère effectués depuis la parution de son livre "L'Ionosphère" (82, 83, 84) et une mise au point sur l'ionisation météorique (81). D. Lepechinsky s'est intéressé au calcul, à partir des données des sondages, des taux de production, de recombinaison et d'attachement des ions dans l'ionosphère (96). M. Nicolet et L. Bossy ont fait une étude théorique étendue de la physique de l'ionosphère pour différents modèles d'atmosphère (absorption du rayonnement, réactions ioniques, mécanisme de l'absorption des ondes radioélectriques) (102). Le même difficile sujet a été traité plus récemment, avec de nouveaux développements par E. Argence, M. Mayot et K. Rawer (3).

VI. Optique de la haute-atmosphère

A. Aurores polaires

D. Barbier a appliqué aux aurores des calculs relatifs à l'excitation des raies interdites dans les nébuleuses et les novae (4). R. Bernard et M. Peyron proposent d'expliquer les aurores rouges du type B par des zones d'établissement de la décharge électronique (11). C. Störmer a résumé dans une publication française les résultats de ses observations, étendues sur un quart de siècle, du développement vertical des rayons auroraux (121). R. Robley, J. Bricard et A. Kastler ont analysé quelques spectres d'aurores pris par eux à Abisko (108).

J. Dufay, partant d'une observation de Meinel, admet la possibilité de diverses raies permises des atomes OI et NI dans le spectre de l'aurore (42). L. Vegard, utilisant un nouveau spectrographe à forte dispersion et grande luminosité, construit en France, obtient des résultats remarquables qui lui permettent de donner une liste de radiations nouvelles et des interprétations nouvelles aussi (127, 128). A. Meinel a donné une interprétation de plusieurs bandes intenses du spectre auroral (98).

B. Ciel crépusculaire

J. Dufay et M. Dufay montrent un renforcement appréciable de la raie verte de l'oxygène au crépuscule, pendant un temps court (47) et M. Dufay étudie des bandes de la molécule d'azote ionisée dans le ciel crépusculaire, dont la présence est presque quotidienne, avec renforcement pendant les orages magnétiques (50, 51). D. Barbier a repris des observations sur les raies rouge et jaune avec un spectrographe très dispersif. Ses résultats pour la raie rouge le conduisent à admettre une émission par pure résonance optique et à apprécier la hauteur de la couche émettrice (5). J. Bricard et A. Kastler ayant perfectionné leur dispositif de mesure de la polarisation de la lumière du ciel nocturne (15) poursuivent avec R. Robley l'étude de la raie jaune crépusculaire; leurs nouveaux résultats confirment leur conclusion antérieure d'une émission de résonance optique (17, 16). G. Courtès observe dans le ciel crépusculaire une raie de l'azote fréquente dans les aurores de basse latitude (33). G. de Vaucouleurs retrouve les discontinuités crépusculaires de Grandmontagne à partir de mesures visuelles de la brillance du ciel au zénith (126).

C. Ciel nocturne

D. Barbier a comparé à d'autres formules celles qu'il a calculées pour effectuer la correction d'extinction dans les observations (6). J. Bricard et A. Kastler au moyen des dispositifs créés par eux, qui viennent d'être signalés à propos du ciel crépusculaire, (15, 17) étudient la polarisation des raies verte et rouge du ciel nocturne et montrent qu'elle est pratiquement nulle (16). R. Grandmontagne et Ch. Delestrade mesurent photoélectriquement l'intensité du rayonnement nocturne zénithal reçu à travers des filtres (67).

Plusieurs travaux sont relatifs à la description et l'interprétation du spectre de la lumière du ciel nocturne. Mme Herman a signalé la présence possible du spectre de la molécule d'hélium (78). J. Dufay a exploré le spectre du ciel nocturne dans l'infrarouge jusque vers 9000 Å (41) et il a repris récemment cette étude avec M. Dufay (49). Les mêmes auteurs avec J. Cabannes, utilisant un nouveau spectrographe, améliorent la connaissance du spectre entre 5800 et 6900 A et partant d'un résultat de Meinel montrent que ce spectre doit être attribué dans son ensemble à la molécule OH (21). J. Dufay généralise ce résultat jusqu'à 11,000 A (43). Dans le même ordre d'idées D. R. Bates et M. Nicolet font une étude théorique du problème de l'émission de la molécule OH (7).

En ce qui concerne l'altitude des couches luminescentes nocturnes, J. Dufay et Tcheng Mao-Lin poursuivent leurs mesures et font une étude étendue de leurs résultats en insistant sur la cause d'erreur venant de la non-uniformité des couches émettrices (44); d'autre part, P. Abadie, Mme Vassy et E. Vassy poursuivent à Tamanrasset des mesures commencées au Pic du Midi et interprètent ces nouveaux résultats en admettant maintenant une couche émettrice épaisse à altitude élevée et variable pendant la nuit (1, 2, 125).

VII. Radioastronomie. Rayonnement cosmique

Une bibliographie sommaire des travaux pouvant intéresser la géophysique a été donnée dans les comptes-rendus annuels du Comité national.

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GERMANY

RAPPORT GÉNÉRAL

Par F. Errulat
(read in the session 23.8.51)

Les géophysiciens de la "République Fédérative Allemande" sont réunis dans la "Société Allemande de Géophysique" qui a constitué l'Union Allemande de Géodésie et Géophysique comme représentante de notre science dans l'Union Internationale. La Section de Géomagnétisme a livré pour cette assemblée les rapports des instituts et de quelques personnes, et ces rapports seront publiés dans le bulletin officiel de l'association. Vous savez que nous avons en Allemagne d'Ouest seulement deux observatoires magnétiques: celui de Fürstenfeldbruck près de München et celui de Wingst près de Hamburg et que ces deux observatoires donnent des enregistrements de la déclinaison, de la composante horizontale et verticale. A Fürstenfeldbruck on enregistre aussi les courants telluriques en deux composantes. A Wingst nous avons deux variomètres d'induction pour la composante horizontale et verticale. De cette manière nous espérons à parvenir à une définition plus exacte du commencement de quelques perturbations magnétiques.

Du levé magnétique de l'Allemagne de 1935 les valeurs de plus de 500 stations sont publiées et nous espérons que nous serons bientôt en état de publier aussi les cartes de ce levé.

Mr. Bartels a dans son Institut de Géophysique à Göttingen on peut dire une centrale pour les recherches de l'activité magnétique et il vous présentera quelques propositions pour la réduction des chiffres internationaux du charactere magnétique du jour (C_i) aux chiffres planétaires (K_p) dans son système des Potsdamer Kennziffern. A Lindau près de Göttingen Mr. Dieminger a créé un institut pour les recherches ionosphériques; il vous rapportera lui-même de ses travaux. Enfin, nous avons une Union pour l'Etude de l'Ionosphère - Arbeitsgemeinschaft Ionosphäre - constituée de tous les instituts géophysiques, astronomiques et physiques qui ont quelques relations avec ces recherches. Cette Union, dont le Président est le Prof. Regener, fait des efforts pour rechercher les rapports entre les effets solaires, géomagnetiques, ionosphériques et des rayons cosmiques. Le Bureau Central Technique Postal pour la Radio-Communication à Darmstadt (Fernmeldetechnisches Zentralamt) donne tous les jours des télégrammes de radio pour tout le monde à l'aide de la Station Norddeich-Radio, en accord avec les recommandations du Comité Consultatif International de Radio-Communication à Genève. Mr. Menzel, membre de notre délegation, vous donnera tous les détails que vous aurez peut-être le désir de savoir - p.ex. le code. On a l'intention de publier un bulletin mensuel qui contiendra un sommaire de toutes des dates observées.

Finalement, je vous remercie au nom de mes collègues allemands de votre bonne volonté et de toutes les aides qu'un grand nombre de collègues et d'instituts étrangers nous ont montrées dans les années où nous n'étions pas en état de travailler sans votre assistance.

Bericht über die Tätigkeit des Geophysikalischen Instituts Potsdam bis Marz 1950 und über eigene Arbeiten

Von Prof. Dr. R. Bock

1) Mit gütiger Unterstützung des Chefs der Geodätischen Sektion des Army Map Service, Colonel Hough, dem auch an dieser Stelle der ergebenste Dank ausgesprochen wird, wurden alle die Deklinationsmessungen endgültig bearbeitet, die von der während des zweiten Weltkrieges aufgestellten sogenannten Magnetmessbatterie 653 in allen Operationsgebieten durchgeführt worden waren. Die Ergebnisse wurden mit allen in der Literatur vorhandenen Deklinationsangaben zusammengefügt. Weiterhin wurden die Vermessungen verwertet, die von mehreren europäischen Ländern durchgeführt worden waren. Wenn die Ergebnisse noch nicht veröffentlicht vorlagen, wurden sie von den Ländern im Manuskript überlassen. Den betreffenden Ländern sage ich auch hier für ihr Entgegenkommen meinen besten Dank.

Aus diesem Material endstand der Atlas der Magnetischen Deklination von Europa für die Epoche 1944.5. Die Isogonen wurden durch das Army Map Service, Washington, D. C., auf Blätter der Internationalen Weltkarte 1: 1 000 000 gedruckt, nachdem die Grundkarten in besonders geeigneten Farbtönen speziell hergestellt worden waren. Das bearbeitete Gebiet reicht von 72° N.Br. bis 32° N.Br. und von 348° E.v.Gr. bis 60° E.v.Gr. Es wird mithin eingenommen von den Blättern der Internationalen Weltkarte auf den Querstreifen R bis I und den Längsstreifen 29 bis 40.

Übersichtskarten mit generalisierten Isogonen und mit Reduktions- und Grundwerten in den Massstäben 1:6 000 000, 1:10 000 000, 1:20 000 000 und 1:40 000 000 wurden hergestellt. Instruktiv zeigt besonders eine Karte im Massstab 1:6 000 000, die in Einteilungen von 1° Breite und 1° Länge sechs verschiedene Signaturen der Stationsdichte enthält, wo Deklinationsmessungen für eine ausreichend genaue Isogonenführung fehlen.

Der Text berichtet über die Quellen und bildet damit eine vollständige Bibliographie aller in Europa durchgeführten magnetischen Vermessungen.

Die deutsche Ausgabe, die allerdings unter dem Druck der Papierknappheit nicht alle Karten enthält, ist als Abhandlung 12 des Geophysikalischen Instituts Potsdam im Akademie-Verlag Berlin erschienen.

2) Die als Abhandlung 13 vorgesehenen Karten der Horizontalintensität, Inklination und Vertikalintensität von Europa (Massstab 1:6 000 000) sowie eine Weltkarte der Deklination (Massstab 1:15 000 000, 2 Planigloben, je vier Quadranten) konnten nur in druckfertigen Folien hergestellt, aber noch nicht veröffentlicht werden.

3) Die Abhandlungen 8 - 11 des Geophysikalischen Instituts Potsdam bilden einen vierteiligen Katalog, der auf losen, auswechselbaren Blättern alle reproduzierbaren Jahresmittel der magnetischen Elemente der Observatorien und auch der Stationen enthält, die vorübergehend in Betrieb waren. Den Institutionen, die der Bitte entsprochen haben, verbesserte Werte mitzuteilen, danke ich auch hier. Dir Korrekturen werden bei Nachdrucken der auszuwechselnden Blätter berücksichtigt werden. Die nächste Ausgabe ist für den Termin vorgesehen, an dem jeweils die Mittel des Jahres 1950 vorliegen, um dadurch gleichzeitig die Blätter vollständig zu füllen, die die Jahresmittel 1901 bis 1950 enthalten.

4) Als Abhandlung 14 erschien im Akademie-Verlag Berlin eine Studie über den Gesteinsmagnetismus von W. Schumann, in der die magnetischen Anomalien Europas eingehend behandelt werden.

5) Die Bemühungen, die Abhandlung 6 des Geophysikalischen Instituts Potsdam, die im Jahre 1948 erschienen ist und die Tabellen mit den Ergebnissen der Magnetischen Reichsvermessung I. Ordnung (1935.0) enthält, durch eine weitere Veröffentlichung mit Karten und speziellen Angaben zu ergänzen, werden fortgesetzt.

6) Die Jahrgänge 1932 und 1933, die bisher in der jetzt von 1890 bis 1944 vorliegenden Reihe der magnetischen Beobachtungen in Potsdam, Seddin und Niemegk fehlten, wurden abschliessend bearbeitet und sind im Akademie-Verlag im Jahre 1950 erschienen. Die Veröffentlichung behandelt eingehend die Geschichte und den Bau des Observatoriums Niemegk.

7) Über die Ableitung eines paneuropäischen erdmagnetischen Normalfeldes wurde vorläufig in der Zeitschrift "Gerlands Beiträge zur Geophysik" berichtet. Die Arbeiten sind fortgeführt und für die magnetische Vertikalintensität abgeschlossen worden.

Das erdmagnetische Normalfeld wird durch eine Kugelfunktionsreihe mit Gliedern bis zur dritten Ordnung und bis zum dritten Grad dargestellt. Durch Differentiation werden TAYLORsche Reihen gebildet, die für Bereiche, die beliebig begrenzt werden können, die Normalwerte in der Form liefern, wie sie in der Praxis seit langem üblich ist. Im Vergleich zu früher treten aber an den politischen Grenzen keine Sprünge auf, sondern die aus den TAYLORschen Reihen gecildeten Normalwerte gehen allenhalben stetig ineinander über, wenn die Entfernung der Punkte, für die $\Delta\phi$ und $\Delta\lambda$ gleich Null sind, nicht zu gross gewählt werden.

Mit Hilfe des paneuropäischen Normalfeldes weredn die magnetischen Anomalien Europas einheitlich abgeleitet und auf einer Karte im Massstab 1:6 000 000 dargestellt.

8) Erdstrombeobachtungen, die die deutsche Reichspost in den Jahren 1932 und 1933 auf einer Linie und 1938 bis 1941 auf zwei Linien durchgeführt hatte, wurden bearbeitet. Die Mittel über Intervalle einer und mehrerer Stunden wurden den entsprechenden Mitteln der magnetischen Elemente gegenübergestellt. Eine weitgehende Übereinstimmung des Verlaufes lässt sich feststellen.

9) Die vagabundierenden Ströme, die die elektrisch betriebene Vorortbahn Berlin - Potsdam hervorruft, wurden auf dem Observatoriumsgelände, das ein Kilometer vom Endpunkt der Bahn entfernt ist, für Untersuchungen verwendet. Auf einem Registrierstreifen wurden sowohl die vagabundierenden Ströme, die von Elektroden über Widerstandskombinationen zu Spiegelgalvanometern geführt wurden (und zwar drei Azimute) als auch ihre magnetischen Wirkungen in drei Richtungen aufgezeichnet. Diese Untersuchungen, die gute Ergebnisse zu liefern versprachen, mussten abgebrochen werden. Es scheint erfolgreich zu sein, wenn ähnliche Versuche dort angestellt werden, wo magnetische Observatorien wegen der Störung durch vagabundierende Ströme aufgegeben werden mussten und die elektrischen Anlagen, die die Störungen verursachen, verhältnismässig einfach sind und die Stromwege daher annähernd überblickt werden können, um daraus Schlüsse über die Ursache und Wirkung des natürlichen Erdstromes zu ziehen.

10) Nachdem die Zeitschrift: "Gerlands Beiträge zur Geophysik" lizenziert worden war, erschienen die Hefte 2 bis 4 des Bandes 61, dessen Herausgabe mit Heft 1 im Jahre 1944 abgebrochen werden musste, sowie der Band 62. Die Zeitschrift wird wie früher von der Akademischen Verlagsgesellschaft, Geest und Portig K.G., Leipzig C 1 verlegt.

Veröffentlichungen:

R. Bock, F. Burmeister, F. Errulat. Magnetische Reichsvermessung 1935.0 - Teil I (Tabellen). Abh. d. Geophys. Inst. Potsdam Nr. 6, Berlin 1948.

R. Bock und W. Schumann. Katalog der Jahresmittel der magnetischen Elemente der Observatorien und der Stationen, an denen eine Zeitlang erdmagnetische Beobachtungen stattfanden. Abh. d. Geophys. Inst. Potsdam Nr. 8 bis 11, Berlin 1948.

R. Bock. Atlas der magnetischen Deklination von Europa fur die Epoche 1944.5 (Mit Übersichtskarten im Massstab 1:6 000 000, 1:10 000 000, 1:20 000 000 und 1:40 000 000). Abh. d. Geophys. Inst. Potsdam Nr. 12, Berlin 1950.

W. Schumann. Erdmagnetische Anomalien in Europa und ihre Beziehungen zu den geologischen Verhältnissen (Eine Studie uber den Gesteinsmagnetismus). Abh. d. Geophys. Inst. Potsdam Nr. 14, Berlin 1949.

R. Bock. Ergebnisse der Beobachtungen am Adolf Schmidt-Observatorium für Erdmagnetismus in Niemegk in den Jahren 1932 und 1933. Geophys. Inst. Potsdam, Berlin 1950.

R. Bock. Die normale Verteilung der erdmagnetischen Vertikalintensität in Europa für die Epoche 1944.5. Gerlands Beiträge zur Geophysik 61 (104-115) 1950.

R. Bock. Herausgabe der Zeitschrift: "Gerlands Beiträge zur Geophysik" von Band 61, Heft 2 (1949) ab.

Geophysikalisches Institut der Universität, Göttingen

Von Prof. Dr. J. Bartels

Das Institut wirkte mit bei der Einführung planetarischer erdmagnetischer Kennziffern K p und täglicher Charakterzahlen Cp, sowie bei der Reduktion und Veröffentlichung der Kennziffern für das Internationale Polarjahr 1932-33 (Vgl. J. Bartels, Bericht des "Committee on Characterization of magnetic disturbances"). Lunare Variationen wurden berechnet für D in Hermanus, wobei sich für den Südsommer besonders grosse Amplituden ergaben, ferner für D in Lovö, und für fF2 und hF2 in Huancayo (Vgl. S. Chapman, Bericht des Joint Committee ..... on the study of lunar variations .....). Eine 27-tätige Wiederkehr-Neigung in fF2 über Huancayo wurde untersucht. Im Gausshaus registrieren Sturm-Variometer.

Veröffenlichtungen

Bartels, J.:

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Tätigkeitsbericht des Erdmagnetischen Observatoriums in Fürstenfeldbruck in den Jahren 1948-1950

Von Direktor Dr. F. Burmeister

Die Registrierung der Variationen der erdmagnetischen Elemente D, H und Z wurde ohne Unterbrechung mit zwei Systemen ("Schultze" Skalenwerte 0.437, 2.70, 2.30, "Edelmann" Skalenwerte 1.284, 6.51, 6.65) durchgeführt. Die Auswertung der Registrierkurven erfolgte nach achtstündigen Mitteln, so dass das Tagesmittel aus drei Einzelwerten gebildet wird. Zur Kontrolle der Registrierung wurden dreimal in jedem Monat absolute Messungen vorgenommen.

Zur Sicherung der Reichsaufnahme 1934-35 und Ableitung der Säkularvariation sind sieben Beobachtungspunkte neu vermessen worden, die sich auf Bayern, Württemberg, Baden und die Rheinpfalz verteilen. Die Vermessung II. Ordnung in Bayern in D, Z und jezt auch in H ist 1949 in Angriff genommen worden, zunächst wurde das Gebiet südlich der Linie Munchen-Augsburg bis zur österreichischen Grenze bearbeitet. Durchschnittlich entfallen auf jedes Messtischblatt 1:25,000 zwei Beobachtungspunkte. Diese Arbeiten werden fortgesetzt, falls die finanziellen Mittel dafür zur Verfügung gestellt werden.

Aus sämtlichen in der Bundesrepublik vorliegenden Deklinationsbeobachtungen (ab 1854) wurden Nadelabweichungswerte berechnet und in 28 Karten 1:300,000 dargestellt. Diese Karten wurden den Landesvermessungsämtern zum Abdruck auf den topographischen Karten zur Verfügung gestellt.

Im Jahre 1948 wurde mit der Errichtung einer Registrieranlage für den natürlichen Erdstrom begonnen. Die anfangs benutzten Saitengalvanometer konnten später durch die moderneren Punktschreiber ersetzt werden. Im Frühjahr 1950 sind zwei weitere Sondenleitungen in Betrieb genommen worden, so dass gegenwärtig zwei Farbschreiber für den Erdstrom in magnetisch E-W (Leitungslänge 160 m), geogr. E-W (150 m) und geogr. N-S (150 m) und für die Horizontalintensität registrieren. Letzte Einrichtung erwies sich für Vergle ichszwecke als notwendig und erforderte längere Entwicklungsarbeiten, da hier grössere Genauigkeit als bei den üblichen Fernübertragungsanlagen gefordert wird. Sowohl die praktischen als auch die theoretischen Arbeiten für diese Anlagen sind abgeschlossen und werden demnächst in einer Abhandlung veröffentlicht werden.

Wegen des grossen Einflusses von atmosphärischer Elektrizität auf Erdströme war für Vergleichszwecke eine Parallelregistrierung des luftelektrischen Potentialgefälles erwünscht. Daher wurde 1949 der früher in München stationierte und durch Luftangriffe beschädigte Benndorf-Apparat am Observatorium wieder hergerichtet und in einer besonderen Beobachtungshütte in Betrieb gesetzt. Zur Zeit werden Entwicklungsarbeiten an einem neuartigen magnetischen Messgerät (Magnetische Feldmühle) durchgeführt.

Die ausserdem in der Berichtszeit ausgeführten theoretischen Arbeiten, soweit veröffentlicht, sind:

K. Burkhart. Deutung erdmagnetischer Sturmvariationen durch Stossionisation. Zeitschrift "Die Naturwissenschaften" 1949.

" Beziehungen zwischen magnetischen Tagesvariationen und der geologischen Beschaffenheit des Untergrundes. Ebenda 1949.

" Die allgemeine Theorie des Erdinduktors. Geofisica pura e applicata. Milano 1949.

" Die Magnetflussänderung der Zone von 30° südlicher bis 60° nördlicher Breite seit 1900. Zeitschrift für Meteorologie 1950.

Amt für Bodenforschung, Hannover

Von Dr. D. Closs

Das Amt für Bodenforschung, Hannover, führte im Bereiche des Rheinischen Schiefergebirges und im Harz Variometermessungen zur Erfassung von Anomalien der Vertikalintensität durch, um Anhaltspunkte über die Verteilung von Eruptivkörpern im tiefen Untergrund zu erhalten.

Die Messungen erstreckten sich über einen Zeitraum von insgesamt etwa 4 Monaten.

Spezielle magnetische Messungen zur Bestimmung der Änderung der Vertikalintensität sind im Bereich der Erzlagerstätten des Siegerlandes durchgeführt worden (Seismos) und im Bereich des südlichen Rheinischen Schiefergebirges vom Hessischen Geologischen Landesamt Wiesbaden.

Eine Veröffentlichung von Ergebnissen ist bisher noch nicht erfolgt.

Institut für angewandte Geophysik der Universität München

Von Prof. Dr. H. Reich

Das Institut für angewandte Geophysik der Universität München wurde 1948 neu gegründet und nahm erst Ende dieses Jahres seine Tätigkeit auf.

Das Institut hat sich in der Berichtszeit in der Hauptsache mit seismischen und erdmagnetischen Untersuchungen beschäftigt.

Es wurden lokale Untersuchungen im Nördlinger Ries vorgenommen und dort der regionale Anschluss an die Vermessung I. Ordnung hergestellt. Die Ergebnisse sind in Bearbeitung. Weitere Messungen, über die Herr Direktor Burmeister berichtet, wurden im Geciet von Würzburg vorgenommen.

In Zukunft wird sich das Institut weiter mit diesen und ähnlichen Problemen beschäftigen, die in der Hauptsache geologische Fragen in Süddeutschland behandeln sollen. Von Mitgliedern des Instituts sind weitere Untersuchungen geplant und zum Teil schon durchgeführt, die sich mit der radioaktiven Wirkung des Bodens und der Gesteine beschäftigen. Bischer wurden Ionisationsmessungen der Bodenluft durchgeführt, Gammastrahlenmessungen sind geplant und werden hoffentlich 1951 in Gang kommen. Ein weiterer wichtiger Zweig der Institutsarbeiten beschäftigt sich mit der Erforschung der magnetischen und elastischen Eigenschaften von Gesteinen und Bodenarten. Die Versuche sind bereits z.T. angelaufen und werden weiter durchgeführt werden. So weit die Mittel reichen, wird das Institut auch auf dem Gebiet der Schweremessungen (Gravimeter und Drehwaage) und elektrischen Messungen (insbesondere nach dem Widerstandsverfahren) Untersuchungen vornehmen. Die hier bestehenden Möglichkeiten hängen von der Finanzierung ab.

Deutsches Hydrographisches Institut, Hamburg

Von Prof. Dr. F. Errulat

Über die erdmagnetischen Arbeiten des Instituts geben die vom Direktor des Instituts (Dr. G. Böhnecke) erstatteten Jahresberichte Auskunft (No. 3 für 1948, No. 4 für 1949, No. 5 für 1950). Das dem Institut unterstellte Observatorium Wingst veröffentlichte die Registrierungen von 1943 bis 1945 in Form von Jahrbüchern (No. 1 - 3); das Jahrbuch für 1946 ist im Druck. Die Monats- und Jahresmittel der Elemente bis 1950 sind im Umdruck als vorläufige Mitteilungen, die dreistundigen Kennziffern mit Angaben der s.c. und s.f.e. in monatlichen Mitteilungen versandt. Die K-Reihe umfasst nunmehr die Jahre 1940 bis 1950. An die Zentralstelle der Arbeitsgemeinschaft Ionosphäre wurden Kennziffern, s.c. und s.f.e. täglich telefonisch gemeldet.

Im Jahre 1948 wurden an 7 Stationen der Reichsaufnahme von 1935 Wiederholungsmessungen vorgenommen und anschliessend die Normalwerte der Observatorien Fürstenfeldbruck und Wingst verglichen (O. Meyer). Im Observatorium Wingst wurde eine Anlage zur Registrierung der Änderung des magnetischen Flusses ($^{dH}/dt$ und $^{dZ}/dt$) geschaffen. Die in Solenoiden mit horizontaler bzw. vertikaler Längsachse induzierten Ströme werden über ein Galvanometer optisch registriert. Die Registrierungen ergeben zuweilen ein wesentliches Hilfsmittel zur Präzisierung plötzlicher Einsätze. Sie sind häufig gekennzeichnet durch starke Tagesunruhe, deren Deutung noch aussteht.

Besondere Aufmerksamkeit wurde dem Vergleich der Registrierungen in Wingst mit den der benachbarten Stationen (Rude Skow, Witteveen, Niemegk, Fürstenfeldbruck) gewidmet. Die systematischen Unterschiede, welche besonders an ruhigen Tagen in den Z-Kurven auffallen und lokale Ursachen zu haben scheinen, werden z.Zt. untersucht.

Für Westdeutschland wurden Karten von D, H, Z_{obs} und Z_{normal} für 1950.5 herausgegeben. Das Normalfeld und die regionalen Anomalien des peribaltischen

Gebietes wurden von J. Saldukas zusammenfassend bearbeitet und kartographisch dargestellt (bisher nicht veröffentlicht).

Veröffentlichungen seit 1949:

Errulat, Fr.: Messungen der Horizontalintensität des erdmagnetischen Feldes auf der Ostsee in den Jahren 1938 und 1939, ausgeführt mit dem Doppelkompass als Tauchgerät (Deutsche Hydrographische Zeitschr. vol. 2, Heft 1/2, S. 1-21, 1949).

" Zur Frage der lokalen und regionalen Anomalien der Säkularvariation. (ebda vol. 3, Heft 1/2, S. 153-161, 1950).

" Messungen der erdmagnetischen Vertikalintensität auf See auf mehrfach befahrenen Profilen zur Prüfung der mit einem geschleppten Rotationsgerät erreichbaren Messgenauigkeit (ebda vol. 3, Heft 3/4, S. 249-257, 1950).

Meyer, Otto: Die Messung der Vertikalintensität des erdmagnetischen Feldes auf See mit dem Magnetron (ebda vol. 2, Heft 1/2, S. 22-34, 1949).

" Zwei erdmagnetische Grossstörungen (ebda vol. 2, Heft 1/2, S. 100-101, 1949).

" Über erdmagnetische Registrierungen von Mögel-Dellinger-Effekten (ebda S. 185 ff).

" Ergebnisse der erdmagnetischen Messungen im nordwestdeutschen Raume 1948 zur Erfassung der Säkularvariation (ebda vol. 3, Heft 1/2, S. 161-162, 1950).

Bericht über theoretisch-erdmagnetische Arbeiten, 1948-1951

Von Dr. Hans G. Macht

Die eigenen theoretisch-analytischen Arbeiten auf dem Gebiet der erdmagnetischen Grundlagenforschung wurden fortgesetzt. In einer demnächst erscheinenden Studie [6]x) wird das Wesen und die mögliche (geo)physikalische Bedeutung der Potential-Konstituenten 2. und höherer Ordnung des Erdmagnetfeldes eingehend untersucht.

Wie bereits mitgeteilt [1], lassen sich prinzipiell für die nicht-sektoriellen Koeffizienten 2. Ordnung der "geomagnetischen" Potentialentwicklung konkrete geometrisch-physikalische Deutungsmöglichkeiten aufzeigen, sofern hypothetisch bestimmte äquivalente (fiktive), "pseudo-homogene" Magnetisierungsverteilungen $\underline{I} \equiv I_x(x,y,z)$, $I_y = I_z = 0$, zugrunde gelegt werden (x-Achse = magnet. Achse). Derartige Deutungen werden nunmehr [6b] auf alle zonalen sowie "halb-sektoriellen" $\underline{P}_n^o$- und $\underline{P}_n^{n-1}$-Kugelfunktionsterme (n = 1,2,3...) ausgedehnt. Die zugehörigen Koeffizienten c_n^o ("geomgt." Entwicklung.) sind allgemein den -mittleren- achsialen I-Änderungen (n-1). Ordnung, $\partial^{n-1} I_x/\partial x^{n-1}$, direkt proportional, während die c_n^{n-1} entsprechende transversale I_x-Änderungen, senkrecht zur (geo)magnetischen x-Achse, ausdrücken. Hingegen lassen sich die sektoriellen $\underline{P}_n^n$-Terme nur durch sog. "absolute Quermagnetisierungen", d.h. rein transversale $\underline{I}$-Verteilungen (n-1). Ordnung (I_x=0) ohne eigene Dipol-Momente, interpretieren [6b,d].

Die geomagnetischen Potentialanteile 2. Ordnung insbesondere charakterisieren bestimmte "planetarische" Asymmetrien der äquivalenten Erdmagnetisierung (Nordsüd- und Ostwest-Asymmetrie; polare Feld-Deformationen), welche zu ebenfalls

x) S. Literaturverzeichnis am Schluss des Berichts.

"planetarischen" H- und Z-Anomalien Anlass geben [6c]. Letztere sind den eigentlichregionalen krustalen Anomalien des Erdmagnetfeldes übergeordnet.-Dagegen erfassen die höheren P_n^o-Terme (n>3) praktisch nur pseudohomogene Magnetisierungsanteile relativ oberflächen-naher, krustaler und subkrustaler Schichten der (geomagnetischen) Polarzonen, die P_n^{n-1}-Terme in 1.Linie nur solche des Aequatorgürtels.

Die physikalisch-analytische Sonderstellung des sektoriellen P_2^2-Partialgliedes der "geomagnetischen" Potentialentwicklung (Invarianz von $c_2^{2\prime}$ gegen Koord.-Translationen) wurde speziell erörtert [2]. Wie noch des näheren bewiesen werden wird [6d], lässt sich dieses sog. "absolute geomagnetische Quadrupolmoment" potentialtheoretisch auch durch Überlagerung der Felder zweier exzentrischer, zueinander senkrechter Dipole interpretieren. Hieraus kann hypotnetisch die Möglichkeit eines im wesentlichen aus zwei Teilfeldern zusammengesetzten erdmagnet. Innenfeldes gefolgert werden. Tatsächlich lassen sich bestimmte Charakteristika des terrestrischen Oberflächenfeldes (insbes. die elliptische Deformation polarer isomagnetischer Kurvensysteme) sowie die grosszügige Gestaltung des geomagnet. Restfeldes bereits durch ein einfaches Modell von 2 orthogonalen, exzentrischen Elementarmagneten in der 0°-Meridianebene gut darstellen [3]. Dieses vorläufige Zweidipol-Modell wurde weiter vervollkommnet, so dass es sämtlichen Partialgliedern 1. und 2. Ordnung der erdmagnetischen Potentialentwicklung exakt Rechnung trägt [4]. Ferner wurde die Säkularvariation des (verbesserten) Modells untersucht; die von 1829-1945 erfolgten systematischen Verlagerungen seiner beiden -äquivalenten- exzentrischen Dipole dürften die Hypothese eines komplexen, hauptsächlich aus zwei individuellen Teilfeldern aufgebauten Erd-Innenfeldes erheblich stützen.

Schliesslich ermöglicht dieses Modell die exakte Definition und Berechnung eines entsprechenden "planetarisch-erdmagnetischen Grund- oder Normalfeldes", dessen Ursprung zunächst vollständig im tiefen Erdinnern angenommen wird [5]. Sodann müsste das terrestrische Restfeld "beobachtetes Feld minus planetarisches Grundfeld", welches nur überwiegend krustal bedingte Potentialanteile 3. und höherer Ordnung enthält, eine bessere Zuordnung zur Geotektonik aufweisen als das bisherige Eindipol-Restfeld. Wie eine Berechnung des nordhemisphärischen "Grund-Restfeldes" für Z (1945.0) zeigt [5], ergibt sich in der Tat im mittleren und vor allem höheren Breiten eine gewisse Anpassung desselben an die Erd-Oberflächengestaltung. Diese Zuordnung lässt sich weiter verbessern, wenn man ein um 10-15 per cent reduziertes "planetarisches Grundfeld" zugrunde legt. Dieser Sachverhalt würde - entgegen der ursprünglichen Annahme- auf ein Dipol-Moment ebenfalls der Erdkruste, von rd. 1/10 bis 1/7 des gesamten magnet. Moments der Erde, hindeuten.- Die Untersuchungen über diese Probleme werden fortgeführt.

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Die Arbeitsbemeinschaft Ionosphäre

Von Dr. W. Menzel

Die deutschen geophysikalischen Institute, deren Arbeitsprogramm ionosphärische Probleme berührt, haben sich in einer Arbeitsbemeinschaft Ionosphäre zusammengefunden, deren Zweck in der schnellen Sammlung und Verteilung von Mess- und Beobachtungsergebnissen liegt. Darüber hinaus bemüht sich die Arbeitsgemeinschaft, Informationen und Anregungen über Arbeiten auf dem Gebiet der Ionosphärenforschung weiterzugeben. Die Zusammenarbeit liegt bisher auf rein ideeller Ebene, jedoch ist die Arbeitsgemeinschaft bemüht, den z.T. schwer um ihre Existenz ringenden Instituten auch materielle Erleichterungen zu schaffen.

Die Arbeitsbemeinschaft steht unter dem Ehrenvorsitz von Geheimrat Professor Dr. J. Zenneck und unter dem Vorsitz von Prof. Dr. J. Bartels, Göttingen. * Die Geschäftsführung liegt in den Händen des wissenschaftlichen Mitarbeiters im Fernmeldetechnischen Zentralamt Dipl. Ing. W. Menzel, Darmstadt. Ihr stehen tägliche Messwerte aus folgenden Instituten zur Verfügung: 1) Fraunhofer Institut, Freiburg/Breisgau-Schauinsland (Prof. K. O. Kiepenheuer, gegenwärtig vertreten durch Prof. Dr. Siedentopf, Tübingen) mit Sonnenbeobachtungen (Flecken, Eruptionen, Sonnenfleckenrelativzahl, Fackeln); 2) Sonnenobservatorium Wendelstein der Universitätssternwarte München (Prof. Rolf Müller) mit Sonnenbeobachtungen (Flecken, Fackeln, Eruptionen, Relativzahl und Korona); 3) Institut für Ionosphärenforschung in der Max Planck-Gesellschaft, Lindau b. Göttingen (Dr. W. Dieminger) mit Ionosphärenmessungen (kritische Frequenzen, Dämpfung, Mögel-Dellinger-Effekte); 4) Ionosphärenstation Neuershausen des Service de Prévision Ionosphérique Militaire Freiburg (Breisgau)-(Dr. Rawer) mit Ionosphärenmessungen (kritische Frequenzen, Dämpfung, Mögel-Dellinger-Effekte); 5) Erdmagnetisches Observatorium Wingst des Deutschen Hydrographischen Instituts Hamburg (Prof. Dr. Errulat, Dr. Meyer) mit erdmagnetischen Messungen (Erdmagnetische Elemente Sturmbeginn, Sonneneruptionseffekte; 6) Erdmagnetisches Observatorium Fürstenfeldbruck/Bayern (Dr. Burmeister) mit erdmagnetischen Messungen (erdmagnetische Elemente, Sturmbeginn, Sonneneruptionseffekte); 7) Geophysikalisches Institut J. B. Ostermeier, Mering/Oberbayern (Dipl. Ing. Ostermeier) mit Erdstrommessungen in kurzen Leitungen (Kennziffern, Sturmbeginn, Sonneneruptionseffekte); 8) Physikalisches Institut der Universität Freiburg/Breisg. (Prof. Gentner, Dr. Sittkus) mit Messungen der Ultrastrahlung (Genaue Ionisationskammermessungen); 9) Forschungsstelle für Physik der Stratosphäre, Weissenau/Württemberg (Prof. Dr. Regener, Dr. Ehmert) mit Messungen der Ultrastrahlung (Zählrohrkoinzidenzapparaturen); 10) Dr. J. Zirkler, Wallgau/Oberbayern mit Messungen der Ultrastrahlung (kleine nur bodengeschirmte Ionisationskammer); 11) Fernmeldetechnisches Zentralamt Darmstadt

* seit 1951: Prof. Regener Vorsitzender, Prof. Bartels stellv. Vorsitzender.

(Dr. Salow, Dr. Beckmann, Dipl. Ing. Menzel, Augustin) Messungen der Ultrastrahlung (mit verschiedenen Ionisationskammern und Zählrohrkoinzidenzapparaturen) sowie Beobachtungen auf dem Gebiet des Funkbetriebs. Weiterhin sind die verschiedenen deutschen Wetterdienste an der Sammlung von Nachrichten und Messergebnissen beteiligt. Ausser den genannten Stellen sind eine grosse Anzahl von Instituten und Wissenschaftlern, die sich mit einzelnen Gebieten der Ionosphären- und verwandter Forschung befassen, Mitglieder der Arbeitsgemeinschaft.

Die Arbeitsgemeinschaft verteilt die deutschen täglichen Routinemess- und Beobachtungsergebnisse telegraphisch an alle interessierten deutschen Stellen und das National Bureau of Standards in Washington. Über Norddeich Radio wird werktäglich eine Zusammenstellung der wichtigsten Werte in Telephonie und Telegraphie an "All geophysical institutes" verbreitet. Der Schlüssel zu diesen Sendungen in deutscher, englischer und französischer Sprache ist bei der Geschäftsführung der Arbeitsgemeinschaft Ionosphäre, Darmstadt, Fernmeldetechnisches Zentralamt, erhältlich.

Es ist beabsichtigt, die Sendungen vor allem im Hinblick auf Luftelektrizität, Erdmagnetismus und Kurzwellenausbreitung zu erweitern.

Die Arbeitsbemeinschaft beabsichtigt, jährlich in relativ engem fachlichen Rahmen eine Arbeitstagung von etwa 3 Tagen Dauer zu veranstalten. Es ist weiterhin vorgesehen, die einschlägigen Mess und Beobachtungsergebnisse in einem deutsehen Ionosphärenzirkular monatlich zu veröffentlichen.

Bericht über die Arbeiten im Zeitraum 1946 bis 1951

Von Dr. H. Wichmann

In Anlehnung an das Physikalische Staatsinstitut, Hamburg, wurden 1946 zwei Messtationen - darunter eine auf einem Turm in 25 m Höhe - mit einer Dauerregistrierung des luftelektrischen Feldes (Rth-Kollektor und Elektrometerverstärker) und einer speziellen Apparatur für die Untersuchung von Blitzfeldschwankungen eingerichtet.

Es wurden Untersuchungen über die aerologischen Verhältnisse bei Gewittern und insbesondere über die Ausbildung des Aufwindstromes und des Hagels durchgeführt. Als wesentlich ist die gewonnene Vorstellung zu bezeichnen, dass der gesamte gebildete Niederschlag beim Gewitter im Aufwindschlot vom Aufwind (10-40 m/s) in den Gipfel der Wolke emporgetragen wird. Der schwere Niederschlag (Hagel) stürzt ausserhalb des eigentlichen Aufwindschlotes herab, während der leichte Niederschlag (Eiskristalle) am Herabfallen stark gehindert wird. Die Ergebnisse wurden unter Heranziehung von mikrophysikalischen Vorgängen in Wolken auf den Ausbau der kolloidmeteorologischen Gewittertheorie, sowie auf die Vorhersage von Schauern und Gewittern angewendet.

Aus der Registrierung des elektrischen Feldes bein Gewittern und Schauern wurde die Raumladungsverteilung in der Gewitterwolke und ihre Einwirkung auf die Gestaltung des Bodenfeldes gewonnen und daraus auf eine einheitliche Raumladungsverteilung bei allen Gewittern geschlossen. Die Aufnahme der Feldschwankungen bei Gewittern ergab wertvolle Hinweise auf die Ausbildung des Blitzes und due Änderung der Ladungsverhältnisse in der Gewitterwolke.

Die Beziehung der Weltgewittertätigkeit zum luftelektrischen Feld der Erde wurde einer Untersuchung unterzogen. Aus Messungen der atmosphärischen

Rundfunkstörungen, der Feldstärke in grösseren Höhen mittels Ballon und des Vertikalstromes auf Bergen wurde der Schluss gezogen, dass der wohl sehr wahrscheinlich vorhandene Gleichlauf beider Erscheinungen durch die Einwirkung der bodennahen Schicht, wie auch durch den täglichen Wechsel der Ionisation hoher Schichten der Atmosphäre, völlig verschleiert wird.

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Der elektrische spesifische Widerstand, eine hydrologische Kennzahl

Von Dr. H. Thiele

Der elektrische spezifische Widerstand grundwasserführender Lockersedimente ist der charakteristische Durchschnittswert aus den Einzelwiderständen einer Sedimentationsfolge innerhalb eines durch die Messanordnung des angewandten geoelektrischen Verfahrens bestimmten Bereichs. Die bisherigen Untersuchungsergebnisse über seine Bedeutung als einer mittleren hydrologischen Kennzahl des Messbereichs werden durch neuere bodenphysikalische und kolloidchemische Arbeiten unterbaut.

Die spezifische Oberfläche eines grundwasserführenden Lockersediments bestimmt einerseits seinen Durchlässigkeitsbeiwert, andererseits aber auch sein elektrisches Oberflächenpotential als Summe der elektrokinetischen Teilchenpotentiale der einzelnen Bodenpartikel. Die Grösse der elektrokinetischen Teilchenpotentiale hängt wesentlich von dem elektrochemischen Verhalten des hygroskopischen, verdichteten Wassers ab, das in seiner Beschaffenheit und Anlagerungsmenge, je nach der hydrochemischen Entwicklung im Sediment, stark variieren kann. Massgebend für die Grössenordnung des spezifische Widerstandes sind die elektrokinetischen Teilchenpotentiale sowie die Potentialdifferenz zwischen hygroskopischem Wasser und Grundwasser.

Die Formeln von Sundberg, Hummel und Archie haben keine generelle Gültigkeit, da bei gleichem hydrologischem Verhalten und gleichem spezifische Widerstand des Grundwassers der spezifische Widerstand des grundwasserführenden Sediments um eine Zehnerpotenz schwanken kann (Süsswasservorkommen als Linse im Küstengebiet und Grundwasservorkommen in grundwasserchemisch einheitlich entwickelten Gebieten).

Für hydrochemisch unterschiedliche Grundwasservorkommen wurden bestehende Gesetzmässigkeiten zwischen spezifische Widerstand und spezifische Oberfläche bzw. anderen hydrologischen Grössen erforscht und ein neues Auswertungsverfahren der Geoelektrik erarbeitet. Jedes Grundwasservorkommen hat seine eigene Charakteristik. Ist die bestehende Beziehung ermittelt, dann können mit ihrer Hilfe die mittleren hydrologischen Verhältnisse des gesamten Vorkommens und eines jeden Punktes in ihm geoelektrisch bestimmt werden.

Wichtigstes Schrifttum

Geoelektrik in Beziehung zur Grundwasserchemie und Hydrologie. "Die Wasseraufbereitung", Sonderheft des Deutschen Vereins von Gas- und Wasserfachmännern, Hannover, 1949.
Der elektrische spezifische Widerstand, eine hydrologische Kennzahl. Gas- und Wasserfach 90, 1949, S. 491.
Stand der geoelektrischen Methoden in der Grundwassererschliessung, praktische Ergebnisse und Entwicklungsmöglichkeiten. "Neuere Methoden der Grundwasserschliessung", Sonderheft des Deutschen Vereins von Gas- und Wasserfachmännern, 1951.
Die Geophysik in der Wassererschliessung. In H. Schneider, H. Thiele, Chr. Truelsen "Die Wassererschliessung", Vulkan-Verlag Dr. W. Classen, Essen (im Druck).

Kurzer Bericht über die luftelektrischen Untersuchungen am Jungfraujoch/Schweiz

Von Dr. H. Israël

Auf dem Jungfraujoch wurdem mit Unterstützung der Schweizerischen Luftelektrischen Kommission 1950-51 luftelektrische Registrierungen des Potentialgefälles und des vertikalen Leitungsstromes durchgeführt. Die Untersuchungen wurden von Dozent Dr. H. Israël, dem Leiter der luftelektrischen Forschungsstelle Buchau am Federsee (Deutschland) - Forschungsstelle im Rahmen des Observatoriums Friedrichshafen (Landeswetterdienst Württemberg-Hohenzollern) - angeregt und von ihm und seinen Mitarbeitern Dipl.-Phys. H. W. Kasemir und Dr. K. Wienert ausgeführt. Diese Arbeiten sind ein Teil des von H. Israël aufgestellten Spezialprogramme zur Erforschung der luftelektrischen Verhältnisse in der freien Atmosphäre und ihrer Koppe lung mit dem meteorologischen Geschehen. Die Arbeiten sind noch nicht abgeschlossen.

Eines der ersten Ergebnisse ist folgendes: Am Jungfraujoch sind die Tagesgänge von luftelektrischem Feld, Vertikalstrom und Leitfähigkeit an klaren Tagen im Sommer auch in dieser Höhe noch von der Tagesvariation des vertikalen Massenaustausches gesteuert. Im Herbst ist dies nicht mehr der Fall. Die Winterergebnisse liegen noch nicht vor.

Im Sommer herrscht also im Niveau des Alpenkammes der kontinentalkonvektive Typ der luftelektrischen Tagesvariationen vor, während schon im Herbst dort eine klare Annäherung an den ozeanischen Typ stattfindet.

Dieses Ergebnis wird besonders deutlich, wenn man nach dem von G. R. Wait (Terr. Mag., vol. 47, 243-249, 1942) vorgeschlagenen Verfahren die Tagesvariationen des "Säulenwiderstandes" (Widerstand einer Luftsäule von Einheitsquerschnitt und Atmosphärenhöhe über der Station - englisch: "columnar resistance") analysiert: Vergl. nebenstehende Abb. 1. Im Sommer besteht ein eindeutiger Zusammenhang zwischen dem Säulenwiderstand und der Leitfähigkeit am Messort (obere Teilfigur), wie es als Folge des bis in diese Höhen wirksam werdenen Tagesvariation des Massenaustausches zu erwarten ist. - Im Herbst dagegen ist dieser Zusammenhang fast völlig verschwunden (untere Teilfigur). Da aber trotzdem eine deutliche Tagesvariation des Säulenwiderstandes bestehen bleibt, ist zu

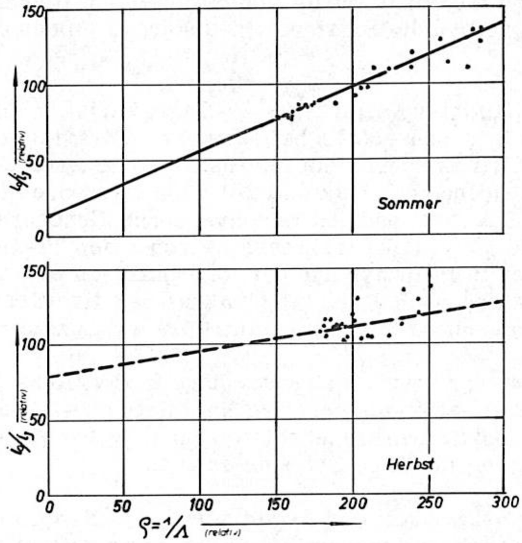

Abb. 1--Der Säulenwiderstand in Abhängigkeit von der reziproken Leitfähigkeit am Messort. Oben: Jungfraujoch, Sommer. Unten: Jungfraujoch, Herbst.

vermuten, dass für diese am Alpenkamm noch andere meteorologische Einflüsse verantwortlich sind. Es ist dabei etwa an advektiven Luftaustausch und dadurch hervorgerufene Aerosol-Aenderungen zu denken.

Bericht über die geophysikalisch interessierende Ultrastrahlungsforschung in Deutschland 1948-1951

Von Dr. A. Ehmert

Die fortlaufende Registrierung der kosmischen Ultrastrahlung wurde in Deutschland an verschiedenen Stellen fortgesetzt bzw neu aufgenommen. Dabei wurde teilweise die Genauigkeit erheblich gesteigert mit dem Ziel feinere erdmagnetische Einflüsse auf die Ultrastrahlung zu erfassen.

Der Einfluss des Erdfeldes auf die solare Ultrastrahlung wurde von Ehmert (1) an Hand seiner älteren Registrierungen eingehend diskutiert. Der Einfall ist auf bestimmte Ortszeiten beschränkt, wobei allerdings durch zusätzliche Ringstromfelder die Grenzen stark verschoben werden können. Diese Beschränkung bestätigte der Ultrastrahlungsausbruch am 19.2.1949, bei welchem in Deutschland Augustin und Menzel (2), Ehmert (3), Salow (4) und Sittkus (5) nur Zunahmen um 10 bis 15 °/o fanden gegenüber 43 °/o in Amerika. Weiter Ausbrüche registrierte Ehmert (6) am 24 und 25.12.1948. Während des magnetischen Sturms am Abend des 25.12.1948 ist ein Zusammenhang zwischen den erdmagnetischen Pulsationen und Pulsationen der Ultrastrahlung angedeutet.

Mit der Entstehung der solaren Ultrastrahlung befassen sich theoretisch Arbeiten von Bagge und Biermann (7) und (8). Dir Frage der interstellaren Magnetfelder, welche eng mit der isotropen Verteilung der extraterrestrischen

Ultrastrahlung zusammenhängt wurde von Schluter und Biermann (9) eingehend untersucht. Sie begründen die Existenz eines solchen Feldes der Grössenordnung 10^{-6} Gauss.

E. G. v. Roka (10) interpretierte die 27-Tage-Variation der Ultrastrahlung als Folge des erhöhten Mesonenzerfalls bei stärkerer Ultravioletteinstrahlung in die Ozonosphäre und stützt das durch die Herausarbeitung einer überzeugenden negativen Korrelation zwischen den maximal 2 °/o ausmachenden Ionisationänderungen in Cheltenham und Huancayo und den Züricher Sonnenfleckenrelativzahlen von 1936 bis 1946. Weiter zeigte v. Roka (11), dass zwischen den 27-Tagemitteln der Ionisationsschwankungen in Huancayo und der ionosphärisch wirksamen Wellenstrahlung (in den Masszahlen nach Bartels) eine gute negative Korrelation besteht, während der Zusammenhang mit der Partikelstrahlung ungleich loser ist.

Mit der Methode der überlagerten Stichtage fand v. Roka (11) am Material von Huancayo ebenfalls eine gute negative Korrelation zwischen den Variationen der Ultrastrahlung und Sonnenfleckenrelativzahlen, wobei die Welle der Ultrastrahlung um 4 bis 6 Tage später ihre Extreme erreicht.

Durch erhöhte Genauigkeit der Registrierung konnten Ehmert und Sittkus (12) einen gelegentlich schwacher magnetischer Störungen auftretenden Tagesgang der Ultrastrahlung feststellen, dessen Maximum am Mittag etwa 1 °/o erreicht und der in Freiburg und in Weissenau mit auffallendem Gleichlauf auftritt. In einem besonders ausgeprägten Fall ist er auch in einer japanischen Registrierung zu finden und zwar mit gutem Gleichlauf nach Ortszeit, die dort um 9 Stunden früher liegt Es wird vermutet, dass sich hier eine Unsymmetrie des magnetischen Störungsfeldes um die Erde auswirkt.

Die Registrierungen mit einer 500-Liter-Kammer in Freiburg wurden von Sittkus seit Januar 1950 im Sonnenzirkular des Fraunhofer-Instituts in Freiburg laufend veröffentlicht.

(1) Alfred Ehmert. Zeitschrift für Naturforschung, 3a, 264-285, 1948.
(2) Otto Augustin und Willi Menzel. Journal of Atmospheric and Terrestrial Physics, 1, 37-39, 1950.
(3) Alfred Ehmert. Ebenda, 1, 39-40, 1950.
(4) H. Salow. Ebenda, 1, 40-41, 1950.
(5) Albert Sittkus. Ebenda, 1, 41-42, 1950.
(6) Albert Ehmert. Zeitschrift für Naturforschung, 4a, 559-560, 1949.
(7) E. Bagge und L. Biermann. Die Naturwissenschaften, 35, 120-121, 1948.
(8) Ludwig Biermann und Erich Bagge. Zeitschrift für Naturforschung, 4a, 303-315, 1949.
(9) Arnulf Schluter und Ludwig Biermann. Zeitschrift für Naturforschung, 5a, 237-251, 1950.
(10) E. G. v. Roka. Zeitschrift für Naturforschung, 5a, 517-530, 1950.
(11) E. G. v. Roka. Zeitschrift für Naturforschung, 6a, 117-122, 1951.
(12) A. Ehmert und A. Sittkus. Physikalische Verhandlungen, 2, 29, 1951.

GREAT BRITAIN

BRITISH NATIONAL REPORT ON TERRESTRIAL MAGNETISM AND ELECTRICITY 1949-51

(A) Terrestrial Magnetism and Electricity.

(1) Magnetic Work of the Royal Greenwich Observatory.

At Abinger continuous recording of the elements declination, horizontal force and vertical force has been maintained. Frequent determinations of base-line values have been made and as a check on those of H and Z, obtained respectively with the Schuster-Smith and Dye Coils, regular observations of dip, with an earth inductor, have been secured.

Following a resolution by the Committee on International Comparison of Magnetic Standards of the Association of Terrestrial Magnetism, a check upon the determinations of H made at Abinger, Lerwick, Eskdalemuir and Rude Skov was undertaken in 1950 using QHM instruments. These instruments have now been returned to the Meteorological Institute, Charlottenlund, and it is expected that the results of the comparisons will be published in due course.

The Observatory has continued to undertake the testing of magnetic instruments when required, and to supply information to institutions engaged in geophysical and radio investigations.

In the summer of 1948 a short survey in declination, ranging over 59 points distributed throughout the British Isles, was undertaken by the Ordnance Survey. Checks of the instruments employed were provided at Abinger, which also served as one of the bases for reference.

The Abinger K-indices have been prepared back to the year 1929, and those for the period 1929-1939 will be appearing in Bulletin 12c of the Association of Terrestrial Magnetism and Electricity. Current values will henceforth appear in the Journal of Atmospheric and Terrestrial Physics.

With the extension of electrification of the railways since the Magnetic Station was set up at Abinger in 1924, the growing need for a more suitable site has been recognized for a number of years. In November 1948 a magnetic survey of three regions in the neighborhood of Hartland, North Devon, was undertaken. This was chosen as being one of very few districts not lying within ten miles of a railway. It was felt that, providing the district proved free from serious magnetic anomalies, no other locality in the south of England was likely to combine such a freedom from artificial disturbance with reasonable amenities for the observing staff. The tests were carried out using a QHM and a BMZ. In the following summer three additional sites were examined. Since these appeared more promising than the others, a further detailed examination of them was undertaken in the autumn. The most favorable site appeared to be one situated immediately north of the village of Hartland. The ground, 20 acres in extent, is well drained and lies in a sheltered position bounded on the north and west sides by wooded country. Observations of H and Z, secured at a number of points separated by intervals of 25 yards, revealed the existence of no serious anomalies. In consideration of these results the site has been approved as suitable for a magnetic observatory and details of requirements are now being examined, prior to seeking sanction to proceed with the work of erecting the buildings.

In anticipation of the removal a complete duplicate set of La Cour recording instruments has been purchased for use at the new station. It is intended that both stations shall continue to operate for a time, the base-line determinations being effected at one with a QHM and BMZ which will, from time to time, be compared with the instruments in use at the other station. During the period 1949 April to October, frequent determinations of Z were made with a BMZ for comparison with the Dye Coil. A slow drift in the difference between the values given by the two instruments was noted. This amounted, however, to only about 3γ per month, from which it was concluded that, when calibrated at intervals, the BMZ would serve adequately to establish the values of the Z base-line at the secondary station, as stated above.

The non-observing staff of the Magnetic Department was transferred from Greenwich to Herstmonceux Castle early in 1950. Preparation of the manuscripts of the annual magnetic results is up to date, but publication is much in arrears, the last annual volume in print being that for 1937.

From time to time observations of magnetic declination are received from ships, but the dearth of new observational data, such as is essential for the preparation of reliable world magnetic charts, is a matter of grave concern. Much material is available for the past, but with our restricted knowledge of the secular variations this material will progressively lose value. The commissioning of a non-magnetic Survey Ship, as originally envisaged in the R.R.S. Research, is thus becoming a matter of urgency.

A detailed study of the Abinger magnetograms, in conjunction with those of other observatories, published by the U. S. Department of Commerce, is in progress. It is hoped that such a study may throw further light upon the nature of world wide movements, as distinct from those having an apparent local origin.

A paper on "Observational Aspects of the Sunspot-Geomagnetic Storm Relationships" by H. W. Newton, has been published in "Geophysical Supplement" of M.N.R.A.S. 5, 321, 1949. Using international magnetic character figures (C), the statistical behavior of geomagnetic activity has been investigated for the solar disk passage of sunspots (1914-44), divided into four groups according to area.

For the biggest sunspots (exceeding 1500 millionths of the sun's hemisphere in mean area during disk passage) there is a very definite increase of geomagnetic activity centered at about two days after central meridian passage of the (mean) sunspot. But, with decreasing group size, the relationship rapidly becomes insignificant. However, groupings of sunspots based on solar flare incidence much improve the relationship and extend it to groupings of sunspots other than the very largest. Remarks are offered on the 27-day recurrence tendency shown by the smaller storms. On the whole, such 27-day sequences appear unrelated to sunspots and solar flares.

A note on "A Distinctive Geomagnetic Epoch, 1941 June 9-14" is given in "The Observatory" 68, 60, 1948. A letter to the same journal (Dec. 1950) draws attention to the marked non-random time distribution, both of great magnetic storms and the greatest solar flares. Both phenomena tend to occur in pairs or even triplets, separated by a mean interval of 3 to 4 days. This feature is significant of the relationship between the two phenomena.

A summary of investigations published during the last three or four years on solar corpuscular radiation has been prepared by H. W. Newton and W. Jackson, for inclusion in the forthcoming 7th Report on Solar-Terrestrial Relationships sponsored by the International Council of Scientific Unions. A list of intense solar flares (importance 3+) from 1942-50 is included together with relevant geomagnetic data.

Annual lists of geomagnetic storms (recorded at Abinger), together with solar notes, have been published in "The Observatory" in continuation of previous lists therein since 1928, and of collected data, 1874-1927, published in the "Greenwich Photoheliographic Results" for 1927, p. 127-139.

(2) Work in Terrestrial Magnetism and Atmospheric Electricity at Observatories of the Meteorological Office.

(a) Lerwick and Eskdalemuir Observatories

La Cour magnetographs have been maintained continuously at Eskdalemuir and Lerwick Observatories. Gaps in the registration have been infrequent and of short duration. All but one have been filled in from supplementary instruments with a larger scale value. At Eskdalemuir the standard instruments have been the Schuster-Smith coil for H, the Kew magnetometer for D, and the Schulze inductor for V. At Lerwick similar instruments were used for H and D, but a B.M. magnetometer was used for V. By means of travelling Q.H.M's and a B.M.Z., the standards at the two observatories and at Abinger were compared. Opportunity was taken of the presence of a team of Ordnance Survey workers in the neighborhood to check the azimuth of the fixed marks used for orientation at both observatories.

Direct measurements from the photographic curves of hourly or instantaneous values and the allocation of magnetic character figures and three-hourly range indices were done at the two observatories. Computational work and preparation of copy for the Year Book was done at the Edinburgh Meteorological Office but no publication has as yet been done. Daily magnetic character figures and three-hourly range indices K were forwarded monthly to De Bilt and copies to Mr. H. F. Johnston of the Committee for Magnetic Characterization. Since 1950, copies of these figures have been sent to the Editor of "The Journal of Atmospheric and Terrestrial Physics" for publication in that Journal and the 3 K_S figures have been computed for both observatories and forwarded to De Bilt. There have also been forwarded to De Bilt a list of "sudden commencements" and "solar flare effects" occurring at the two observatories. In order to help in the selection of magnetic effects which could fairly be ascribed to solar flares, there have been received (a) lists of visually observed solar flares from the Royal Observatory, Greenwich, and the Royal Observatory, Edinburgh, (b) lists of sudden fade outs from Cable and Wireless, Ltd., (c) sudden phase anomalies observed at Cambridge in a reflected long wave. These latter have not been received regularly.

"K" indices have been allocated for both observatories for years previous to 1940 when routine measurement of this quantity began. The years 1937-1939 and 1932, 1933 have been completed. In addition, K-indices were measured from the magnetograms from Fort Rae during the Polar Year Expedition to that place.

An auroral watch was maintained at Lerwick, except for a period around the summer solstice when twilight persists all night with an intensity which prevents visual observation of aurora. No attempt could be made at photography.

Various authorities have used the magnetograms or tabulated values of magnetic quantities in work on measurements in deep mines, in magnetic surveys, and in investigations of atmospheric tides and solar flares.

The radio sonde work at Lerwick demands an extensive use of hydrogen and the poor communications with the mainland causes a considerable and very variable mass of hydrogen cylinders to be collected there. Some anxiety was felt as to the possible magnetic effect of this pile of cylinders. Calculation and direct test by moving one cylinder in the immediate neighborhood of the magnetic houses agreed in in showing that past records had not been affected, but that the point should be watched in any future changes of routine of handling of the cylinders.

Eskdalemuir Observatory suffered from the sudden death of Mr. J. B. Beck in March after 30 years as magnetic observer.

Special work on magnetism has resulted in the preparation of the following reports and papers:

J. Crichton. The K-index of Geomagnetic Activity at Eskdalemuir 1940-47. Journal of Geophysical Research.
R. A. Watson and D. H. McIntosh. Sudden Commencements in Geomagnetism. Nature.
D. H. McIntosh. Geomagnetic Sudden Commencements at Lerwick. Journal of Atmospheric and Terrestrial Physics.
D. H. McIntosh. On S.F.E's. In ms.

In atmospheric electricity the routine of maintaining and standardizing the electrograph determination of the exposure factor and preparation of the data for the Observatories' Year Book was continued at both observatories without interruption.

(b) Kew Observatory

Work in atmospheric electricity was largely limited to maintaining the measurements and recordings of those atmospheric electrical elements near the surface which had formed the basic program of work before the war.

Continuous autographic records have been maintained of the following elements:

(1) Potential gradient
- (a) by Kelvin photographic equipment
- (b) by auxiliary Benndorf electrograph (since 1942), with half the sensitivity of the Kelvin instrument

(2) Point discharge from artificial point (Geophysical Memoirs No. 68, 1936)

Measurements of the earth's field have been made regularly for standardizing the autographic records, and air-earth current and conductivity have been measured when conditions were suitable.

(B) Aurora.

The following is a summary of auroral work done in Scotland under the direction of Mr. J. Paton of the Department of Natural Philosophy, University of Edinburgh.

The photographic station at Newburgh has been transferred to Abernethy (56°20′01″N. 3°18′38″W.) and a new station with a Meyer camera has been established at Rosneath, Dunbartonshire (56°00′32″N. 4°48′00″W.).

Watch was kept at Abernethy on each night until 11 p.m.; when aurora developed later, warning was given by telephone by the night observers at the Meteorological Office, Leuchars, and the Royal Observatory, Edinburgh.

During the period, aurora was observed on the following nights. A stroke below the date, thus Jan. $\underline{2}$, signifies that luminosity did not extend above an elevation of 20° over the N. horizon on the night of January 2-3. A stroke above the date figure signifies that activity extended beyond the zenith. Brackets are used to indicate that the observation is doubtful, either because the luminosity was observed through cloud or because of bright moonlight or, in summer, twilight.

	1948	1949	1950
January	$\underline{2}$ $\underline{3}$	$\underline{18}$ $\overline{24}$ (25)	$\underline{1}$ $\underline{13}$ $\underline{14}$ $\underline{15}$ $\underline{16}$ $\underline{17}$ $\underline{20}$ $\underline{21}$ $\underline{22}$ 24
February	(5) $\underline{14}$ (15)	$\underline{3}$ 21	$\underline{4}$ $\underline{5}$ $\underline{7}$ $\underline{8}$ $\underline{9}$ $\underline{13}$ ($\underline{15}$) ($\underline{18}$) 19 $\overline{20}$ $\underline{21}$ $\underline{22}$ 23
March	$\underline{15}$	$\underline{1}$ 17 $\underline{18}$ $\underline{20}$ $\underline{21}$ $\underline{22}$ $\underline{23}$	$\underline{4}$ $\underline{5}$ $\underline{10}$ $\underline{11}$ $\underline{14}$ $\underline{15}$ $\underline{19}$ $\underline{21}$ $\underline{22}$ $\underline{23}$ $\underline{24}$ $\underline{26}$ $\underline{27}$ $\underline{31}$
April	Nil	($\underline{8}$) ($\underline{10}$)	$\underline{1}$ $\underline{2}$ 3 5 $\underline{6}$ $\underline{7}$ $\underline{11}$ $\underline{17}$ $\underline{18}$ $\underline{21}$ $\underline{23}$ $\underline{24}$
May	15	3 $\underline{5}$ $\underline{12}$	Nil
June	Nil	Nil	Nil
July	5 (7)	(23)	$\underline{24}$
August	14	$\underline{3}$ $\underline{18}$ $\underline{29}$	7 $\underline{14}$ $\underline{16}$ $\overline{19}$
September	$\underline{1}$ $\underline{15}$	$\underline{1}$ $\underline{25}$ $\underline{26}$ $\underline{27}$	(3)
October	$\underline{3}$ (8) 15 18 $\underline{21}$ $\underline{22}$ $\underline{26}$	(7) (8) $\overline{15}$ $\underline{16}$ 22	$\underline{2}$ $\underline{14}$ $\underline{15}$ $\underline{18}$ $\underline{19}$ $\overline{28}$
November	$\underline{4}$ $\underline{6}$ $\overline{20}$ (30)	$\underline{2}$ $\underline{5}$ ($\underline{7}$) $\underline{14}$ $\overline{19}$ $\underline{21}$	$\underline{4}$ $\underline{5}$ $\underline{9}$ $\underline{10}$ $\underline{11}$ $\underline{16}$ $\underline{24}$
December	$\underline{5}$ $\underline{25}$ 30	$\underline{3}$ $\underline{4}$ $\underline{5}$ $\underline{6}$ $\underline{7}$ $\underline{9}$ ($\underline{11}$) $\underline{15}$ (17) (21) $\underline{22}$ $\underline{23}$ $\underline{26}$ $\underline{28}$ $\underline{29}$	$\underline{12}$ $\underline{13}$

The cloudiness of Scottish skies makes simultaneous photography at two or more stations extremely difficult. Though photography was possible and was successfully carried out at one or more stations on nineteen nights, simultaneous photography at two stations was achieved on only four nights and at three stations on two nights. On no occasion did cloud allow simultaneous photography at all four stations.

The arrangement for photography of quiet area, according to a prearranged time scheme proposed by Professor Störmer, was continued.

Luminous night (noctilucent) clouds were photographed on two occasions, July 10-11, 1949, and July 24-25, 1950. The latter display was particularly brilliant and extensive and was accompanied in its early stages by a diffuse auroral arc with sunlit rays.

Photographs with some preliminary measurements have appeared in the Observatory (June 1949), the Meteorological Magazine (December 1949), and the Proceedings of the Physical Society B (December 1950). Measurement of the plates is proceeding. The continuation of this work has been made possible by a grant of £140 from the Gassiot Committee of the Royal Society, London.

C. Magnetic Surveys.

The Ordnance Survey has completed the reduction of some magnetic declination (magnetic variation) observations made in the summer of 1948. Advantage was taken of the fact that the stations of Walker's 1914-15 Survey (1) were permanently marked by the Ordnance Survey, and that their descriptions, with azimuths of reference objects, are still available in guard books in this office.

The survey involved one season's work for an observing party of two; 24 stations were looked for and not found within the day allowed, but 54 were found and observed for declination only. In some cases new azimuths had to be computed, from triangulation data, as old reference objects had been destroyed.

The purpose of the survey was to make a rapid preliminary check on the validity of magnetic information currently being supplied on Ordnance Survey maps, and it was intended as an exploration survey only, to provide information which would be of assistance in relation to decisions concerning possible future magnetic surveys.

The instrument used was the Wingfield Standard Compass of Messrs. E. R. Watts, with reversible needle, on a circle reading to one minute. A set of observations at each station consisted of the mean of sixteen magnetic pointings, reading both the upper and lower points of the end section of the needle, with approach from either side, twice over in each case. Preliminary calibration showed this mean to be correct within better than a quarter-minute.

Examination of past survey results suggested that regional or local anomalies, of up to twenty minutes or so, were in large measure permanent, and that the secular change rates showed a considerably smaller anomaly content than the declinations themselves. This was confirmed in the new observations.

Reduction to epoch 1948.5 was made using simultaneous values obtained from Abinger, Eskdalemuir, and Lerwick, by a simple weighted-mean procedure. Final accuracy is considered to be of the order of one minute.

It should be remarked that the secular change rate cannot be considered to be constant over the period 1915-1948. Records of the permanent observatories, and also their reduction by Vestine (2), show that the annual rate has first increased and then decreased by about two minutes per annum in Britain over this period. At present the rate is about eight minutes per annum and seems likely to reduce to a figure of six in perhaps five to ten years; but prediction is very difficult, as there is some evidence of a slight - possibly temporary - increase in the border region, as apart from a continuing decrease both in Northern Scotland and in Southern England.

(1) Walker, G. W. The Magnetic Re-survey of the British Isles for the Epoch January 1, 1915. Phil. Trans. Roy. Soc. (A) 219 (1919), 1-72.
(2) Vestine, E. H. and others. Description of the Earth's Main Magnetic Field and its Secular Change, 1905-1945. (Carnegie Institution of Washington Publication 578. Washington, 1947).

D. Electric Currents in the Sea.

The following results of work by the Admiralty Research Laboratory have been published:

(a) N. F. Barber. The Magnetic Field produced by Earth Currents flowing in an Estuary or Sea Channel. Mon. Not. R. A. S. Geophys. Suppl., vol. 5, No. 7, p. 258, 1948.
(b) M. S. Longuet-Higgins. The Electrical and Magnetic Effects of Tidal Streams. Ibid., vol. 5, No. 8, p. 285, 1949.

E. Report on British Theoretical Researches, by V. C. A. Ferraro and A. T. Price.

(1) GEOMAGNETISM

(a) <u>The earth's main field and its secular variation</u>

There has been a notable revival of interest in the old and difficult problem of accounting satisfactorily for the existence of the earth's magnetic field. The suggestion that the main dipole field might be a consequence of some as yet undiscovered fundamental relation between magnetism, rotation and gravity, which would make every massive rotating body a magnet, was revived and discussed by P. M. S. Blackett in 1947 (Nature <u>159</u>, 658). This idea has been further elaborated by him in a paper (Phil. Mag., Ser. 7, <u>40</u>, 125, 1949) in which he considers some alternative forms of a "fundamental" theory, and the possibility of testing them by measurements of the magnetic field in mines and under the oceans. He also reviews the astronomical evidence for such a theory.

It was pointed out in 1947 by E. C. Bullard that the variation of the magnetic field within the earth, as calculated from a "fundamental" theory of the above type, would show important differences from that derived from any "core" theory, which assigns the source of the field to causes within an inner core of the earth. This might provide a crucial test between the two groups of theories. On any "core" theory the dipole field increases inwards according to an inverse cube law until the surface of the core is reached. The distribution of the field according to any "fundamental" theory has been considered by S. K. Runcorn (Proc. Phys. Soc., <u>61</u>, 373, 1948), and in greater detail by S. Chapman (Annales de Géophysique, <u>4</u>, 109, 1948). In this case it is found that the horizontal component <u>decreases</u> with increasing depth and ultimately reverses in sign; the vertical component increases for small depths at the same rate as in a "core" theory, but at greater depths it increases less rapidly. The changes of both field components near the surface, amounting to a few γ per 1000 feet, should be just detectable by comparing measurements made in deep mines with corresponding measurements at the surface. Preliminary measurements made in South Africa and in England showed, however, that it would be necessary to evolve methods for eliminating the effects of local anomalies before reliable results could be obtained. Such methods have since been successfully developed by S. K. Runcorn and others, who have described (Phil. Mag., Ser. 7, 41, 783, 1950) an extensive series of measurements made in English coal mines. Their results are close to those predicted by a "core" theory, and are significantly different from those predicted by any "fundamental" theory.

A new "core" theory of the earth's field has been proposed by E. C. Bullard (Proc. Roy. Soc., A, 197, 433, 1949). This attributes the field to electric currents circulating in the liquid core of the earth, which behaves like a self exciting dynamo. The ideas are basically similar to those put forward by Sir Joseph Larmor in 1919, but there is an important difference in the fluid motions which are involved; in consequence the objection raised by Cowling to Larmor's dynamo theory does not apply to the present one. Bullard assumes that the fluid motions are due to convection produced by radioactive heating. These motions are not, however, confined to meridional planes because any radial motion in a rotating fluid sphere is necessarily associated with a radial variation of angular velocity, such that the outer layers rotate more slowly than the inner layers, in order to conserve the angular momentum. In the presence of a magnetic field these motions will induce electric current systems and their associated fields. Based on Elsasser's discussions of the interactions between magnetic fields and fluid motions in a sphere, Bullard has constructed a chain of interactions which appear to lead to a continued regeneration of a dipole field, and he has suggested that the earth's field may have been built up and maintained in a similar way. One important feature of his theory is the existence of a large toroidal magnetic field, which is confined within the liquid core. The theory raises a number of difficult mathematical problems which require solution. Some of these have been considered by Bullard in a second paper (Proc. Roy. Soc., A, 199, 413, 1949). He has also examined in greater detail the possibility of thermal convection occurring in the core, and the transfer of heat from the core through the surrounding solid mantle (Mon. Not. R. A. S., Geophys. Suppl., 6, 36, 1950).

Bullard has also suggested that the secular variation of the field is due to a varying electric current system induced in the material of the liquid core by movement of this material through the general magnetic field of the earth. The movement is assumed to arise from thermal convection, and that responsible for the secular variation takes the form of whirls and eddies near the surface of the core. Bullard has examined this hypothesis in detail in relation to the area of rapid change in South Africa (Mon. Not. R. A. S., Geophys. Suppl., 5, 248, 1948). He finds it necessary to assume the existence of a large magnetic field at the surface of the core, and has since suggested that this field may be identified with the toroidal field mentioned above.

The secular variation field is probably closely associated in origin with the non-dipole part of the main field. Bullard and his co-workers (Phil. Trans. Roy. Soc., 243, 67, 1950) have made a detailed study of the westward drift of both these fields. They find in each case that the drift has an angular velocity which is independent of latitude; it is of magnitude $0.18° \pm 0.015°$/year for the non-dipole field, and $0.32° \pm 0.067°$/year for the secular variation. This drift receives an explanation on Bullard's dynamo theory of the earth's field, which requires the outer part of the core to rotate less rapidly than the inner part. The surrounding solid mantle of the earth is, however, strongly coupled by electromagnetic forces to the core as a whole; consequently the outer part of the core travels westwards relative to the earth's surface and carries the minor features of the field with it.

F. J. Lawes and S. K. Runcorn (Proc. Roy. Soc., 1951, in press) have described a graphical method for obtaining a representation of the secular variation field by a set of dipoles within the core. They find that the dipoles must be radial, and that 12 such dipoles suitably located below the surface of the core give a good representation of the field for 1922.5. They interpret these dipoles in terms of horizontal currents flowing near the surface of the core, and point out that their results do not support an electromagnetic induction theory of the secular variation.

Some field observations which are of considerable interest in relation to theories of the earth's magnetism have been described by J. M. Bruckshaw and E. I. Robertson (Mon. Not. R. A. S., Geophys. Suppl., 5, 308, 1949). They have investigated the magnetic anomalies associated with the system of tholelite dykes, which extends across the north of England. They find that the entire system is magnetized in a direction opposite to the present field, and regard their results as indicating that the earth's field was reversed some 30 million years ago.

(b) Theories of magnetic storms and aurorae

A discussion of the present state of the theory of the aurora has been given by S. Chapman (Report of the Gassiot Committee of the Physical Society, 1948). He reviews the reasons for the belief that aurorae are caused by electric particles entering the atmosphere in the auroral zones from outer space and examines their source and nature. He emphasizes the outstanding difficulty concerning penetration into the earth's atmosphere of solar corpuscles whose speeds correspond to the time of travel from the sun to the earth, inferred from the observed time lag of certain storms after the solar flares apparently associated with them. He reviews the various theories proposed - the one-sign theories of Birkeland and Störmer which are subject to Schuster's criticism of complete dispersal of the streams by electrostatic repulsion, the ultra-violet light theory of Hulbert and Maris, which has been criticized by Chapman on the ground, inter alia, that the speed of the particles (10 km/sec) is inconsistent with the observed lower limit of aurorae, and Alfven's theory which has been criticized by Cowling.

Chapman discusses the influence of corpuscular radiation generally on the upper atmosphere (J. Geophys. Res., 55, 361, 1950) and has proposed a model experiment of the Chapman-Ferraro theory of magnetic storms which, if successful, may also throw light on the theory of the aurora.

F. Hoyle (Recent researches in solar physics, Cambridge, 1949) has given a sketch of a new theory of magnetic storms which, like Alfven's, depends on the existence of a general solar magnetic field. He supposes that when a stream of corpuscles is emitted from the sun it pushes back material accreted by the sun and the stream is thereby able to carry with it magnetic energy to great distances from the sun. He infers that near the earth the magnetic field within the stream is of the same order of magnitude as that of a magnetic storm. He also suggests a mechanism which may accelerate the stream particles to speeds sufficient to penetrate the atmosphere down to auroral levels.

The possibility of detecting spectroscopically streams of corpuscles emitted by the sun, which are generally supposed to cause geomagnetic storms, was first suggested by S. Chapman in 1929. He has reviewed this suggestion (Rélations entre les phénomènes solaires et géophysiques, Colloques de Lyons, Paris, 1949) in the light of the recent spectroscopic observations by Richardson (at Mt. Wilson) and Brück and Ruttland (at Cambridge). These observations are discussed and further considerations are given to methods and optimum times for making such observations. It is suggested that these should begin as soon as a bright chromospheric eruption is seen, as the detection of the solar stream is likely to be easiest then when the density of the gas is at its maximum. The possibility that spectroscopic observations may lead to the detection of Bartels' M-regions is also discussed. Finally, Chapman discusses the dependence of absorption intensity on storm intensity and suggests that the former ranges over a smaller ratio than the latter.

F. D. Kahn (Mon. Not. R. A. S., 109, 324, 1949) has also discussed the question of the spectroscopic detection of solar streams, extending his discussion so as to take into account a possible velocity spectrum at emission from a solar flare. He investigates the mode of expansion and ionization of such a stream and shows that the ions and electrons in the stream can never completely recombine. Kahn estimates the particle density in the cloud to be such that near the M and K lines of Ca II there may be observable absorption soon after the end of the flare. Should this absorption be not observable, this will not necessarily disprove the corpuscular theory of magnetic storms, as the depth of absorption may well lie below the observational limit. Kahn also gives reasons for treating the observations of Richardson at Mt. Wilson and those of Brück and Ruttland at Cambridge with caution.

V. C. A. Ferraro (J. Geophys. Res., 55, 493, 1950) shows that on the hypothesis that aurorae are due to particles escaping from the surface layers of the solar streams of corpuscles on arrival near the earth (mainly along the magnetic lines of force), the angular radius of the auroral zone should shift southwards (in the northern hemisphere) during intense magnetic storms. In this connection S. Chapman (J. Geophys. Res., 55, 361, 1951) suggests that these particles may be accelerated towards the polar regions by the electric fields of the charged surface layers to speeds of the order of 10^9 cm/sec, sufficient to give a reasonable explanation of the degree of penetration usually observed in aurorae.

(c) Diurnal variations of the geomagnetic field

S. Chapman (Terr. Mag., 53, 247, 1948) has suggested that Uganda, which has an abnormally large amplitude of the solar daily variation S of the horizontal magnetic force H, may be the northern counterpart of Huancayo. Observations made by A. Walter in Uganda in March 1941 at 18 stations were combined to give a mean variation in H, represented by a composite curve which is strikingly similar to the average solar daily variation in H found at Huancayo. It would appear that such large variations in S may be expected at stations in the belt between the geographic and geomagnetic equators and possibly near the intersection of these two equators.

A new method of analyzing the Sq-field has been developed by A. T. Price and G. A. Wilkins, with the object of taking into account the non-local time part of the variations and the abnormally large amplitudes found near the magnetic equator. The method of spherical harmonics is unsuitable for this purpose, and the new method is based on surface integral formulae derived from potential theory. Apart from obtaining a more accurate knowledge of the ionospheric current systems responsible for the diurnal variations, this investigation is intended, if possible, to detect the influence of currents induced in the oceans and to improve earlier estimates of the conductivity of the earth at great depths. One interesting result which has emerged from this study of the Sq-field is that the line of maximum amplitude of the horizontal component is not a fixed line determined solely by the earth's magnetic field, but a line which varies with the season, moving in the direction opposite to that of the sun.

Some calculations of the electric currents induced in the oceans by the magnetic diurnal variations have been made by A. T. Price and J. M. de Wet (paper in preparation). The induced currents are likely to have an important effect on the observed field, particularly on the vertical component.

(d) Sudden commencements and similar movements

V. C. A. Ferraro and W. C. Parkinson (Nature, 165, 243, 1950) have analyzed the hourly frequencies of sudden commencements of magnetic storms, and of similar movements simulating these but not followed by disturbance, at six stations (Cheltenham, Tucson, San Juan, Honolulu, Huancayo, Watheroo). They found that the hourly frequencies of such sudden movements for the combined data at stations in middle latitudes show the minimum around 8h local time found by Newton at Greenwich, but that the data for the group of stations in low latitudes does not show any such marked feature. With H. W. Unthank they are continuing the analysis, in the hope of determining whether a distinction must be drawn between sudden commencements of magnetic storms and similar movements simulating these sudden commencements but not followed by disturbance.

H. W. Newton (Terr. Mag., 52, 441, 1947) considers the comparison afforded by the reproduction of magnetograms from various observatories, especially as regards (a) the various types of sudden commencements, (SC), and (b) the so-called "similarity phenomenon" in which there is close correspondence in time and character of small sudden movements. Newton illustrates the usefulness of such day-to-day comparisons by comparing Greenwich and Cheltenham (Md.) records. In particular, he gives instances where an SC may be inverted at Greenwich but may be represented by a positive impulse at Cheltenham.

(e) Short period fluctuations of the geomagnetic field

An explanation of a remarkable feature of the magnetic fluctuations during disturbed periods, first noticed by Sangster in 1910, has been proposed by A. T. Price (Nature, 162, 110, 1948). Sangster found that the horizontal disturbance vector rotates for considerable periods in the same direction; from 0h to 10h the rotations are mostly clockwise but from 10h to 24h they are almost all anticlockwise. Price points out that, if electric currents are produced in the ionosphere, e.g. by electromagnetic induction by an external varying field, these currents will form vortex systems whose centers will move rapidly, through self induction effects, towards the more highly conducting parts of the ionosphere. The effect of this motion on the field at a given station would be precisely that noted by Sangster. Price also points out that Schmidt had established the existence of "wandering vortices" many years ago, and that Sangster's phenomenon is another aspect of these.

The general theory of the induction of electric currents in non-uniformly conducting sheets and spherical shells, upon which the above explanation is based, has been developed by Price (Q. J. Mech. and Appl. Math., 2, 283, 1949). The case of the spherical shell is considered in some detail with a view to various geomagnetic applications.

An investigation of some of the effects of the non-uniform distribution of conductivity in the ionosphere has been made by A. A. Ashour and A. T. Price (Proc. Roy. Soc., A, 195, 198, 1948). They show that electromagnetic shielding by the ionosphere of rapid fluctuations of an external magnetic field would have an important effect on the distribution of field changes observed on the earth's surface. This might lead, for example, to an apparent diurnal variation of frequency of occurrence of sudden commencements at a particular station, such as that found by Newton at Greenwich. They also show that the mean integrated conductivity of the ionosphere cannot much exceed 10^{-7} e.m.u. They also suggest explanations for some observed features of micropulsations and other disturbance fluctuations of the field.

The varying magnetic fields and electric potential gradients associated with electric currents flowing in the sea have been investigated and described by N. F. Barber (Mon. Not. R. A. S., Geophys. Suppl., 5, 258, 1948), and by M. S. Longuet-Higgins (Mon. Not. R. A. S., Geophys. Suppl., 5, 285, 1949). The potential gradient shows a steady variation with tidal period which is attributed to electromagnetic induction caused by tidal motion of the water through the earth's magnetic field. There are also rapid fluctuations of the potential gradient, which are correlated with rapid changes of the magnetic field and are presumably due to induced earth currents. It is shown that the earth current induced in the English Channel must appreciably affect the magnetic records at Abinger.

(f) Electromagnetic induction within the earth

Various analyses of geomagnetic variations have indicated an increase of electrical conductivity with increasing depth within the earth. This is probably due to the increase of the temperature. A theoretical and experimental study of the electrical conductivity of rocks at high temperatures has been made by H. P. Coster (Mon. Not. R. A. S., Geophys. Suppl., 5, 193, 1948). He finds that the increase of conductivity with temperature is sufficiently high to account for that found with increasing depth. As a matter of fact the conductivities estimated by Coster at various depths, from considerations of temperature and pressure, are considerably higher than those estimated by Lahiri and Price from geomagnetic studies. S. K. Runcorn and H. Hughes are making a further study of this problem.

Some geomagnetic phenomena involve varying magnetic fields of decidedly local character, and it is often desirable to estimate the effects of earth currents induced by them. In this case it is possible to treat the earth as a semi-infinite conductor bounded by a plane. The general theory of electromagnetic induction in such a conductor, with special reference to the induction field as distinct from the radiation field, has been developed by A. T. Price (Q. J. Mech. and Appl. Math., 3, 385, 1950).

It has been suggested that some knowledge of the earth's conductivity at moderate depths might be obtained from a field experiment in which a large alternating current is passed through a horizontal loop of large extent, and the induced field mapped over the surrounding region. This possibility has been examined by A. N. Gordon, who has made detailed calculations of the field induced by an oscillating dipole outside a semi-infinite conductor (Q. J. Mech. and Appl. Math., 4, 1951, in press).

(2) SOLAR AND COSMIC MAGNETISM

S. Chapman (Mon. Not. R. A. S., 108, 236, 1948) has computed the magnetic field of the sun on the hypothesis of a fundamental magnetization by rotation. Using the density distribution given by Blanch, Lowan, Marshak, and Bethe for the point convective model of the sun, and the variation of the angular velocity deduced theoretically by Schwarzschild, the corresponding angular momentum of the sun is computed and shown to fit in well with Blackett's theory. Chapman also finds that the magnetic field deduced on the basis of this theory increases downwards to a depth of about 100,000 km approximately, as if it were due to a centered magnetic dipole. Lower down the variation is less rapid. The non-uniform rotation of the sun introduces non-dipole terms which appear to be too small to be detected by observations. Chapman also shows that the sunspot magnetic fields cannot reasonably be accounted for by a fundamental theory.

E. A. Milne (Mon. Not. R. A. S., 110, 1951, in press) has used the methods of kinematic relativity to obtain a theoretical relation between gravitation and magnetism similar to that suggested by Blackett for a rotating system. The result only applies to a galaxy and depends on the degree of flattening of the system. For our own galaxy a magnetic field of the order 10^{-10} gauss is suggested which agrees with Alfven's calculations (Cosmical Electrodynamics, Oxford, 1950, p. 223).

V. C. A. Ferraro and H. W. Unthank (Mon. Not. R. A. S., 109, 462, 1949) have considered the electric field engendered by the rotation of the sun or of a star in its general magnetic field, thus completing the discussion of the rotation of the sun in its magnetic field begun by Ferraro in 1937. They show that the equipotential surfaces of the electric field coincide with the surfaces traced out by the rotation of a magnetic line of force about the axis of rotation, and that this law must hold in the whole of the solar atmosphere and corona. Any slight local violation of this law will give rise to local electric fields capable of accelerating protons to speeds of the order of 2×10^9 cm/sec.

P. A. Sweet (Mon. Not. R. A. S., 109, 507, 1949) has considered related problems with special reference to the effects of large scale convection currents and differential angular velocity on the sun's general magnetic field. He shows that dynamo action of the convection currents themselves would only produce a general magnification of the external field if the Hall current is sufficiently large. He extends Ferraro's work on the non-uniform solar rotation by allowing for Hall currents and concludes that the observed differential angular velocity is incompatible with the existence of a steady general magnetic field in the solar atmosphere.

In a later paper (Mon. Not. R. A. S., 110, 69, 1950) Sweet extends this work to include turbulent convection and shows that this reduces the effective electrical conductivity of a gas.

(3) IONOSPHERIC RESEARCH

(a) Ionization and ionized layer formation

D. R. Bates and H. S. W. Massey (Proc. Roy. Soc., A, 192, 1, 1947) have continued their discussion of recombinations in the ionized layers, and again note that recent work renders ionic-recombination theory difficult to maintain. The authors consider two alternatives, (i) the dust recombination theory, and (ii) the molecular recombination theory, and conclude that only the latter alternative seems promising. The recombination processes in the E, F1 and F2 layers are discussed but confirmation of the theory must await the exact determination of reaction rates.

The production of the E-layer has been discussed by Hoyle and Bates (Terr. Mag., 53, 51, 1948). Difficulties in the current theory of photo-dissociation of O2 are discussed and consideration is given to the possibility that the E layer may be produced by high-energy photons thought to be emitted by the solar corona. The layer formation by such photons is examined in detail and it is found that to give agreement with observations, the incident energy flux must have a maximum in one of two regions, near 325 e.v. and near 1300 e.v. Only in the former case is there detailed agreement with observation.

The various theories of layer formation are further discussed by D. R. Bates (Proc. Roy. Soc., A, 196, 562, 1949). While there is general agreement that the F1 layer is produced by the ionization of atomic oxygen by solar radiation, there is still considerable uncertainty regarding the formation of the E and F2 layers. As regards the E layer, two theories seem possible, the pre-ionization theory due to Nicolet and the high-energy photon theory of Hoyle and Bates described above. Evidence from eclipse effects, variation of E-layer ionization with sunspot cycle, distribution of ionization with height, are insufficient to discriminate between the two theories, though on the whole the pre-ionization theory seems preferable. Bates revives a suggestion first made by N. E. Bradbury that the F1 layer produces by itself enough ionization to give rise to the F2 layer, the appearance of separate layers being ascribed to variations of the coefficient of recombination with altitude.

This question is duscussed also by D. R. Bates and M. J. Seaton in Proc. Phys. Soc., 63, 1929, 1950.

K. Weekes and M. V. Wilkes (Proc. Roy. Soc., 192, 80, 1948) consider to what extent the resonance theory of atmospheric oscillations restricts the possible variation of temperature in the atmosphere. They show that the results of Appleton and Weekes on the lunar tide in the E layer can be reconciled with the oscillation theory, provided that a suitable temperature distribution in the E region is assumed.

S. Chapman (J. Geophys. Res., 55, 395, 1951) suggests a new terminology for the upper atmosphere regions. For a classification based on temperature he proposes the terms stratosphere for the nearly isothermal region above the troposphere, mesosphere for the region between the stratosphere and the deep temperature minimum somewhat below 100 km, thermosphere for the region of temperature increase above the mesosphere. For a classification based on composition, homosphere is suggested for the region from ground level up to about 100 km where the composition first begins to change, heterosphere for the region of different composition, and turbosphere for the region where turbulence overcomes diffusion. Chapman suggests that the term pause be used for an upper boundary, thus, stratopause, mesopause, etc., and Elvey's term airglow be used for the light of the night sky.

Sir Edward Appleton and W. R. Piggott (Nature, 165, 130, 1950) discuss the world morphology of ionospheric storms on the basis of the variation of storm manifestation with latitude, the accompaniments of sudden-commencement geomagnetic disturbances and the influence on F2-layer variability.

(b) Aurora, night sky light, cosmic rays

D. R. Bates (Mon. Not. R. A. S., 106, 509, 1946) discusses the various theories which have been put forward for the origin of the night sky light, and in particular Chapman's theory involving the region of dissociated oxygen and Mitra and Ghosh's theory of recombination processes in the ionospheric regions. Evidence from the absolute intensity, altitude, and space and time variations and correlation with magnetic activity, inter alia, seem unfavorable to both these theories. Bates suggests a third possibility, namely, that the night sky light may be due to incident charged particles such as those producing aurorae.

A theoretical discussion of the intensity distribution in the negative and first and second positive band systems of nitrogen for a number of excitation processes is given by D. R. Bates (Proc. Roy. Soc., 196, 217, 1949) with a view to understanding the processes occurring in the upper atmosphere, and aurorae in particular. The hypothesis that the emission is due to electron excitation is discredited, since one would have to assume vibrational temperatures of the molecules of the order of many thousands of degrees absolute. Bates maintains that a more plausible interpretation of the observations is that heavy particles forming part of the incident auroral streams contribute to the excitations.

D. R. Bates and M. Nicolet (J. Geophys. Res., 55, 239, 1950) discuss theoretically the altitude of this layer responsible for the nocturnal emission of the sodium D line and conclude that if the luminosity originates directly from atmospheric sodium, the layer must be far lower than is indicated by the recent observations of Barbier and Roach.

M. Ryle (Proc. Phys. Soc., A, 62, 491, 1949) reviews some recent observations at radio frequencies and suggests that they provide some evidence in support of the hypothesis made by several authors that cosmic rays are due to the acceleration of charged particles in the atmosphere of certain stars. The author doubts whether coherent oscillations of a large number of electrons can produce the intense radiation observed and suggests that this must be due to a genuine electron temperature of the order of 10^{14}°K. This in turn implies the existence of regions for which the mean electron energy is of the order of 10^{10}e.v. It is suggested that these regions may arise in rapidly rotating stars having a magnetic field.

INDIA

REPORT ON WORK ON GEOMAGNETISM, ATMOSPHERIC ELECTRICITY, IONOSPHERE AND COSMIC RAYS DURING THE PERIOD 1949-1951

By S. K. PRAMANIK

Geomagnetism

1. Alibag (Director - Mr. S. L. Malurkar)

(a) Continuous photographic registration of H, D and Z was maintained with the Watson magnetographs which have been in operation at the Alibag Observatory since 1904. La Cour D, H and Z variometers were also in continuous operation. Records of la Cour H and Z were taken on the same paper. These records were being studied and compared with those taken with the Watson instruments which, however, continue to be used for routine tabulation and analysis.

Absolute observations of H and D were carried out regularly once every week with the observatory standard magnetometer and of I with two inductors on all days except Sundays and public holidays. Besides these, absolute observations of H and D were also made with one more magnetometer and two pairs of magnets for the purpose of comparison.

International character figures C were assigned to every day and K-indices to every 3-hour interval. These data up to the end of the year 1948 were regularly communicated to the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for the determination of International Quiet and Disturbed Days. Short reports of magnetic storms as recorded at Alibag were published regularly in the Journal of Geophysical Research.

Starting on 1st January 1949, K-indices and international character figures C, together with lists of "Sudden Commencements", geomagnetic storms, and solar flare effects were regularly sent to Dr. J. Veldkamp, Koninklijk Nederlands Meteorologisch Instituut, De Bilt, Holland, in accordance with Circular No. 1, dated 31st December 1948, from the Committee for the Characterization of Magnetic Disturbance of the International Association of Terrestrial Magnetism and Electricity (International Union of Geodesy and Geophysics).

Arrangements made for the interchange of magnetic and ionospheric data with All-India Radio, New Delhi, were continued and from the middle of 1949 radio fade-out data from Radio Ceylon were also received on request and were correlated with geomagnetic phenomena. Close cooperation was maintained with the Solar Physics Observatory, Kodaikanal. Telegrams reporting magnetic storms were sent to these and other scientific institutions regularly, thereby providing facilities to carry on special observations if necessary, during such storms. Attempts have been made to correlate solar and ionospheric data received from these stations with that of the magnetic data at our disposal.

The Observatory data are published in the form of a volume. The data for years 1942-44 are in the press and are expected to be published soon. The published data includes information regarding performance of variometers, absolute observations, base-line determinations, scale-value determinations and temperature coefficients, etc.

(b) Magnetic surveys of two suitable sites in the forests about 20 to 30 miles from the Observatory were carried out in case it became necessary to establish an additional observatory there, on the introduction of electricity in Alibag, with suitable restrictions.

2. Demand for the introduction of electricity in Alibag had been received in the past and the question of having experiments to observe the effects of current on the magnetographs was raised in 1939, but due to the war no progress was made. Since the termination of the war, demands for the introduction of electricity in Alibag have been increasing and it was decided to have a series of experiments in different seasons to observe the effects on magnetographs of electric current leaking into the earth and passing through wire nearby. Three series of experiments were carried out in September and November 1950 and February 1951, when A.C. and D.C. currents were leaked at different distances from the magnetographs and were passed through wires close to the Observatory, and the effects on the magnetographs noted.

3. Kodaikanal (Director - Dr. A. K. Das)

The Magnetic Observatory at Kodaikanal, which was closed down in 1923, has been restarted with the Watson type recording variometers which were in use in this Observatory before 1923. Regular photographic registration of H, D and Z began from 1949. Measurements of absolute values of H and D are being made regularly once a week with the Kew magnetometer No. 3 belonging to the Colaba and Alibag Observatory. Absolute measurement of dip is made on all working days except Saturdays with earth inductor No. 46 and galvanometer No. 203.

A set of la Cour variometers is expected shortly and will be installed for continuous registration of the three elements side by side with the Watson instruments.

Steps are also being taken to acquire a visible recording magnetograph for horizontal force which will be very useful for the study of solar flares and for short-term forecasting of ionospheric disturbances.

Publication of the magnetic data of Kodaikanal in the Bulletins of this Observatory will be begun soon.

4. Reoccupation of Repeat Stations

Under the direction of Mr. B. L. Gulatee (Director, Geodetic Training Circle, Dehra Dun), 15 repeat stations were reoccupied during the period.

5. Measurement of H and Z near the Magnetic Equator

(a) Under the direction of Mr. B. L. Gulatee, observations of the daily variation of the horizontal force in the region between and near the magnetic and geographical equator were made with QHM at four places in June-August 1950.

(b) Under the direction of the author of this note, observations of the daily variation of the horizontal force and the vertical force between and near the magnetic and geographical equator, were made at three other places with QHM and BMZ in February-March 1951.

Atmospheric Electricity

1. Colaba, Bombay (Director - Mr. S. L. Malurkar)

Atmospheric electric potential was continuously recorded during the period under review, with the help of Dolezalek electrometer at Bombay. The potential gradient at four different hours of each day, hourly means (from positive to negative values) for each month, hourly means for each month (derived from ten quiet days), the electrical character of each day and approximate daily duration of negative potential gradient at Bombay are being regularly tabulated from the electrograms.

2. Poona (Mr. S. P. Venkiteshwaran, Meteorologist)

Atmospheric electric potential gradient was continuously recorded at Poona during the period under review using a Dolezalek quadrant electrometer, except for a short break from July to December 1950. These electrograms are, however, not being tabulated and are preserved for special studies. Measurements of (1) variation of potential gradient with height near the ground and in the upper air, (2) the air-earth current, (3) the electric charge in rain are among the items of research proposed to be taken up in the near future.

Ionospheric Work

Kodaikanal (Director - Dr. A. K. Das)

Work is now in progress for the setting up of an ionospheric station at Kodaikanal (lat. 10°14′, long. 77°28′). An automatic ionosphere recorder, CRPL Model C-3, has already been received and is under test. The construction of the building has been completed and work with the equipment is expected to be started before the middle of 1951.

Measurement and recording at vertical incidence of the virtual height and critical frequencies of ionized regions of the upper atmosphere will become part of the routine work of the ionospheric laboratory. It is expected that in this location close to the geomagnetic equator, these observations will have a special value of their own and will provide very valuable data in the investigation of several problems in the field of ionospheric research.

In addition, the provisional program of work in view includes continuous recording of field intensity of several distant short wave stations as an aid to the study of ionospheric conditions and their correlation with geomagnetic and solar phenomena.

Cosmic Ray Work

Kodaikanal (Director - Dr. A. K. Das)

Work is in progress for the installation of a Kolhorster cosmic ray apparatus. Continuous recording of cosmic radiation will begin shortly.

India Meteorological Department
Poona

IRELAND

REPORT OF WORK ON TERRESTRIAL MAGNETISM

Meteorological Service - Valentia Observatory

A magnetic observatory was first established on Valentia Island in 1888 by the British Administration. Absolute observations of declination, horizontal force and inclination were made, using a unifilar magnetometer by Jones and a dip circle by Barrow. The equipment was loaned by Trinity College, Dublin, and observations were made on the grounds of the meteorological observatory on Valentia Island, where they were continued until the end of 1896. The results of the first few years of the observations were published in the Proceedings of the Royal Irish Academy. After 1896 the instruments were returned off loan.

The meteorological observatory was removed from Valentia Island to Cahirciveen on the mainland, about four miles to the east, in 1892, and in January 1899, absolute observations of D, H and I were started in a wooden hut on the grounds of the new observatory and with a set of new instruments. The instruments were a Kew pattern Dover unifilar magnetometer and a Dover dip circle.

The Meteorological Service, Department of Industry and Commerce, Dublin, took over, inter alia, the management of Valentia Observatory from the British Meteorological Office, in 1937. There has been no interruption in the observations and absolute observations of declination, horizontal force and inclination continued to be made weekly.

The reduction of the observations and the tabulation have been kept up to date. The results up to 1938 have been published by the British Meteorological Office and by arrangement values for 1938, 1939 and 1940 are also being published by that office - in their Observatories Year Book as previously. Values subsequent to 1940 have not yet been published but will be published by the Meteorological Service when conditions permit.

The Observatory was used as the base station for the Irish survey of vertical magnetic force made in 1944-1946 (reported in IATME Bulletin No. 13). It is intended shortly to modernize the magnetic equipment of the Observatory. As a beginning, la Cour magnetic recorders for D, H and Z, now on order, will be installed in the near future.

Dublin Institute of Advanced Studies - School of Cosmic Physics

A magnetic re-survey of the country was carried out in 1950 by the School of Cosmic Physics of the Dublin Institute for Advanced Studies with the cooperation of the Ordnance Surveys of Ireland and Northern Ireland. The magnetometer-inductor No. CIW-13, on loan from the Carnegie Institution of Washington, was used throughout.

Measurements of the three elements D, H and I were made at 44 stations. These stations, with two exceptions, are the same as those of the 1891 and the 1915 surveys. The figures are being reduced with the help of information supplied from the magnetic observatories of Abinger and Eskdalemuir. The instrument was recalibrated at Abinger Observatory during the survey.

The results of the survey will be published in the Memoirs of the School of Cosmic Physics.

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ITALY

RAPPORT SUR L'ACTIVITÉ DE L'INSTITUT GÉOGRAPHIQUE MILITAIRE ITALIEN, POUR LE MAGNETISME TERRESTRE PENDANT LES VINGT DERNIÈRES ANNÉES

Par Luigi Morosini

Le premier levé magnétique du territoire national fut effectué, en grande partie, entre 1875 et 1878 par le Père Denza; la réseau était alors constitué de 80 stations mais, pour divers motifs, les valeurs ne furent pas publièes.

En 1880, l'Institut Central de Météorologie de Rome commença un nouveau levé, à l'intention de refaire et intégrer les levés du Père Denza, en triplant le nombre des stations du Réseau.

Ce travail, exécuté en campagne par le Prof. Chistoni jusqu'à 1888 et successivement par le Prof. Palazzo jusqu'à 1891, aboutit à l'exécution d'un réseau de 237 points et à la publication d'une série de cartes magnétiques des lignes d'égale déclinaison, inclinaison et composante horizontale, référées à 1892.0. Les années suivantes le Prof. Palazzo effectua d'autres déterminations complémentaires pour la mise à jour de ces cartes; de nouvelles observations furent ensuite ajoutées aux précédentes, mais dans le seul but de mettre à jour progressive l'ancien levé du 1880-1892, qui représentait, jusqu'à 1930, la seule base existante en Italie pour la connaissance du champ magnétique.

Ce levé ne pouvait cependant plus répondre aux exigences techniques et scientifiques modernes, soit en vue de l'impossibilité d'effectuer des mises à jour sérieuses après un si long intervalle de temps depuis les premières observations, soit à cause de la faible densité des stations qui constituaient le réseau. Pour ces raisons l'Institut Géographique Militaire se chargea, en 1930, d'effectuer un nouveau levé magnétique du territoire national, avec des instruments modernes et sur un réseau suffisamment dense.

Travaux de l'Institut Géographique Militaire

Pour l'accomplissement de ces travaux, l'Institut Géographique Militaire se pourvut de 4 couples d'instruments magnétiques de campagne, fournies par la Maison française Chasselon, dont on parlera plus loin, et pourvut aussi à l'instruction du personnel spécialisé chargé d'effectuer les observations.

Les travaux commencèrent en 1932 de façon à faire coïncider la période quinquennale, prevue pour l'observation de tout le réseau, à cheval sur les années 1934-1935, époque de minimum des taches solaires et des perturbations magnétiques. La densité des stations fut établie, en suivant l'exemple de ce qui avait déjà été fait en France et en Suisse, de façon à localiser les stations à 20 km les unes des autres, selon des mailles à carreaux; sur ce principe les stations furent placées à peu près au centre des feuilles de la Carte d'Italie à l'échelle du 50,000 ème.

A l'intention de déterminer périodiquement les variations du champ magnétique terrestre, dans le but d'obtenir les variations séculaires, il fut décide d'effectuer des stations fondamentales espacées de 1° en latitude et longitude; en ces stations fondamentales le nombre d'observations fut augmenté.

D'après ce programme, les travaux, commencés comme nous l'avons dejà dit en 1932, se poursuivirent régulièrement les années suivantes et à la fin de 1937 le levé magnétique du territoire national était achevé avec un nombre total de 1500 stations ordinaires et 46 stations fondamentales.

Pour le choix des stations on a eu soin de se tenir assez loin des centres habités, des chemins de fer, des lignes électriques et de toutes ces constructions qui, par la présence de matériels ferreux ou de courants électriques, auraient pu influencer le champ magnétique terrestre; on a cherché, en outre, à réoccuper, quand cela était possible, les stations de l'ancien réseau dans le but d'obtenit des valeurs ultérieures pour l'étude des variations séculaires.

Dans les zones d'anomalie, la densité des stations fut augmentée comme il convenait pour permettre une mise en évidence plus nette des anomalies locales et régionales.

L'étalonnage des instruments, au début et à la fin de chaque campagne annuelle, a eu lieu à l'Observatoire Magnétique de l'Institut Hydrographique de la Marine de Genes; cet observatoire a fourni, en même temps, les élements de réduction pour référer toutes les mesures de campagne aux dates de 1935.0 et 1940.0.

Le premier résultat de ce travail a été la publication (en janvier 1940) des lignes isogones de 10′ en 10′, et plus tard, la publication des cartes des lignes d'égale composante horizontale, référées elles aussi à 1940.0.

L'Institut Géographique Militaire assurait en même temps la répétition des stations fondamentales. Quelques-unes avaient dèjà été répétées en 1937 et en 1938 et presque toutes en 1939; 70 per cent des stations fondamentales fut répété, encore une fois, en 1943 et durant la période 1947-48 elles furent toutes observées de nouveau pour obtenir les éléments nécessaires à la publication de deux nouvelles éditions de la carte magnétique pour la déclinaison et la composante horizontale du champ référées à 1948.0.

Outre les travaux concernants le territoire national, l'Institut Géographique Militaire procédait aussi aux lévés magnétiques de la Libye et de l'Albanie.

Le levé magnétique de la Libye commença en mars 1938, à partir de la frontière tunisienne; il se développa, d'abord, le long de la côte jusqu'à la frontière égyptienne. Les travaux se déplacèrent après vers la Marmarica et la Tripolitaine du sud, progressant ensuite dans le Sahara Libyen jusqu'à la dernière localité accessible où l'on dut même recourir à l'emploi d'avions.

Les travaux en Libye furent suspendus en 1940, à cause de la guerre, avec comme résultat 203 stations magnétiques dont 38 fondamentales.

D'après ces éléments, l'Institut Géographique Militaire mit en état en 1940, une carte des isogones de la Libye, référée au 1er janvier 1941.

Les travaux en Albanie commencèrent en avril 1940 et furent suspendus, pour les mêmes raisons, quatre mois plus tard, alors que le travail avait déjà été effectué sur les deux tiers du territoire (Albanie septentrionale et centrale) avec un total de 66 stations.

Il ne fut pas possible de publier les éléments cartographiques pour ce territoire, mais les valeurs obtenues furent utilisées, cependant, pour la construction de la carte des isogones de la Dalmatie, Croatie, et regions limitrophes, référée au 1er janvier 1941, et d'une carte de la Mediterranée à la date du 1er janvier 1942.

A côté de l'activité susmentionnée dans le domaine des travaux de terrain et cartographiques, l'Institut Géographique Militaire a manifesté une activité remarquable dans le domaine scientifique théorique, comme en témoigne la bibliographie jointe en annexe; cette bibliographie fournissant en outre une illustration des principes qui on étés suivis pour l'exécution des travaux.

Instruments et Méthodes

Comme nous avons dit, les instruments employés etaient ceux fournis initialement par la Maison française Chasselon; chaque équipement était constitué par un théodolite magnétique et par une boussole magnétique. Le théodolite pouvait fournir la déclinaison et la composante horizontale du champ; l'inclinaison était donnée par la boussole magnétique.

La détermination du méridien géographique était effectuée au moyen des observations de soleil (6 visée conjuguées) au voisinage du 1er vertical, avec une précision de 1′ environ sur la moyenne. La détermination du méridien magnétique avait lieu à l'aide de 2 aiguilles, avec 8 lectures par aiguille; tolérance: 2′ entre les deux résultats. On doit toutefois retenir que l'erreur résultante sur la déclinaison ne dépasse pas $\pm$ 2′.

La composante horizontale fut obtenue en observant deux groupes distincts de 200 oscillations simples chacun de l'aiguille magnétique et interposant entre les deux groupes l'épreuve de déviation.

Cette épreuve fut toujours conduite dans les quatre positions de Lamont. En notant par T la valeur moyenne de l'oscillation simple, et par α la valeur moyenne de l'angle de déviation, la valeur de la composante horizontale du champ H est donné par la formule:

$$H = \frac{c}{T.\sqrt{\sin \alpha}}$$

c êtant une constante déterminée par étalonnage, au début et à la fin de chaque campagne, effectuée à l'Observatoire Magnétique de l'Institut Hydrographique de la Marine de Gênes.

La valeur c, pour chaque aiguille, est déduite de la moyenne de 6-8 déterminations, avec une erreur moyenne inférieure à $\pm$ 10 unités de la cinquième décimale logarithmique, qui correspond pour H à une erreur de $\pm 5\gamma$.

La composante horizontale H locale fut obtenue par la moyenne simple des résultats fournis par les deux aiguilles jumelles, en admettant une discordance de 40γ au maximum, ce qui fournit pour cette composante une précision de $\pm 20\gamma$ sur le résultat. Pour assurer ce résultat on avait fixé que, durant le cours des observations faites avec chaque aiguille, la moyenne des températures relatives aux deux épreuves des oscillations ne devait pas s'écarter de plus de 2-3 degrés centigrades par rapport à la température au moment de l'épreuve de déviation. Cette condition fut respectée en effectuant les mesures à l'abri d'une tente amagnétique.

Les appareils Chasselon, achetés en 1931, furent initialement vérifiés à l'Observatoire Magnétique de Val Joyeux dépendant de l'Institut de Physique du Globe de Paris. On pourvut ensuite à un examen comparatif des instruments en faisant une longue série d'observations simultanées sur terrain amagnétique et, en 1932, avant le début des travaux de campagne, les mêmes instruments furent vérifiés encore une fois à l'Observatoire Magnétique de l'Institut Hydrographique de la Marine de Gênes qui, pour une heureuse circonstance, entrait en service cette même année.

Toutes les mesures effectués par la suite furent toujours rapportées aux données de cet observatoire, qui prit soin d'avertir constamment l'Institut Géographique Militaire des éventuelles tempêtes magnétiques pouvant se produir pendant le cours des travaux de campagne, de façon à permettre une reprise des mesures.

L'Observatoire Magnétique de Gênes est équipé de trois appareils enregistreurs et de deux instruments pour la détermination absolue du champ.

Le trois appareils enregistreurs fournissent respectivement les variations de la déclinaison, de la composante horizontale et de la composante verticale du champ; les autres deux instruments sont un théodolite magnétique grand modèle et un inclinomètre à courants induits.

En ce qui concerne la mesure de l'inclinaison, il était apparu que la boussole employée par l'Institut Géographique Militaire ne fournissait pas la précision de la minute sexagésimale nécessaire pour le calcul de la composante verticale. Pour cette raison l'Institut pourvut, en 1940, à l'achat de deux inclinomètres de la Maison Askania, qui furent employés en 1942 et 1943 pour la répétition de nombreuses stations de la péninsule et par la suite pour la répétition de toutes les stations fondamentales. Toutefois, comme la répartition de ces stations de répétition n'offrait pas une densité uniforme par rapport au territoire national, on s'abstint de publier une carte d'isoclines, qui aurait nécessairement dû tenir compte aussi des valeurs peu précises, données par les autres stations.

Chaque station du réseau fait l'objet d'une description détaillée à laquelle est joint un plan avec les mesures de rattachement du point par rapport aux points fixes et aux points caractéristiques environnants sur le terrain.

Chaque point de stations est, en outre, matérialisé à l'aide d'un repère métallique amagnétique; les points fondamentaux sont surmontés d'un pilier en béton amagnétique au dessus duquel est cimenté un autre repère.

Les valeurs du réseau magnétique italien furent mises en rapport avec celles des Pays adjacents, à la frontière italo-française et italo-suisse, à l'occasion de la construction de la carte des isogones référée à 1948.0.

La jonction avec la France fut effectuée en s'appuyant aux stations de Nice, Grasse, Puget-Théniers, Draguignan (Var) (les valeurs furent prises sur l'Annuaire du Bureau des Longitudes de 1948) et à notre station de Ventimille, décelant des discordances, dans la déclinaison, comprises entre 1′ et 4′.

La jonction avec la Suisse fut effectuée en s'appuyant aux stations de Tesserete et Grono et à la station italienne de Bugiolo, trouvant des discordances qui ne dépassent pas 3′.

Ces comparaisons montrèrent, en outre, que les valeurs absolues de l'Observatoire Magnétique de Chambon-La Forêt (Paris), de la station magnétique enregistreuse suisse de Regensberg (20 km environ au N.W. de Zurich) et de l'Observatoire Magnétique de Gênes sont en excellent accord.

L'intention de l'Institut Géographique Militaire est de pourvoir à l'entretien et à la mise à jour du réseau magnétique national par répétition des stations fondamentales tous les 5-6 ans et particulièrement pendant la période de minimum des taches solaires, en se servant des instruments les plus parfaits et les plus modernes, et en se servant, aussi, pour ce travail, des données fournies par les observatoires magnétiques que l'Institut National de Géophysique établira sur le territoire national. Ces observatoires donneront de précieux éléments sur la variation du champ magnétique terrestre à ajouter à ceux fournis par l'Observatoire Magnétique de l'Institut Hydrographique de la Marine de Gênes.

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JAPAN

JAPANESE NATIONAL REPORT

Prepared by the Committee of Terrestrial Magnetism
and Electricity of the National Committee for
Geodesy and Geophysics

By M. Hasegawa, Chairman

Summary

Between 1948 and 1950, the National Council of Science and other institutes were reorganized in Japan. As a result, international cooperation in scientific research has come to be promoted by the new Council in all fields of science more actively than before. This report covers the following subjects:

I. General.
  Organization and activities of committees.
II. Terrestrial Magnetism.
  Magnetic Observatories: 1a, Kakioka. 1b, Memambetsu. 2, Aso. 3, Onagawa. 4, Wakkanai. 5, Kokubunji. 6, Katsuura.
  Magnetic Survey: 1, Kakioka. 2, Geographical Survey Institute. 3, Hydrographic Division. 4, Earthquake Research Institute. 5, Kyoto University.
  Statistical and Theoretical Works.
III. Atmospheric Electricity.
IV. Ionosphere.
  Ionospheric Observatories.
    Routine Observation: Wakkanai. Akita. Kokubunji. Yamagawa.
  Individual Investigations.
V. Earth Currents.
VI. Observations during Solar Eclipses.
VII. Cosmic Rays.
VIII. Radio Frequency Solar Radiations.
IX. Solar Phenomena and Related Phenomena.
X. List of Publications.

I. General

1. Japanese Committee of Terrestrial Magnetism and Electricity. The Science Council of Japan (SCJ) formed by representatives selected among the scientists in all branches of social and natural science throughout Japan was established in January 1949 for the purpose of contributing towards a peaceful rehabilitation of Japan and the advancement of science in unison with the academic societies of the world. The Japanese Committee of Terrestrial Magnetism and Electricity (JCTME), as one of the seven sections of the National Committee for Geodesy and Geophysics, was transferred to the new Council (SCJ) from the former National Research Council of Japan. Corresponding to various international scientific unions, many national committees were organized in SCJ. Among them, four committees, i.e., those of Ionosphere, Radio Science, Astronomy and Solar Eclipse, are intimately connected with JCTME. The latter consists of Chairman M. Hasegawa, Secretary T. Nagata, and 21

members, including representatives from observational or research organizations and individual researchers.

2. Ionosphere Research Committee (Y. Hagihara, Chairman). Throughout the period of reformation of the National Council, this committee has maintained its organization and activity as reported in the last assembly of IATME. (See Trans. of Oslo Meeting, p. 175).

As a continuation of three kinds of reports in Japanese with English abstracts, "Report of Ionosphere Research in Japan", vol. IV, 1950, was issued in English. This publication will be carried on in future.

Containing data from participating observatories of the ionosphere, geomagnetism, field intensity of radio wave, cosmic rays, solar phenomena and other related phenomena, "Catalogue of Disturbances" has been issued since August 1949 to report disturbances recorded during simultaneous cooperative observations. The "Catalogue" is sent to observatories and institutes of the world with the hope that an exchange of observing materials may result.

Warning before disturbances in radio communications and broadcasting of URSI-GRAM are under planning. The results of trial warning since August 1949 are under scrutiny.

3. Special Committee of Standard Magnetometer (S. Imamiti and T. Nagata, Secretaries). This committee was organized in JCTME in October 1950. Designing of a set of instruments of sine galvanometer pattern is in progress. The installation will be completed in three years at Kakioka Observatory.

4. The Society of Terrestrial Magnetism and Electricity of Japan (M. Hasegawa, Chairman). General meetings were held in June 1948 at Kakioka, in October 1948 at Tokyo, in May 1949 at Nagoya, in October 1949 at Tokyo, in May 1950 at Tokyo, in October 1950 at Sendai, and in May 1951 at Tokyo. A quarterly publication, "Journal of Geomagnetism and Geoelectricity" is issued since March 1949.

We regret to report that Honorary Member Dr. S. Fujiwhara died on September 22nd, 1950, after a long illness at an age of 66, and Honorary Member Dr. H. Nagaoka died on December 11th, 1950, at an age of 84. Both members were eminent leaders in observation and research in terrestrial magnetism and electricity, as well as in other fields of geophysical science in Japan.

II. Terrestrial Magnetism

Magnetic Observatories

1. Magnetic observatories under the Central Meteorological Observatory, Tokyo. (K. Wadati, Director)

Both Kakioka and Memambetsu Observatories are administered under the Central Meteorological Observatory. Kakioka is the standard station for magnetic observations and surveys in Japan.

(a) Kakioka Magnetic Observatory.
Lat. 36°13′51″ N, Long. 140°11′21″ E, Elevation 28 m.
Shuiti Imamiti, Director. Misao Hirayama, Chief of Magnetic Section.
Tadao Kuboki, Observer in Charge.

Absolute observations are carried out once a week. The instruments are Ad. Schmidt's normal magnetic theodolite, Edelmann's magnetic theodolite, and Nippon Suirobu type magnetometer,

Magnetic variations are recorded by Eschenhagen type unifilars for the horizontal intensity and declination, and by Lloyd's balance type for the vertical intensity.

(b) The Memambetsu Magnetic Observatory, Hokkaido.
Lat. 43°45.5′ N, Long. 144°11.6′ E.
Tetsuo Yumura, Observer in Charge.

Normal routine observations in this new observatory will be started in January 1952, while self-recording of variations of three components, as provisional work, was begun in August 1950.

2. Aso Magnetic Observatory of Kyoto University.
Lat. 32°52.9′ N, Long. 131°00.6′ E, Elevation 565 m.
Mankiti Hasegawa, Director. Masaziro Ota, Observer in Charge.

Absolute observations are made by Nippon Suirobu type magnetometer. Magnetic variations are recorded by unifilars for the horizontal intensity and declination, the scale values 2.7γ/mm and 0.43′/mm, respectively. The vertical intensity is recorded by a Watson type of metalic fiber suspension, of scale value of 4.2γ/mm. The time scale of 1 hour is 18.3 mm.

3. Onagawa Magnetic Observatory of Tohoku University.
Lat. 38°26′ N, Long. 141°28′ E.
Yoshio Kato and Jusuto Oosaka, Observers in Charge.

Magnetic variometers; Continuous recording. Paper speed, 15 mm/hr. Sensibility, H: 5.4γ/mm, D: 1.20′/mm.

Induction Magnetograph; Time variations of three components are continuously recorded by an induction magnetograph, constructed using a high permeability metal. Paper speed, 4 mm/min. Sensibility, 3γ/sec/cm.

4. Wakkanai Radio Wave Observatory, Hokkaido.
Lat. 45°26′ N, Long. 141°14′ E.
Tatsuzo Obayashi, Observer in Charge.

Since May of 1948, magnetic variations have been continuously recorded by unifilars for the horizontal intensity and declination, the scale values being 3.76γ/mm and 0.42′/mm, respectively. The vertical intensity recorded by a Watson type of metalic fiber suspension, 4.98γ/mm of scale values. The time scale is 22 mm/hr.

5. The Geomagnetic Division, The Central Radio Wave Observatory, Kokubunji Tokyo. (H. Uyeda, Director)
Lat. 35°42′ N, Long. 139°29′ E.
Masao Hirano, Observer in Charge

Visible recording of the H-magnetometer is carried on for the purpose of studying to forecast the disturbances in radio communication.

6. Katsuura Magnetic Observatory. (Wakayama Prefecture).
Shinkichi Utashiro, Observer in Charge.

This Observatory is part of the Hydrographic Division of Marine Safety Agency. Magnetic observations are made every five days by means of Nippon Suirobu type magnetometer.

Magnetic Survey

1. Division of Geomagnetism, The Geographic Survey Institute, Chiba City (K. Muto, Director). Ietsune Tsubokawa, Observer in Charge.

After the Nankaido Earthquake, three elements of the geomagnetic field were resurveyed at 13 stations in the Shikoku District, using Geographic Survey Institute (GSI) type magnetometer in 1948. The detail of the instrument will be reported in the Bulletin of the Geographic Survey Institute, vol. II, part 2, 1951.

Since 1949, first order magnetic survey had been carried out; all first order magnetic points (about 70) throughout Japan will be surveyed by the end of 1951.

2. The Hydrographic Division of Marine Safety Agency, Tokyo (K. Suda, Director). Shigeo Sano, Observer in Charge.

Magnetic surveys were carried out in 1948, 1949 and 1950, using Nippon Suirobu type magnetometer.

In August 1948, after the Fukui Earthquake, observations were carried out at Wajima, Shioya, Mikuni and Fukui.

From November to December 1949 a magnetic survey was carried out at Sakata, Murakami, Ebisu, Aikawa, Sado, Kanagawa, Itoigawa, Kuroiso and Matsuida, and from the middle of May to November 1950 at 31 stations distributed all over Japan. Result of survey will be published in a Report of the Hydrographic Division.

3. Kakioka Magnetic Observatory.

In March 1949, observations of dip were carried out at five stations in the Niigata Prefecture, using Nippon Suirobu type magnetometer.

With the same instrument, three elements were measured in June, 1949, at Jogashima and Nagai (Kanagawa Prefecture), Ooshima Island (Ooshima Meteorological Observatory) and Hoda (Chiba Prefecture).

4. The Earthquake Research Institute of Tokyo University (H. Tsuya, Director).

(1) To study the magnetization of volcano, Takesi Minakami carried out magnetic survey by a dip-circle at volcano Yakeyama (Niigata Prefecture) in August 1949, and at volcano Azumasan (Fukushima Prefecture) in July 1950.

(2) From July 25 to 30 and from September 22 to 26, 1950, Tsuneji Rikitake observed changes in magnetic dip accompanying an eruption of volcano Ooshima, with a miniature earth-inductor constructed by his own design. The 35 observation points were distributed over Ooshima Island.

5. The Geological Institute, Kyoto University.

By Naoiti Kumagai, magnetic survey was carried out from 2 to 29 May, 1950, at 383 points in 110 square kilometers area around Muraoka town, one of the most destructive areas of the Fukui Earthquake on June 28, 1948, using the Schmidt's vertical and horizontal magnetic balances.

Statistical and Theoretical Works

S. Imamiti summarized the data of geomagnetic observations at Kakioka during 21 years 1925-1945, and obtained the characteristics of diurnal variations. In their continuing statistical investigations on the data of the Second Polar Year, M. Hasegawa and M. Ota discussed the residual field of diurnal variation from its mean state.

S. Matsushita proposed a theory on geomagnetic L- and S-field, in which he imagined, in harmony with ionospheric observations, a system of circulatory motion in the ionospheres, in some respects similar in form to the general circulation of the troposphere (see paragraph on the ionosphere).

T. Rikitake calculated an electric current system for both bay and S_D variations on the basis of dynamo-theory. With assumptions of a high conductivity of the auroral zone and a wind over the polar cap expressed by spherical harmonic P_1^1, he obtained a fine diagram. N. Fukushima went on further into this problem, and examined conditions to be satisfied with conductivities and counter air currents in two layers in the upper atmosphere, for interpreting the phase and intensity of observed S_D and S_q field.

Taking various recent studies on relationship between the motions of ionosphere and geomagnetic phenomena into consideration, T. Nagata, N. Fukushima and M. Sugiura investigated to get a unified picture of the electrical and dynamical state of upper layers as consistent as possible in all kinds of observations, and concluded that the dynamo-action of the ionosphere can be responsible for various geomagnetic variations. They assumed two conductive layers which are separately effective to D, S_D and S_q, and calculated a single system of air circulation which covered the whole hemisphere.

M. Hasegawa and H. Maeda analyzed the magnetic field of diurnal variations (DV) into the electric DV field and the DV of electric conductivity in the upper atmosphere, using the data in the middle and lower latitudes during the Second Polar Year, and obtained some results from which it may be quoted that (i) DV of conductivity can be expressed in forms K_x $(1 - 1.3 \cos t + 0.6 \cos 2t)$ for the north direction and K_y $(1 - 1.0 \cos t + 0.4 \cos 2t)$ for the east direction; (ii) in the abstracted electric field, the amplitudes of semidiurnal terms are reduced to the same order of magnitude with those of L-variations; (iii) the amounts of influence of amplitude of geomagnetic DV on the daily mean value can be calculated.

T. Nagata dealt the solar flare type variation in the geomagnetic field theoretically, as a transient dynamo-phenomenon. The analysis of the observed geomagnetic variation yielded a total electrical conductivity of the ionosphere of order of magnitude $5 \cdot 10^{-8}$ e.m.u., which is in good agreement with the value deduced from ionospheric observation. T. Nagata and T. Suzuki confirmed the above by examining the effect of mutual inductance of other conductive layers on the transient changes in the geomagnetic field, caused by the dynamo-action on a layer. The above-mentioned conductivity of the ionosphere was supported also by the result of calculation of shielding effects of the ionosphere by T. Nagata and M. Sugiura.

M. Hirono examined the influence of polarization by Hall effect on the electrical conductivity of the ionosphere, and showed that abnormally good conductivity in the narrow region along the geomagnetic equator, suggested by statistical investigations, can be interpreted as this effect near the E region.

T. Nagata and N. Fukushima studied ionospheric disturbances and their relation to geomagnetic disturbance statistically.

T. Nagata traced the southward shifting of the zonal electric current near the auroral zone following the development of a magnetic storm, and interpreted it as a result of the shift of charged corpuscular stream under the influence of the magnetic field due to the equatorial current ring.

G. Ishikawa carried out a statistical and theoretical study on diurnal frequency of occurrence of sudden commencements of magnetic storms, by using the data of Kakioka, and obtained results almost similar to Ferraro-Parkinson's investigation. Of this problem, R. Yoshimatsu studied more in detail. Classifying according to amplitudes, he computed the mean diurnal and seasonal frequency of occurrence, and showed that the type of diurnal frequency curve about the group of small amplitudes of SC is inverse in feature compared with that of large ones.

Y. Kato and S. Utashiro classified micropulsation of dH/dt into three kinds, according to amplitudes and periods at different phases of the magnetic storm. Kato suggested that there are two kinds of radiant rays having different velocities, during a magnetic storm. Utashiro analyzed regular and irregular pulsations of dH/dt and found that the regular pulsation showed a diurnal variation.

S. Imamiti examined the world-wide and local geomagnetic variations from the data widely distributed over the earth, and pointed out certain variations which occur universally.

M. Ota discussed a treatment of the K-indices, and proposed that the nature of the disturbances be introduced in the indices. T. Kuboki and M. Hirayama also discussed the method of determining the K-indices at Kakioka.

I. Tsubokawa of the Geophysical Survey Institute designed and constructed a new type magnetometer (GSI-type) for the purpose of field survey. This instrument consists of Helmholtz coil for compensation of the magnetic field and a small rotating coil as the detector, and its error is less than 1 gamma or 0.1′. It takes about eight minutes to complete observations of three components.

T. Kuboki succeeded in getting a kind of Fe-Ni-Cr alloy, and by making use of it temperature variations of ordinary magnetometers can be automatically compensated.

T. Nagata and T. Watanabe studied experimentally magnetic behavior characteristics of rocks containing γ-Fe_2O_3. T. Nagata and S. Akimoto measured the magnetic transition points of volcanic rocks, and classified them according to thermomagnetic behaviors, and concluded that the magnetic transition points depend upon chemical constitutions.

Y. Kato designed a new type of astatic magnetometer shielded by high-permeability metal in order to study the orientation of residual magnetism of rocks.

Y. Kato continued the investigation on the changes of the earth's magnetic field accompanying earthquakes or volcanic eruptions.

T. Rikitake studied the regional anomaly in the earth's magnetic field under the assumption that this anomaly is caused by electric currents flowing at a depth of 1000 km. He examined the temperature distribution within the earth on the basis of an electric conductivity distribution inferred from the study of magnetic variations from the viewpoint of the theory of ionic conduction. He also observed the variation of magnetic dip accompanying the volcanic activities of Mt. Mihara and proposed a method for finding the position, direction and intensity of an underground magnetic dipole directly from the anomalies on the surface.

The problem of paleomagnetism was studied by T. Nagata, K. Hirao and H. Yoshikawa by measuring the remanent magnetization of Pleistocene deposits.

N. Kumagai, N. Kawai and T. Nagata summarized the results of measurements on the magnetic polarization of volcanic and sedimentary rocks, hitherto carried out by them and their collaborators, and concluded that the volcanic lava and rocks from sedimentary layers of geological time from Upper Neogene through Lower Holocene almost keep the direction of their magnetization nearly coincident with the present geomagnetic field, while the Azuki tuff (Upper Neogene deposits) and lava at volcano Sigi (Upper Neogene ejecta) showed the reverse direction.

N. Kawai followed T. Nagata's experiments on sedimentary layers of Narita bed, and expanded the ranges of sampling from Upper Pleistocene back to Upper Miocene. Gradual changes of paleomagnetism with geological periods were discussed.

R. Shoji designed a new equipment for measuring the contact potential of different rocks, and obtained some relative values on various rocks.

III. Atmospheric Electricity

Observatories

The routine observation of atmospheric electric potential gradient has been continued at Kakioka and Memambetsu Magnetic Observatories, Honjo Aerological Observatory, Electro-technical Laboratory and Tokyo University. Furthermore, the variations in potential gradient, space charge, atmospheric electric conductivity and point discharge current, were observed temporarily at these observatories and at Kyoto University.

Experimental Work

H. Hatakeyama and K. Utikawa observed the diurnal variation of atmospheric electric potential gradient on the summit and at a foot of Mt. Fuji. M. Kawano made simultaneous observations of the atmospheric electric field, space charge and wind at two points near the earth's surface and noticed that the minute variations in the electric field are caused chiefly by the motion of space charge in the lower atmosphere. Kawano made experimental researches in the laboratory and found that the point discharging current is appreciably affected by the static magnetic field of the order of 1 oersted. While M. Goto investigated the variation of the point discharge current during a rainfall, K. Kawasaki, S. Kikuchi and M. Misaki discussed the diurnal variation of the numbers of atmospheric ions.

With respect to thunder-cloud electricity, Y. Tamura concluded from the records of field changes at the time of lightning discharge that there are, in general, two layers of electric charges of positive polarity in a cloud. Hatakeyama found that the discharging points in a cloud make a "random walk" and brought out other new facts. Kawano found that the electric conductivity suddenly increases at the instant of lightning at a place a few km from the discharge, and suggested that some ionizing agency must begin to act at the same instant.

As to the disturbance of atmospheric potential gradient, Hatakeyama and Utikawa observed that caused by volcanic smoke at volcanos Asama, Yakeyama and Aso; and Utikawa investigated that by dust storm. Kawasaki and Goto observed that due to rainfall. Further, Goto examined a propagation of the disturbance using simultaneous records at two points.

A. Kimpara observed atmospherics in summer daytime and found that their wave form is directly related to the kind of lightning strokes. Direction finding of atmospherics was accomplished with a high accuracy by Kimpara and S. Kitagawa using their own apparatus.

Cooperative observations on special subjects, such as diurnal variations of the potential gradient, are being planned among specialists of this field.

IV. Ionosphere

Ionospheric Observatories

As ionospheric observatories, four stations are now continuing their regular work of hourly observation of h′-f curves.

They are situated at Wakkanai (Lat. 45°26′ N, Long. 141°41′ E), Akita (Lat. 39°43.5′ N, Long. 140°08.2′ E), Kokubunji in Tokyo (Lat. 35°42′ N, Long. 139°29′ E) and Yamagawa (Lat. 31°13′ N, Long. 130°38′ E). They belong to the Central Radio Wave Observatory, Radio Regulatory Commission, which was formerly called "Physical Institute for Radio Wave", Ministry of Education. Shibata Observatory was closed at the end of September 1949 and Fukaura Observatory was transferred to Akita at the beginning of December 1949.

At all the observatories, ionospheric sounding is now carried out with manual type installations, which will be replaced by those of automatic type in the near future.

Individual Investigations

Using the data of observations of the ionosphere in Japan for 16 months, H. Uyeda investigated the mean variations in f_{F2}, Z_m and Z_d, in which day-to-day fluctuations, 27.5-day recurrence and the influence of sunspots were all removed.

First at the Kyoto meeting of the Society of TME in October 1947, S. Matsushita and Y. Aono reported independently on the motion of the ionosphere. Specifically, S. Matsushita obtained latitudinal wind in F2 layer with a speed of 300-600 km/hr, using the data of f^oF2 for many observatories in the Far East, and Y. Aono made a study of fE_{min} using the h′-f curves at three observatories in Japan, and found that some of the deviations of fE_{min} propagate southward with a speed of 300 500 km/hr. In 1948 many persons expressed opinion on this problem. During a magnetic storm, southward propagation phenomena of ionospheric disturbance were observed in the E layer by K. Miya, and in the F2 layer by T. Nagata and N. Fukushima. As for the speed of propagation, the former obtained 280 km/hr in the course of study on the obliquely incident impulses, and the latter obtained 320-330 km/hr from research of the ionospheric storm in F2 layer. On the other hand, S. Matsushita made a detailed study on sporadic-E ionization and found that E_s ionic clouds have a tendency to move south and northward with a speed of about 370 km/hr and to change the direction semi-diurnally. Y. Aono followed this result and obtained a speed of 250 km/hr. The horizontal shifting of the bright night sky light was recognized by H. Huruhata, mostly from north to south with a speed of about 1000 km/hr.

It was found by S. Matsushita that there exists an oscillation period of four hours in the variation of the height of F2 layer, and T. Obayashi made a theoretical study of the oscillation of ionosphere.

The semi-diurnal lunar tide of F2 layer was shown by S. Matsushita to have an amplitude of 2-4 km and a phase difference of about 180° from the earth surface, using the data of maximum ionization height of F2 layer at Kokubunji for 13 months. He also obtained from f^oF2 the amplitude 0.052 mc/sec and the phase about 12 hr in lunar hours after transit at which the maximum occurs. Referring to these results, he discussed the L-field of the terrestrial magnetism.

S. Matsushita constructed a solar convectional circulation and solar tidal motion in the upper atmosphere, which are in harmony with the results of studies of his own and others on the movement of ionosphere as above described, and showed that the geomagnetic S-field may be dynamo-theoretically interpreted with the electric conductivity of ionosphere of order of 10^{-8} e.m.u.

Y. Inoue, on the other hand, suggested that these traveling phenomena of E_s are capable of being generated by the energy transfer of atmospheric sound waves from the disturbed auroral zones, and also S. Hojyo discussed local accumulation of this sound energy in the course of propagation along the layer near the E region.

The solar eruption was shown to be the cause of an increase of fE_{min} by Y. Aono, and the daily and seasonal changes of fE_{min} were discussed by H. Kamiyama in reference to an effect of the sun.

T. Yonezawa showed that the nocturnal variation of electron density in F2 layer, can be best interpreted in the terms of attachment and temperature change. Y. Inoue made a theoretical study of the ionosphere and discussed the transfer of radiation, temperature-gradient and recombination-process in the ionosphere.

Concerning ionospheric storms, N. Fukushima made a detailed study and classified them into a summer type and a winter type, between which there is a marked difference in their behavior.

The geomagnetic field in F2 region inferred from the difference between ordinary and extraordinary critical frequency, was first discussed by Y. Nakata. Later M. Hirono and T. Sato examined ionospheric data at Kokubunji using the theory of H. G. Booker and found that a very large magnetic diurnal variation in the ionosphere is doubtful, because the distribution and gradient of the electron density are considerably effective to the phenomenon.

M. Hirono considered the influence of Hall-current on the electric conductivity of the ionosphere. He also made a theoretical study of the ionospheric solar variation accompanied by diurnal electric current on the basis of theories due to D. F. Martyn, T. G. Cowling and D. R. Bates and H. S. W. Massey, and found a fair agreement with observations. K. Shinno discussed D. F. Martyn's theory. K. Maeda discussed the conductivity of the ionosphere referring to the recent theoretical and experimental studies on the ionospheric mechanism. His numerical results are of the same order of magnitude as those obtained by T. G. Cowling.

Y. Nakata made up an automatic equipment with which each observation of h'-f curve could be completed within 30 seconds and discussed the data obtained with it.

V. Earth Currents

The Work of the Magnetic Observatory

The Magnetic Observatory, attached to the Central Meteorological Observatory, Tokyo, has continued routine observations of earth current potentials at the following stations:

Place	Lat. N	Long. E	Base-length (m) WE	SN
Memambetsu	43°55′	144°12′	160	195
Kakioka	36 14	140 11	1500	780
Haranomachi	37 37	140 56	1330	850
Kanoya	31 25	130 53	2800	1650

At Kakioka, preliminary observations of earth resistivity have been carried out since April 1948 by the method of Wenner-Gish-Rooney, for which effective maximum depth is estimated to be 700 meters.

Temporary Observations

On the occasion of solar eclipses of May 9, 1948, and September 12, 1950, in the vicinity of Japan, and the occurrence of the Fukui Earthquake on June 28, 1948, the temporary observations of earth currents were carried out by several organizations; the Tokyo and Tohoku Universities, Magnetic Observatory, Central Radio Wave Observatory and others.

Theoretical and Experimental Studies

Many papers were read and some of them were printed. Their scopes of treatment extended to such problems as the electromagnetic induction within the earth, significance of absolute values, relations between potentials and resistivity, and further to connections with the ionosphere, earthquakes, volcanos, subterranean structures.

VI. Observations during Solar Eclipse

A solar eclipse occurred twice in the last three years (1948-1950) in Japan, one was the annular solar eclipse of May 9, 1948, and the other was the partial eclipse on September 12, 1950. In both cases, geomagnetic cooperative observations were carried out by the Committee of Solar Eclipse with participation of many organizations concerned. In addition to the established observatories, several temporary stations were set up.

For the eclipse of 1948, geomagnetic variations were observed at Kakioka and at Reibun Island (Hokkaido) by the Kakioka Magnetic Observatory; at Kanazawa (Sado Is.) by the Geophysical Institute, Tokyo University; at Aso and at Saigo (Oki Is.) by the Geophysical Institute, Kyoto University; at Shimoda by the Mitsui Institute; at Wakkanai by the Physical Institute for Radio Wave (PIRW). Time variations of the geomagnetic field were observed at Wakkanai and Onagawa by the Geophysical Institute, Tohoku University. Variations of geomagnetic Z-component were observed at Haranomachi (Fukushima Prefecture) by the Kakioka Magnetic Observatory. Ionospheric soundings by manual type equipment were carried out at Kokubunji, Wakkanai, Fukaura, Shibata and Yamagawa; and ionospheric soundings by automatic equipment and field-intensity measurements by pulsed waves at vertical incidence, at Wakkanai only. All these ionospheric observations were conducted by PIRW. Variations of earth current were observed at Kakioka, at Fukaura; the intensity of cosmic rays was measured at Tokyo by the Scientific Institute Ltd., by the Central Meteorological Observatory, and at Nagoya by the Physical Institute, Nagoya University. Meteorological elements of the upper atmosphere were observed at Wakkanai and at Tateno by CMO.

For the eclipse of 1950, besides stationary observatories, temporary stations were set up and variations of the geomagnetic field were observed at Zenikamezawa near Hakodate in Hokkaido by the Geophysical Institute, Tokyo University, and at Yamagawa by the Geophysical Institute, Kyoto University. Time variations of the geomagnetic components were observed at Nemuro (Hokkaido) and at Katsuura (Wakayama) by the Geophysical Institute, Tohoku University; time variations of the Z-component at Kanoya (Kyushu) by the Magnetic Observatory. Ionospheric soundings by high speed and automatic method with frequency range 1.5 mc/sec to 15 mc/sec at 30 second intervals at Kokubunji by the Central Radio Wave Observatory (CRWO); field intensity, wave form, incident angle and bearing of impulse of WMH 38, at Hiraiso and Kokubunji; measurements of ionospheric absorption at Kokubunji; measurements of solar noise on 200 mc at Obihiro (Hokkaido) by the Tokyo Astronomical Observatory, also on 60 and 175 mc at Kokubunji by CRWO; and measurements of the intensity of cosmic rays at Mt. Norikura by the Physical Institute, Nagoya University.

Analyzing these results, various views were expressed. Y. Kato offered a complicated mechanism on the effect of a kind of corpuscular eclipse on the ionosphere and geomagnetism. It was difficult to point out concretely the effect of a solar eclipse on terrestrial magnetism, but M. Ota, after analyzing the magnetograms, noticed that it was more reasonable to assume the existence of eclipse effect on the geomagnetic field in the sense of Bauer's former conclusion. To confirm these investigations it is desirable to hold world-wide cooperative observations. Y. Nakata and K. Araki's observations with their rapid acting equipments showed that the rapid change of f_{F2} (or abnormal E) was seen near the first contact and the change of f_{F1} was not smooth, but as if indicating irregularity of active regions on the solar disc during the eclipse. From the ionospheric observations during the solar eclipse of May 1948, Y. Aono said that $f_{E\ min}$ was observed at different stations, to increase by the chromospheric eruptions and decrease in consonant with the occultation of the eruptions. During the solar eclipse of 1948, K. Miya conducted measurements of field intensity sent from Hiraiso (9240 kc) at Komuro (near Tokyo), Ono (Hyogo Prefecture) and Okinawa. He obtained the result that the field intensity of receiving sites increased as the eclipse-rate advanced, and the longer the wave path the greater the increase of the intensity became.

VII. Cosmic Rays (By Y. Sekido)

An outline of cosmic-ray research before March 1948 was communicated to the Oslo Meeting as a pamphlet with the title "Geophysical Research of Cosmic-Rays in Japan", compiled by Science Research Institute (formerly IPCR), Nagoya University and Tohoku University.

Since March 1948, a program of continuous observation of cosmic-ray intensity has been extended step by step. Observations with Neher's electroscope and a Nishina's ionization chamber, which were recommenced in the summers of 1946 and 1947, respectively, have been continued until now, as standard observations for secular changes. Observations with a counter-type cosmic-ray meter, recommenced in August 1947, were continued until July 1949, for a precise measurement especially for short-term variations. These observations were carried out at the Science Research Institute, Itabashi, Tokyo, with non- or less-directional instruments, while at Nagoya University a directional cosmic-ray meter was made. Observation with this counter telescope was, after preliminary observations during March-May and September-October 1948, commenced in March 1949, and continued until now to supply data of vertical intensities. In August 1949, the counter-type meter (Itabashi) was modified to get also directional intensities. Besides wide angle observations, vertical intensities have been obtained since September 1949; and oblique intensities (EWNS) have been obtained since June 1950. Meanwhile, at Meteorological Research Institute, Mabashi, Tokyo, a counter-type cosmic-ray meter, with which observations were begun in the summer of 1947, was improved to get intensities of rays of various hardness.

Besides these continuous observations, temporary observations were conducted on Mt. Norikura (2800 m above sea level) in September 1950 by members of the three laboratories mentioned above. A counter-type cosmic-ray meter is in preparation at Tohoku University, and another counter telescope for the measurement of very hard cosmic rays is in preparation at Nagoya University.

The data thus and previously obtained were analyzed by members of the laboratories above mentioned. Beside them, members of Geophysical Institutes of Tokyo and Kyoto Universities also cooperated on the theoretical side.

An attempt to explain a storm effect with an equatorial ring current, was continued (1,4) as before. However, a theory (3) of cosmic-ray path showed that it is difficult to explain it with a simple model. Meanwhile, samples of storm effect were accumulated, and it was found that remarkable cases correspond to a special type of magnetic storm (6).

In 1948, it was found that cosmic-ray diurnal variation suffers a certain change at the time of magnetic storm (13). Beside the solar time variation, sidereal time variation was found from the data obtained at sea level (14,17) and underground. Meanwhile, deflection of cosmic rays in the magnetic field of the earth and the sun was calculated (18) with an attempt to explain the diurnal variation.

In this period, a sudden increase of cosmic-ray intensity was observed on November 19, 1949 (5) and on September 20, 1950. Meanwhile, the nature of flare-type cosmic rays was advanced for a previous increase (12). During the solar eclipse on May 9 (11), 1948 and on September 12, 1950, cosmic-ray intensities did not change.

Diurnal variation, semi-diurnal variation, magnetic storm effect and a sudden increase (16) obtained with various instruments were compared, and their atmospheric effects were discussed (2,19).

In treating such problems, local time variation and universal time variation must be distinguished. Therefore, an exchange of world-wide cosmic-ray data, is desirable.

VIII. Radio Frequency Solar Radiation (By T. Hatanaka)

Earliest Observations

In 1937, D. Arakawa noticed a sudden increase of hissing noise when a radio fade-out occurred. Later M. Nakagami and K. Miya measured the direction of the incoming noise, and they considered that it must have originated in the E layer of the ionosphere.

Observing Stations

In harmony with the recent progress of radio astronomy, the observation of solar radio noise at 200 mc/sec was begun in September 1949 at the Tokyo Astronomical Observatory, Mitaka, Tokyo, in collaboration with the Central Radio Wave Observatory (formerly the Physical Institute for Radio Waves).

Research Works

T. Hatanaka, S. Suzuki and F. Moriyama have derived a correlation between the burst characteristics of the solar radio noise at 200 mc/sec and the heliographic passage of sunspots of certain types, i.e., E type and F type. Echo phenomena in the solar radio bursts have also been studied both observationally and theoretically by these authors.

A close correlation was found between the emission mechanisms of the cosmic rays and the radio frequency radiation from the sun by T. Hatanaka, Y. Miyazaki and their colleagues.

M. Oda and T. Takakura proposed a model for the microwave radiation from the sun based upon their observations at 3000 mc/sec.

At the partial solar eclipse on September 12, 1950, observations of the solar radio noise were carried out in Tokyo and also in Hokkaido by the parties of the Tokyo Astronomical Observatory and the Central Radio Wave Observatory.

IX. Solar Phenomena and Related Problems (By T. Hatanaka)

Observation of solar phenomena at Tokyo Astronomical Observatory, University of Tokyo, is as follows: Sunspots, faculae, K_{2-3} flocculi, H_α prominences and H_α dark filaments are observed daily as a routine work (Chief, M. Notuki) with the following instruments: (i) Zeiss 20 cm equatorial telescope for visual observation of sunspots with a magnifying apparatus (solar image about 25 cm); and for observation of H_α prominences, with a prominence spectroscope; (ii) Steinheil 10 cm suncamera for observation of sunspots (solar image about 9 cm); (iii) Toepfer 3 cm slit spectroheliograph for photographic observation of K_{2-3} flocculi and prominences; (iv) 3 cm slit spectrohelioscope for visual observation of H_α flocculi, prominences and dark filaments. A preliminary report has been sent by wireless telegraph, and a monthly report has been published in Monthly Bulletin of Solar Phenomena of Tokyo Astronomical Observatory until 1948 and in mimeo-type since 1949. A quarterly report has been published since 1949. The results were used for the ionospheric research in Japan (Chairman, Y. Hagihara) and were sent also to IAU.

A 12 cm coronagraph designed by M. Notuki is now under examination at the Corona Station of the Tokyo Astronomical Observatory at Mt. Norikura (2900 m high). A test observation of the intensity distribution of the coronal bright line 5303 Å was made with an improved coronagraph in October 1950. The photometers for standardizing the observation are also under examination and construction by M. Notuki and S. Nagasawa. Percentage of days of observations is about 30 during November 1949-October 1950.

M. Notuki compared Wolf's relative number with Greenwich area of sunspots and obtained an expression of sunspot activity which is free from weather condition and apparent position on the disk (Rep. Ion. Res. Japan, 2, 1, 1948). M. Notuki noticed a lateral displacement of a solar eruption which occurred very far from the rapidly developing sunspot on July 16, 1947 (Tokyo Astr. Bull. II, No. 13, 1949). He also studied the motion of two types of eruptive prominences and suggested a possible mechanism (Jap. Journ. Astr. 1, 1, 1949).

T. Hatanaka and Z. Suemoto of the Tokyo Astronomical Observatory studied the correlation between the area of K_{2-3} flocculi and total electron number of F2 layer (Rep. Ion. Res. Japan, 4, 51, 56, 1950). K. Osawa, also of the Tokyo Astronomical Observatory, found a negative correlation between the intensity of λ 5303 and the daytime electron density of F2 layer (Rep. Ion. Res. Japan, 4, 125, 1950).

Z. Suemoto measured photometrically the contours of H_α, H and K lines in eruptions and flocculi at the tower telescope of the Tokyo Astronomical Observatory and found that they may be accounted for by assigning the high electron temperature of the order of 70,000° to the active layer (Publ. Astr. Soc. Japan, 2, No. 3, in press).

Observations of sunspots and flocculi are being carried out at the Ikomayama Observatory of the Kyoto University. Sunspots and prominences are also being observed at the Kakioka Magnetic Observatory.

X. List of Publications

Abbreviations

BEL	Bulletin of the Electro-technical Laboratory.
BERI	Bulletin of the Earthquake Research Institute, Tokyo University.
BGSI	Bulletin of the Geographical Survey Institute.
CPIRC	Collected paper of the Ionospheric Research Committee, National Research Council.
GM	Geophysical Magazine, published by the Central Meteorological Observatory, Tokyo.
GN	Geophysical Notes, published by the Geophysical Institute, Tokyo University.

JECE	Journal of the Institute of Electrical Communication Engineers of Japan.
JGG	Journal of Geomagnetism and Geoelectricity.
JMS	Journal of the Meteorological Society of Japan.
JSRI	Journal of Scientific Research Institute.
MENU	Memoirs of the Faculty of Engineering, Nagoya University.
NIRC	Note of Ionosphere Research Committee.
NPIRW	Note of the Physical Institute for Radio Waves.
PJA	Proceedings of Japan Academy.
PRAE	Provisional Reports of Observation of the Annular Eclipse on May 9, 1948 by Solar Eclipse Committee. (1948)
PRFE	Provisional Report of the Study of Fukui Earthquakes. (March 1949)
RIRJ	Report of Ionospheric Research in Japan.
RPIRW	Report of the Physical Institute for Radio Waves.
SRIRC	Special Report of the Ionospheric Research Committee, National Research Council.
SRTU	The Science Report of the Tohoku University.
TAB	Tokyo Astronomical Bulletin.

Note: Papers marked with an asterisk (*) are printed in Japanese.

(A) Terrestrial Magnetism

1. Fukushima, N. A special condition of wireless communication during magnetic disturbance. RIRJ, vol. 4, No. 2 (1950) 113-116.
2. __________. Some examples of the special condition of wireless communication during the 20th co-operative observation. RIRJ, vol. 4, No. 3 (1950) 181.
3. __________. Relation between the S_q- and S_D-fields viewed from the standpoint of the dynamo-theory. GN, 2 (1949) No. 20.
4. __________. Progressive change in the current system of the bay disturbance. GN, 3 (1950) No. 22.
5. Hirano, M., and Takahashi, T. Observations of terrestrial magnetism and the earth-current at Wakkanai and Fukaura during the solar eclipse on May 9, 1948. PRAE, 25-28.
6. Hirayama, M., and others. Magnetic and electric observations. GM, vol. XIX, No. 3-4 (1949) 174-193. (Report of solar eclipse observation, May 9, 1948)
*7. __________. On the external field of the geomagnetism. NIRC, 1 (1948) 18-24.
8. Hireno, M. On the influence of the Hall current to the electrical conductivity of the ionosphere. JGG, vol. 2, No. 1 (1950) 1.
9. Imamiti, S. World-wide distribution of geomagnetic K-index and conditions of radio communication. RIRJ, vol. 4, No. 1 (1950) 51.
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MOROCCO

RAPPORT NATIONAL MAROC

Par G. Bidault

Magnétisme terrestre

Depuis 1948, l'Institut Scientifique Chérifien a réoccupé les stations de répétition de Tanger, Rabat, Casablanca, Mazagan, Safi et Mogador. D, H et I y ont été mesurées.

L'Institut Scientifique Chérifien a également occupé 21 autres stations complètes: cinq sur le littoral atlantique du Maroc, sept dans les territoires présahariens, entre le Tafilalt et le coude du Drââ; neuf au Maroc oriental.

Monsieur Dubief, de l'Institut de Physique du Globe de l'Algérie, a complété le réseau des isogones de l'Oranie par une série de mesures de la déclinaison au Maroc oriental, il aurait ainsi déterminé une importante anomalie autour de Tendrara.

Les géodésiens du navire hydrographe "Amiral Mouchez" ont déterminé sept valeurs de la déclinaison entre Safi et Mogador. A cette occasion, une étude de la variation diurne de la déclinaison en ces points a pû être effectuée.

Le théodolite Chasselon, moyen modèle de l'Institut Scientifique Chérifien a été comparé à Alger au début de 1951, aux appareils QHM de l'Institut de Physique du Globe de l'Algérie. La concordance des valeurs de H ainsi obtenues a été jugée satisfaisante en vue de l'établissement des cartes magnétiques de l'ensemble de l'Afrique du Nord.

L'équipement du Maroc en appareils de mesures magnétiques limité depuis plusieurs années au théodolite et à la boussole d'inclinaison de l'Institut Scientifique Chérifien, s'est enrichi récemment de trois appareils QHM et d'une balance BMZ.

Electricité atmosphérique - Ionosphère

Sous l'active impulsion de Monsieur Haubert, un radiogoniomètre cathodique a été installé à Fédala, et un sondeur ionosphérique est en cours d'essais à Casablanca.

Publications

G. Bidault et J. Debrach. Physique terrestre - Paragraphe III. Magnétisme dans Physique du Globe et Météorologie au Maroc. Vol. Jubilaire de la Société des Sciences Naturelles du Maroc. Année 1948, p. 85. Cartes au Ier Janvier 1949 de D, I et H; valeurs moyennes des variations séculaires.

G. Bidault. Mesures magnétiques au Maroc en 1942. Ann. du Service de Physique du Globe et de Météorologie. Année 1942, p. 69.

M. Eyries. Observations magnétiques sur la côte marocaine. Bull. d'information du comité central d'océanographie et d'étude des côtes IIIe année, No. 3. Mars 1951, p. 100.

ANNEXE

Composition de la section de magnétisme et d'électricité terrestres du Comité national marocain de Géodésie et de Géophysique.

Organisme adhérent:

Monsieur le Directeur de l'Institut scientifique chérifien, avenue Biarnay, Rabat, Maroc.

Services intéressés:

L'Annexe du Maroc de l'Institut national de géographie, Rabat.

Le Service de Physique du Globe et de Météorologie, 2, rue de Foucauld, Casablanca.

Le Bureau de Recherches et de Participations minières, 38, avenue de la République, Rabat.

Membres:

C. Aynard - Directeur de la Compagnie marocaine de Géophysique, 3, rue de la Marne, Rabat.
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J. Debrach - Géophysicien au Service de Physique du Globe et de Météorologie, 2, rue de Foucauld, Casablanca.
A. Haubert - Docteur ès-sciences, immeuble du Parc, Fédala, Maroc.
J. Liouville (Docteur) - Conseiller scientifique du Gouvernement chérifien - Kasbah des Oudaïa, Rabat.
F. Mayot - Ingénieur géographe - Annexe du Maroc de l'Institut géographique national, Rabat.
L. Pasqualini - Directeur de l'Institut scientifique chérifien, Rabat.
G. Roux - Chef du Service de Physique du Globe et de Météorologie, 2, rue de Foucauld, Casablanca.

NETHERLANDS

REPORT ON GEOMAGNETIC AND IONOSPHERIC WORK DURING THE YEARS 1948-1951

By J. Veldkamp

Geomagnetism

The magnetic observatory at Witteveen has functioned without interruptions during the period 1948-1951, and is now managed by D. van Sabben. Records of normal speed from sensitive and insensitive variometers, as well as records from a quick-run recorder, are available.

The magnetic observations for the years 1946 and 1947 have been published in the series Yearbook B, Geomagnetism, issued by the Royal Netherlands Meteorological Institute, De Bilt.

Field measurements have been made in 1948 and 1949, in order to complete the magnetic survey of the Netherlands. The results have been published under the title "A new magnetic survey of the Netherlands, reduced to 1945.0".

A complete set of variometers and a set of field instruments was given in loan to the Magnetic and Meteorological Observatory, Djakarta, in order to make possible the reestablishment of the magnetic work in Indonesia.

The staff of the geomagnetic section of the Netherlands Meteorological Institute bestowed part of their time on the compilation and publication of international magnetic character figures and disturbance phenomena. The results for the years 1949 and 1950 have been published as IATME Bulletins 12c and 12e (Geomagnetic Indices K and C).

Ionosphere

At the Royal Netherlands Meteorological Institute at De Bilt regular ionospheric measurements are made by an automatic sweep recorder with a range of 1.4-16 Mc/s in 7 minutes. The hourly values are published in a monthly bulletin. Special investigations are in progress about triple magneto-ionic splitting and about the information which can be obtained from fading in the neighborhood of skip-distances. Various extensions are under preparation, a.o. for absorption measurements and for panoramic recording. Connections between ionospheric and magnetic disturbances and solar activity are investigated in particular at the magnetic station at Witteveen and are used for predictions of disturbances in radio communication.

NEW ZEALAND

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

CHRISTCHURCH GEOPHYSICAL OBSERVATORY

By J. W. Beagley

General

During 1948 the Department of Scientific and Industrial Research embarked on an extensive reorganization of the observatories under its control with the object of improving the coordination between allied sections and using to better advantage the services of officers with long term experience in observatory research. At Christchurch two units emerged, the Magnetic Survey Branch and the Christchurch Geophysical Observatory. This change became effective from December 1948 when the institution long known as the Christchurch Magnetic Observatory ceased to exist as such. Statistical work on the records obtained at the Amberley magnetic recording station, cosmic ray research, and the maintenance of climatological observations at Christchurch, formerly the responsibility of the Christchurch Magnetic Observatory, now devolved on the newly formed Geophysical Observatory. In addition, the new institution became responsible for the activities of the Apia Observatory and the ionospheric recording stations at Lincoln, Rarotonga and Campbell Island.

Geomagnetism

Photographic registration of the three magnetic elements was continued at Apia using the Eschenhagen variometers for D and H and La Cour vertical force variometer for Z. Absolute observations of declination, inclination and horizontal force were made each week using DTMCIW magnetometer No. 9 and Schulze earth inductor No. 2. Close cooperation with the Magnetic Survey Branch in the instrumental operation of the Amberley magnetic recording station was maintained.

International character figures have been assigned to each day of the Apia and Amberley magnetograms while K-indices have been derived for every three-hour interval of these records. These data have been regularly communicated to the Meteorological Institute, De Bilt, Holland, and the Association of Terrestrial Magnetism, International Union of Geodesy and Geophysics. Since June 1950, tabulations of 3KS for Amberley have been forwarded to Dr. J. Bartels. Details of magnetic disturbances recorded at both Apia and Amberley have been published regularly in the Journal of Geophysical Research. Arrears of Apia magnetic data from 1938 to 1948 were completed and placed in the hands of the printer. The years 1938, 1939, 1940, 1942, 1944, 1946 and 1947 have been published and issued. Data for 1949 have been completed. Similarly, arrears for Christchurch covering the period 1937 to 1945 were finished and are now being printed while data for the years 1946-1949 have been completed.

Investigations into the reliability of the magnetic standards at Apia from 1936 onwards were made. This work has indicated the need for frequent intercomparisons with standard equipment from another observatory such as Amberley and the maintenance of standard observing techniques to insure the positive determination of instrumental drifts in addition to changes in magnetic content of recording buildings resulting from structural modifications.

Ionosphere

Ionospheric recorders have been operated at Christchurch (Lincoln) 43.5°S., 172.7°E, Campbell Island 52.5°S, 169.2°E, and Rarotonga 21.3°S, 159.8°W. The installation at Lincoln is an Australian built type J.28 recorder which programs half-hourly, the frequency sweep 1-13 mc/s taking two minutes. The Campbell Island and Rarotonga stations are equipped with manual recorders. During 1948 the latter station was completely rebuilt.

Measurements have been made of the penetration frequencies for the E1, E2, F1, F2 layers; virtual heights of E2, F1, F2 and Es layers and maximum frequency and blanketing frequency of Es. Data for hpF2 and M3000 F2 were also obtained. Relevant information has been forwarded monthly to the Radio Research Board, Sydney, and the Central Radio Propagation Laboratory, Washington, D. C., as well as other organizations on an exchange basis.

Arrears in the Campbell Island data were overcome.

Cosmic Radiation

The operation of the Carnegie Institution's Compton-Bennett cosmic ray meter was continued and data dispatched regularly to them.

Ilford C2 nuclear research plates were exposed on various mountain peaks throughout the country up to 9700 feet, as well as on a mosquito aircraft between 25,000 feet and 40,000 feet. A wealth of data has been obtained and studies of these are still in progress.

A Blackett M.U.2 intensity recorder was installed during 1950 and the two counter units arranged to obtain measurements of the north-south effect under 15 cm of lead. Each unit was tilted to accept particles within an angle of 76° from the vertical.

Investigational Work

In addition to the current recording program, studies between magnetic and ionospheric storm relationships have been undertaken. Through the courtesy of the Carter Astronomical Observatory information regarding solar flares has been made available. This has greatly assisted in the examination of records for geomagnetic crochets. The National Broadcasting Service and Post and Telegraph Department have cooperated with current advice concerning Dellinger fade-outs which has been a valuable adjunct to our own ionosphere records. A fixed frequency ionosonde was installed to assist in these studies. The examination and classification of magnetic "sudden commencements" recorded at Amberley was commenced with the object of determining their characteristics and any periodic variations in the frequency of their occurrence. Some progress was made in analyses for the determination of lunar daily harmonic variations in the magnetic vertical force at Amberley.

An improved ionospheric index was developed for use as an indication of ionospheric storminess.

Appendix

List of papers prepared during 1948-1950. Read at the Seventh Pacific Science Congress, February 1949.

1. Atkinson, H. R. A survey of sub-antarctic aurorae 1941-46.
2. Beagley, J. W., and J. M. Bullen. Trends in magnetic declination at Apia and Christchurch.
3. Beagley, J. W., and A. C. Stanbury. Preliminary report on the use of photographic emulsions for recording cosmic ray tracks at high altitudes in New Zealand.
4. Gardner, A. L. Some observations of "E" region effects.

Presented at 1949 Geophysical Conference of New Zealand Department of Scientific and Industrial Research.

5. Atkinson, H. R. Recording of fluxmeter installation at Godley Head.
6. Beagley, J. W. Geomagnetic disturbances 1947-49 with associated ionospheric and other effects.
7. Bullen, J. M. The use of mathematics in geophysical observatory work.
8. Gardner, A. L. Ionospheric recording techniques.
9. Stanbury, A. C. Cosmic ray research progress during 1949.

Presented at 1950 Geophysical Conference of New Zealand Department of Scientific and Industrial Research.

10. Beagley, J. W. An analysis of geomagnetic "sudden commencements"
11. Bullen, J. M. An ionospheric disturbance index.
12. Stanbury, A. C. Double stars in photographic emulsions.

MAGNETIC SURVEY OF NEW ZEALAND

By H. F. BAIRD, Director

Summary

Information about stations on Campbell, Auckland, and Chatham islands is given. Progress in reoccupations is reported along with facts about new stations. The reoccupation of about twenty stations per year will continue along with, it is hoped, work on oceanic islands to the north.

Westerly drift of isoporic lines is discussed with reference to two lines of zero secular change in Z and F now crossing New Zealand.

Publication of extensive report and charts for Magnetic Resurvey of New Zealand and Outlying Islands epoch 1945.5 is in hands of printer. Annually navigation charts for a wide area of the South Pacific are prepared.

Satisfactory international intercomparisons with IATME QHM's 33, 51 and 52 are reported from Amberley with note on performance of QHM's 21 and 22 there over eleven years.

Work with an airborne total force magnetometer is already turning in good results. A new Ruska land magnetometer-inductor has arrived, been studied, and is ready for immediate field use.

Secular Variation Stations

Sub-antarctic and Chatham Island stations and others were reoccupied by the Director late in 1948. Perseverance Harbour tube on Campbell Island was reoccupied. Through erosion by sea mammals Venus Cove tube had gone, but we dug up a large iron hinge which may have been worked over in 1907. Camp Cove tube on Auckland Island was reoccupied; there too, erosion was almost complete. Tube Coleridge Bay was found; owing to weather conditions, safety first to our small ship prevented reoccupation. Long search earlier by some surveyors failed to find any other sub-antarctic tubes. On Chatham Island pegs Waitangi B and Te Roto were reoccupied. Road access on this island remains scant, but H. E. Garlick, who stayed longer, found pegs Karewa, Kaingaroa, and Kaingarahu; nine others were gone; seven were not visited so may remain. Eighteen other reoccupations extended from Paterson's Inlet, Stewart Island, to Rangiriri, near Auckland.

On Auckland Island, Terror Cove is a new station over a block used earlier for tubular compass work by geodetic surveyors. The German Transit of Venus 1874 site is near in this basaltic area. The collapsed German columns were separately unrecognizable, but future visitors with better descriptive details may succeed. Iron wire was strewn amongst them, and a gale blowing so the new sheltered site had to be used. On Campbell Island a new station by the astronomical base quite near the permanent scientific camp was established. To compliment Carnegie Institution of Washington, because their instruments had been used, the station was named "Vannevar Bush", after the Institution's President.

In 1949 five South Island stations north of Christchurch were reoccupied, and early in 1950 Conway, Rotorua B, Whakatane, and Kuripapanga stations. Eleven new stations were established central in the North Island, mainly by A. L. Burrows. Formation there is largely volcanic, but cooperation with Departmental geologists and geophysicists suggested these sites as being over non-ferrous sedimentaries.

We plan to reoccupy about 20 magnetic stations per year, and to do some stations on oceanic islands. Work with a new Ruska instrument will begin next week - mid-February.

In theMagnetic Chart Section a possible way of getting needed extensive oceanic secular variation data is mentioned.

Secular Variation

Since the preparation of the D, H and I isomagnetic charts shown in "A New Magnetic Survey of New Zealand" by H. F. Baird and A. L. Cullington, published in the Journal of Geophysical Research, December 1950, a good deal of additional observational data have been obtained including new occupations and repeat observations.

For the purpose of reducing to epoch 1950.5 the field observations beginning 1941 throughout New Zealand, A. L. Cullington has investigated the secular variation in D, H and I. The secular variation of the elements X, Y, Z and F was also determined by him and isoporic charts drawn for Z and F as at 1947.5. The results show that, for Z and F isopors, New Zealand is in a most interesting phase magnetically. For vertical intensity the Z zero isopor runs south-west traversing New Zealand from Gisborne through Picton and Preservation Inlet. To the north-west of this line the secular change is positive, i.e., the value of Z is numerically increasing while to the south-east of it the secular change is negative, i.e., the numerical values of Z are decreasing. For total force F the zero isopor runs north-east through Auckland and to the north-west of this line F is increasing, while to the south-east of it F is decreasing. The world isoporic charts for epochs 1912.5, 1922.5, 1932.5 and 1942.5 by Vestine show that there is a westerly drift in the pattern of the secular variation. As the Z and F isoporic charts are the first to have been constructed for New Zealand by this Branch it will be interesting to see if this westerly trend persists in our region when the next isoporic charts are prepared for epoch 1952.5.

Magnetic Charts

With Government Printer, Wellington, is an extensive report with charts on Magnetic Resurvey of New Zealand at epoch 1945.5. It is by H. F. Baird and A. L. Cullington and covers field work beginning 1941 until the end of 1948. Excepting magnetic disturbance force charts, it gives in modern form, and with isopors as well, information like that for epoch 1903.5 published by Farr in 1916. Disturbance force charts will be better founded when information now being obtained by airborne magnetometer is extensive enough. An abstract of 1945.5 report was prepared for December 1950 issue, "Journal of Geophysical Research".

Declination charts are prepared each year for the New Zealand Nautical Almanac and Tide Tables, and for New Zealand Air Pilot and Flight Information Manual. That manual covers just beyond area 150°E to 150°W from 20°N to 60°S. There on some islands the Carnegie Institution of Washington had stations. Recently with information supplied by us, a squadron of Royal New Zealand Navy cooperated splendidly by inspecting many old sites. The revealed loss was high so need to replace and extend the network exists. Many of the islands now have air strips. Either by cooperation with Navy or air services much data of global significance could be obtained on those islands. An important service like Navy must have a rigid time schedule, so to reduce observation time Department of Scientific and Industrial Research have ordered QHM's and BMZ's for our use. Need for work there since loss of "Carnegie" in 1929 is so urgent that preliminary steps for some such work by us are under way.

International Intercomparisons

We are grateful that following 1948 report the International Association of Terrestrial Magnetism and Electricity (IATME) sent QHM's 33, 51 and 52 for intercomparisons at Amberley. W. A. Carpinter's observations gave mean difference QHM-Amberley, as -2.5γ, mutual accordance between single QHM's at Amberley was good. Carpinter has compared differences between QHM 21 base-line values and QHM 22 base-line values for eleven years commencing 1940. Results 1940, -0.8γ, 1941, $+0.2\gamma$, 1942, -0.7γ, 1943, $+0.9\gamma$, 1944, $+0.9\gamma$, 1945, $+0.5\gamma$, 1946, $+0.1\gamma$ 1947, $+1.0\gamma$, 1948, $+1.2\gamma$, 1949, $+0.8\gamma$, 1950, $+1.1\gamma$. In the last four years absolute observations were done weekly, earlier at longer intervals, the mean of QHM's 21 and 22 is used. Another IMS intercomparison is desired.

On a recent private visit to Copenhagen it was a privilege and pleasure to see divided circles of the type the IATME is using for international comparisons.

Because declination changes proved too small for needed precise measurement the attempt to check orientation of H- and D-variometers with QHM's will be replaced by use of a magnet.

Magnetic Airborne Survey

The branch now operates a total force magnetic detector which is mounted on the tail of a twin-engined Miles Aerovan. Recording is in the cabin. Flights have given some very useful data around Banks Peninsula and even out to Mernoo Bank, submerged some 140 miles east. A close grid was flown over a thermal region in the North Island. Longer flights have been made from Bulls to White Island and V. B. Gerard and J. A. Lawrie are now relating Amberley base-station and land magnetic survey stations en route with air-flown traverses between here and the thermal area where over an area of 9000 square miles a special geological problem is being studied. Areas of magnetic disturbance towards as well as in and around Cook Strait region have been revealed at 5000 feet. The gradient with height has been ascertained, and early work already completed indicates that this speedy tool will be most useful in magnetically mapping both the disturbed and undisturbed areas in and about New Zealand. This activity is very young yet but correlation with land magnetic stations on non-ferrous sedimentaries is good. Already it has thrown some light on the extent of disturbed regions referred to in the penultimate paragraph of my 1948 report.

PERU

GEOPHYSICAL WORK IN PERU

By Albert A. Giesecke, Jr.

Active interest in geophysics on the part of the Peruvian Government greatly increased because of the generous transfer of the Huancayo Magnetic Observatory by the Carnegie Institution of Washington to Peru on July 1, 1947, and the creation of the Instituto Geofisico de Huancayo.

The period following the transfer was characterized by increasing recognition of the importance of geophysics, as evidenced by the fact that appropriations for Huancayo are at present 500 per cent greater than those for the year 1948. Furthermore, the proposed 1952 budget recognizes the importance of initiating research at the Huancayo Instituto, and is hence even larger. Financial aid was received from the Carnegie Institution of Washington through June, 1949, and since that time operation of the ionospheric laboratory, as an associated laboratory to the Central Radio Propagation Laboratory of the National Bureau of Standards in Washington, D. C., has resulted in additional income.

The Instituto Geologico del Peru, through its Director Dr. Jorge A. Broggi, who is also President of the Directive Committee of the Instituto Geofisico de Huancayo, has its own geophysical section, and has been responsible for the continued operation of an oscillograph in Lima for the purpose of recording violent earthquakes.

The framework for a Geophysical Union has been established and preliminary steps have been concluded to create the Instituto Geofisico del Peru.

After the transfer of the Huancayo Observatory all of the Carnegie Institution's staff was replaced by Peruvians, three of whom received training over a two and a half year period in the United States, aided by fellowships provided by the Carnegie Institution of Washington and the National Bureau of Standards of the U.S.A. At the same time the Observatory functioned continuously, operating equipment for terrestrial magnetism, seismology, cosmic rays, ionosphere and field intensity, spectrohelioscope observations, and meteorology. The atmospheric electric and earth current observations were discontinued in 1946; the equipment, however, remains "in situ".

Reduction of records, formerly done in Washington, was done at Huancayo and a series of monthly publications was initiated at the beginning of 1951. It has also been possible to do special experiments for the C.R.P.L. in the study of radio transmission modes; to do field work for the I.A.T.M.E. Committee No. 11 "to promote observations of the daily variation of horizontal force between and near the geographic and magnetic equators", occupying 14 stations in Peru, Ecuador and Colombia; to cooperate with the Committee No. 7 of the I.A.T.M.E. "to promote international comparisons of magnetic standards"; and through the Inter-American Geodetic Survey to occupy six old and five new secular variation stations in 1949 and seven old and four new in 1950.

New ionospheric and field intensity equipment was received from the C.R.P.L. and a new Radio Laboratory constructed at Huancayo; improvements have been made in the optical system of the seismographs and a microbarograph was installed in the cosmic ray meter. Approval has been obtained, and certain funds allocated, for the construction of a new seismological station at Iquitos, Peru, and for improvement of the vertical seismograph at Huancayo. Plans are also approved for the installation of an ionospheric station either in Lima or in Cerro de Pasco.

Preliminary steps have been taken to study the publication of the meteorological data which have been obtained during the past 30 years in this high altitude southern hemisphere station (Huancayo is at 3350 meters above sea level).

The Instituto Geofisico de Huancayo will now attempt to initiate a research program and because of its long record, good equipment, and location, particularly its position on the magnetic equator, feels that it can expect to interest scientists outside of Peru to devote some of their efforts at Huancayo. Through a grant from the Carnegie Institution of Washington an International Guest House has been built and is maintained at the Instituto.

REPUBLIC OF THE PHILIPPINES

GEOMAGNETIC WORK IN THE PHILIPPINES

By Lt. Cdr. Avelino D. de Guzman

The work in geomagnetism in the Philippines for the years 1948-51 has been confined to four main activities, namely,

I. Establishment of a new magnetic observatory to replace the one totally destroyed during the last war.

II. Observations of declination in a few stations incident to hydrographic surveys undertaken.

III. Training of personnel abroad.

IV. Procurement of additional equipment for magnetic surveys.

Also, during the period, the transfer of geomagnetic work from the Weather Bureau, Department of Commerce and Industry, to the Bureau of Coast and Geodetic Survey, Department of National Defense, was made.

Previous to the outbreak of World War II, the Philippines had one magnetic observatory located in the town of Antipolo (lat. 14°36′N; long. 121°10′E), Rizal Province, and operated by the Manila Weather Bureau Observatory under the Jesuit priests. This observatory was first established in Manila in 1890, but due to the inauguration of a street railway system in 1904, had to be transferred some 18.5 kilometers east of the city. From 1911, continuous records have been kept at Antipolo until the war operations in 1944, when the buildings and all the equipment at the station were completely destroyed.

Upon the return of civil government to normal functions, the Bureau of Coast and Geodetic Survey made representations and acquired funds for the reconstruction of the observatory. The United States, through the U. S. Coast and Geodetic Survey, generously assisted in the rehabilitation program by providing the initial instruments and training of personnel. The amount of $10,000 was spent by the Philippines for the buildings and quarters while some $43,000 worth of instruments was provided by the United States.

There were three factors which made a new site for the new observatory desirable. These were: (1) The Antipolo site is on private property and expropriation proceedings will cause additional expenses and delays. (2) Piles of war debris were heavily strewn all around the place. (3) Security purposes.

A search in many localities for a new site was made and a portion of the Insular Prisons Reservation at Muntinlupa, Rizal, was tested and finally selected. The site consisted of a 4-hectare lot for the non-magnetic buildings and additional space for quarters and service buildings. The place is about 32 kilometers southeast of Manila, and 61.94 meters above mean sea level, on a rolling ground overlooking Laguna Bay. The geographic coordinates of the absolute pier are: lat. 14°22′28″N; long. 121°00′56″E.

The non-magnetic buildings were constructed and patterned after those of U. S. Coast and Geodetic Survey magnetic observatory at Barbers Point, Hawaii. Foundations and instrument piers were cast with crushed non-magnetic limestones, white sand and white cement.

The instruments consist of a set of Eschenhagen-type variometers manufactured by Ruska Corporation, with a 20 mm/hour drum photographic recorder. Pending arrival of an observatory type magnetometer and earth inductor, a CIW field magnetometer is being used for absolute baseline observations.

During the United States Rehabilitation Program in the Philippines in 1947-50, five officer-trainees have been given specialized training in geomagnetism which covered both field observations and observatory work. The training also included the testing and standardization of the instruments later transferred to the Philippines.

Observations for magnetic declination were obtained on 15 new stations by hydrographic parties while undertaking detached surveys. No extensive magnetic surveys or reoccupation of repeat stations were accomplished due to lack of personnel and equipment.

Some funds have been made available for the procurement of additional equipment for field surveys. Delivery of three Hamilton marine chronometers and one Gurley transit magnetometer has already been made, while two quartz horizontal magnetometers (QHM) and two magnetometric zero-balances (BMZ) have been ordered. Also, some non-magnetic tents and accessories for field parties are being prepared and observers trained at the Observatory for future field work.

POLAND

REPORT ON GEOPHYSICAL WORK FOR THE PERIOD 1948-1950

By Z. Kalinowska

The program of work carried out by the Geophysical Observatory at Swider during the period 1948-1950 included the observations of terrestrial magnetism and atmospheric electricity, together with additional meteorological observations.

The magnetic work included: (a) Absolute measurements of declination, inclination, and horizontal force performed once every week (previously, during the winter months, at intervals of two weeks); (b) Continuous photographic registration of the three elements: D, H, and Z by means of a slow-run recorder (20 mm per hour) at Swider; (c) Continuous registration of horizontal and vertical force, H and Z, at a new station - Glinianka, established at a distance of 12 km from Swider; (d) Field work; (e) The reduction of observations. This included the calculation of mean annual values, the assignment each month of the daily magnetic character figures C, of the three-hour-range indices K, and of the sudden commencements. These data were sent regularly to de Bilt.

In the absolute measurements and in the registrations we have not introduced either new methods or new instruments. For absolute observations the following instruments were used: the Kew magnetometer, the Sartorius magnetometer, and the Schultze earth inductor. Also, in 1950, a series of observations was conducted with the quartz magnetometers of la Cour (QHM's) in order to control the D and H variometers. As a result of these observations corrections to the position of these instruments have been made.

The curves of diurnal changes at Swider show certain additional disturbances due to the electrification of the neighboring railway which runs at a distance of 1.2 km from the Observatory. The disturbances can be eliminated, and we will have a distinct picture of diurnal variations. For control observations, however, a new registration station was started in 1948 and built at a distance of 12 km from Swider. A second registration instrument and two variometers for the determination of the horizontal force H and the vertical force Z were installed at this station. This additional material is being reduced at present.

Field measurements were undertaken in 1947 with the view of working out a new magnetic survey of the country. Magnetic observations were made in 1947 at 60 stations; the three elements D, H, and I have been determined at 43 stations and at 17 additional stations declination and inclination only were observed. Only seven stations were occupied in 1948. The three elements were determined in 1949 at 25 stations and, in addition, the declination and inclination at ten additional points. Finally, in 1950, observations of the three elements were made at 46 stations.

This total of more than 100 stations is a major contribution to the new magnetic survey of Poland. Under favorable conditions it may be finished in 1952. The incorporation of the Observatory during 1951 into the National Geological Institut will make the work of the Observatory much easier. The Department of Applied Geophysics of the Institut has carried on many unusual geophysical studies. If we take into consideration the new circumstances, namely the fact that researches can be carried on jointly by the Observatory and the Department, we can expect very interesting and important results.

During the years 1947-1950 observations were in many cases made at the same places as were used by Professor Kalinowska when he made his first magnetic survey of Poland in 1925-1928. Some stations observed in 1947 were reoccupied in the years 1949 and 1950. Thus the collected series of observations is giving not only the picture of the magnetic field in our country, but can serve also as the basis for determination of secular variations in this territory. The special net of magnetic secular variation stations was not yet established.

The following instruments were used for the field surveys: the Chasselon magnetometer middle type, the Dover inclinator, the quartz magnetometer of la Cour (QHM). In 1949 and 1950 the vertical magnetic force Z was determined also at many stations, using the Schmidt vertical-force field balance.

We have resumed, in 1948, with the use of two Benndorf electrometers, continuous autographic records of changes of the electric potential gradient, carried out before the war and stopped in 1939. In connection with observations of atmospheric electricity there have been undertaken certain meteorological observations including continuous registration of the change of temperature, of atmospheric pressure, and of humidity; the observations of direction of wind, of state of clouds, and of quantity of rainfall. The investigation of the solar insolation could not yet be started.

Swider, Poland

SPAIN

RAPPORT NATIONAL ESPAGNE

Par Jose Rodriguez-Navarro de Fuentes

INSTITUT GÉOGRAPHIQUE ET CADASTRAL

Par l'intermédiaire de sa Section de Géodésie et de Géophysique, celui-ci est chargé, entre autres, du Service de Magnétisme et d'Electricité Terrestres sous les ordres de la Direction Générale de l'Institut à Madrid, dont dépendent les observatoires suivants:

OBSERVATOIRE CENTRAL GÉOPHYSIQUE DE BUENAVISTA (TOLÈDE)

Cet Observatoire est située à proximité de Tolède. Actuellement les services de Séismologie, de Magnétisme et d'Electricité Terrestres y sont établis, ainsi que les installations de Météorologie nécessaires à leurs travaux.

Nous référant uniquement à ce qui est de la compétence de notre Section, nous traiterons brièvement des Sections de Magnétisme et d'Electricité Terrestres.

Magnétisme terrestre

Les pavillons correspondants sont groupés en un seul édifice dont les parties essentielles sont les salles de mesures absolues et de variomètres, unies par un autre corps de bâtiment de 19,40 mètres de long. La salle des mesures absolues compte 17,70 mètres de long sur 6,80 mètres de large.

L'installation des variomètres est constituée par trois salles pour l'installation du même numero d'equipements et elles sont toutes entourées d'un corridor commun pour l'isolement.

Les édifices sont en maçonnerie et en ciment, avec une toiture sur une charpente de bois et pour garantir l'isolement parfait au point de vue thermique toutes les précautions dues ont été prises en posant une couche de liège sur les solins pour éviter l'humidité, ainsi que des revêtements de liège sur les murs, les plafonds et les pans de la toiture.

Pour compenser les basses températures de l'hiver à Tolède, il a été necessaire d'installer un système de chauffage supplémentaire construit tout en cuivre.

Le "magistral" de cet observatoire pour la détermination des absolues est constitué par la Théodolite magnétique normale de Schmidt, l'inducteur terrestre de Askania et un magnétomètre La Cour, QHM, alors que jusqu'à ce jour fut utilisé le magnétomètre Carnegie prêté par l'Observatoire de la Marine de San Fernando.

Deux équipements de variomètres sont utilisés, le numéro 1 est constitué par les trois variographes pour D, H et Z de la Askania Werke et le numéro 2 par un déclinomètre de Copenhague, un variographe de H de Exhenhagen et une balance pour Z de type Llyod.

Les premières données que l'on put obtenir d'une manière régulière furent celles de 1947. Depuis 1948, cet Observatoire donne les valeurs des indices K au Réseau magnétique mondial centralisé au De Bild.

Electricité terrestre

La Section de Géoélectricité est plus récente, dans cet Observatoire, que celle de Géomagnétisme et on comença à construire en 1942 l'installation de COURANTS TELLURIQUES qui fonctionne actuellement dans le cadre du plan générale projeté. Elle dispose d'une double prise de courant par ligne aérienne et par câble souterrain avec une composante N.-S. de 1.884 mètres en l'air et de 1.585 mètres sous terre, les valeurs respectives de la composante E.-W. étant 1.792 et 1.520 mètres.

Les extrémités de chaque composante sont formées d'électrodes en maille de plomb, enterrées à un mètre de profundeur.

Les quatre courants ainsi obtenus passent par deux tables d'épreuve et de mesure. Quatre galvanomètres à cadre mobile enregistrent, par des moyens optiques, les quatre valeurs obtenues sur une bande de papier photographique à une vitesse horaire de 20 millimétres.

Dépuis le début de l'année fonctionne un appareil enregistreur rapide, 160 millimètres à l'heure, conçu par l'ingénieur chargé M. de Miguel. Sur cet appareil sont annotés les courants qui circulent par les deux composantes aériennes, ce qui permet d'étudier les pulsations et les variations rapides qui ne pouvaient pas être bien déterminées avec l'enregistreur lent. Cependant quatre nouveaux galvanomètres de mêmes caractéristiques ont été acquis dans le but d'en installer deux en parallèle dans chacune des composantes aériennes à l'effet d'obtenir un enregistrement rapide et un autre lent qui permette de comparer ce dernier à celui obtenu au moyen des lignes souterraines comme on l'a fait jusqu'à ce jour.

Cette installation est complété par la mesure de la résistivité du terrain.

L'installation pour la détermination des PARASITES ATMOSPHÉRIQUES (CROTOSCOPIE) montée dans un pavillon indépendant comporte un système collecteur formé par une antenne omnidirectionnelle de 60 mètres et une autre à cadre dirigé qui peuvent être employées indistinctement et qui conduisent les ondes à un récepteur qui actuellement capte celles de 500 à 1.050 mètres. A la sortie, un relais substitue le signal reçu par un autre plus puissant qui agit sur l'électro-aimant d'un enregistreur dont la bande a une vitesse de 18 centimètres à la minute. Cette installation fonctionne d'une manière automatique dix minutes par heure, enregistrant pendant ces intervalles la fréquence des parasites atmosphériques. Pour l'étude des autres caractéristiques de ces parasites existe un oscillographe à rayons cathodiques situé avant le relais et dans lequel apparaissent graphiquement la forme, le période et la intensité du parasite.

Une station réceptrice de radio pour longeurs d'ondes de 20.000 à 30.000 mètres qui est plus appropriée pour ces études est en construction.

La déterminatiqn du POTENTIEL ATMOSPHÉRIQUE est constitué par la sonde radioactive accouplée à un électromètre à cadran du type Benndorf.

Pour l'étude de l'IONISATION ATMOSPHÉRIQUE a été acquis et se trouve en cours de montage un compteur d'ions type Ebert qui sera connecté à un appareil enregistreur pour l'inscription des déterminations et il existe également un autre appareil type Gerdien pour la détermination de la conductibilité électrique de l'air.

La publication de toutes les donées obtenues et des investigations qui en découlent est en et projet et celles concernant les courants telluriques depuis 1948 ont déjà été publiées.

OBSERVATOIRE GÉOPHYSIQUE D'ALMERIA

Une propriété voisine des terrains sur lesquels est édifié l'Observatoire Séismologique a été acquise. On y a construit les Pavillons magnétiques. On a profité d'une pente pour placer celui des absolues au niveau du sol et pour presque enterrer celui des variomètres. La salle des absolues mesure 13,70 mètres de long sur 7 mètres de large et contient les piliers d'observation nécessaires.

Une galerie couverte de 14 mètres de long et de 3 mètres de large sépare ce pavillon de celui des variomètres dont la chambre centrale, mesurant 8 mètres sur 4,40 peut contenir, avec la séparation nécessaire, deux équipements de variomètres.

La construction de ces édifices a été faite sur la base de voûtes et de murs de forte épaisseur afin d'assurer principalement l'isolement thermique.

Le sol est en ciment recouvert de liège et les parois ont un revêtement de fibre de verre ou "vitrofib". Le plafond, comme nous l'avons déjà dit, est vouté et sur il et, appuyé sur des cloisons de briques creuses en deux directions perpendiculaires, trouvent appui an plafond plat, laissant une grande chambre d'air, sur lequel est posée une couche de vitrofib, un second plafond plat et la toiture de la terrasse formée d'une couche d'argile et de carrelages.

Ces édifices sont déjà terminés et l'installation des instruments est en cours.

OBSERVATOIRE GÉOPHYSIQUE DE LOGROÑO

Celui-ci est actuellement en construction à environ 5 kilomètres à l'ouest de la Ville. Les Sections de Séismologie et de Géomagnétisme s'y installeront bientôt, la dernière étant la plus avancée.

Le pavillon des variomètres est aussi presque enterré et la salle intérieure mesurera 7,25 mètres sur 4,25 mètres.

A 16,40 mètres de ce pavillon se trouvera celui des absolues dont la salle mesure 13,40 de long sur 6,50 mètres de large.

On a adopté la solution des toitures de tuile sur charpente de bois, ainsi que toutes les précautions nécessaires pour l'isolement thermique telles que revêtement de "vitrofib" pour les murs et les plafonds, grandes chambres d'air, sols de liège, fenêtres doubles, etc.

La construction est très avancée et les instruments en cours d'installation.

OBSERVATOIRE GÉOPHYSIQUE DE SANTIAGO DE COMPOSTELA

Aux abords de la ville, à 1 kilomètre à l'ouest de celle-ci, des terrains ont été acquis. On va y commencer la construction d'un Observatoire qui dépendra également de l'Institut Géographique et Cadastral, où s'installeront les Sections de Séismologie et de Géomagnétisme, la priorité étant donnée à cette dernière.

TRAVAUX EN CAMPAGNE

Il existe des Brigades de campagne, dépendant de la Direction du Service de Magnétisme et d'Electricité Terrestres, qui, avec des magnétomètres portatifs, se sont consacrées, au cours des dernières années, à l'observation de stations séculaires et qui, actuellement, se préparent à relever en une période de cinq ans la Carte magnétique de L'Espagne. Ces travaux s'effectueront en complet accord avec le Service Metéorologique National Portugais qui s'occupera de la même tâche sur son territoire.

Dans une brochure séparée est donné le projet de cette carte.

OBSERVATOIRE DE L'ÈBRE (TORTOSA)

Cet Observatoire fonctione presque depuis le début du siècle sous la direction des PP. Jésuites et comme ses travaux sont parfaitement connus, surtout par la part magnifique qu'il a apporté dès sa fondation au Magnétisme et à l'Electricité Terrestres, il ne nous reste plus à mentionner que ce qui suit:

Pendant la guerre civile espagnole, l'Observatoire a continué de fonctionner avec une régularité suffisante jusqu'aux premiers jours d'Avril 1938 qu'il fut démantelé par l'armée rouge en retraite.

Les appareils de l'Observatoire, récupérés en fevrier 1939, furent transportés de nouveau à Tortosa en avril.

Les magnétomètres absolus et les variographes furent réparés. Les nouvelles constantes du magnétomètre Dover 153 furent déterminées par comparaison avec les magnétomètres Dover 173 de San Fernando et Carnegie 103 de la Commission Hydrographique de la Marine, accidentellement dans l'Observatoire de Géophysique de Buenavista de Tolède et ensuite a Tortosa avec l'aide des magnétomètres QHM 22, 33 et 34 prêtés à cette occasion par le Professeur La Cour. L'enregistrement des éléments magnétiques fut repris le 1er Janvier 1942 et celui des Courant telluriques le 1er Janvier 1943. En 1948, un nouvel équipement constitué par les magnétomètres QHM 109, 110, 111 et BMZ 28 commença à fonctionner.

En 1948, la Direction Générale des Régions Dévastées remplaça l'ancien pavillon des absolues, à l'état de ruine, par deux nouveaux, l'un pour l'équipement Dover-Schmidt et l'autre pour le QHM-BMZ.

En 1937 fut publié le résumé annuel des observations magnétiques et électriques se rapportant à l'année 1935, beaucoup plus étendu par rapport à celui de 1934. En 1942, furent publiés le Bulletin Mensuel et le Résumé annuel de 1936. A partir de cette date, il ne fut plus possible de continuer la publication par faute de personnel. Elle fut remplacèe en partie par des notes trimestrielles et annuelles sur "l'activité solaire et géomagnétique" dans la "Revista de Geofisica" (Madrid) pour les années 1942-1946. La publication des données de 1943 a 1950 est actuellement préparée et sortira prochainement.

Depuis la fin de la guerre mondiale la collaboration aux travaux de la Commission Internationale pour la Caractérisation des perturbations magnétiques a recommencé, et depuis l'assemblée d'Oslo à ceux de la Commission pour la détermination de l'amplitude de H dans les régions équatoriales et pour l'étude de l'influence de la lune dans les phénomènes géophysiques. Des travaux ont été également faits sur les baies géomagnétiques et sur la variation séculaire de F et de G.

STATION MAGNÉTIQUE DE L'OBSERVATOIRE DE MARINA (SAN FERNANDO)

Cet Observatoire, qui dépend de la Marine de Guerre espagnole, dispose d'installations d'Astronomie, de Séismologie, de Magnétisme et de diverses autres qui sont en service depuis plusieurs années, fonctionnent parfaitement et sont d'un apport des plus intéressants pour les Sciences correspondantes.

Nous référant exclusivement à ce qui concerne notre Section, nous exposons ce qui suit:

Pour l'observation du magnétisme terrestre, on emploie un bâtiment spécialement construit a 60 mètres au Nord du centre de l'édifice principal de l'Observatoire. Sa base est un octogone de 4,30 m. de côté et il a deux étages, l'un, souterrain, de 4,10 m. de haut, au plafond voûté, où sont installés les magnétographes et l'autre, au-dessus, destiné aux observations absolues.

La chambre des magnétographes est limitée par un mur octogonal qui suit parallèment le mur des fondations, formant avec celui-ci une galerie voûtée de 1,50 m. de large. Crâce à ces dispositions, les variographes sont pratiquement insensibles aux variations diurnes de la température.

Les magnétographes sont du système Adie, le déclinographe et le variographe de force horizontale se trouvent sur le diamètre E-W de la chambre et leurs appareilles enregistreurs au centre de celle-ci. La balance est placée au Sud et son enregistreur est également au centre de la chambre. Les aimants du déclinographe et du variomètre de force sont égaux, de forme rectangulaire.

Les magnétographes sont notablement dérangés par la ligne de tramways électriques, malgré la distance considérable qui les en sépare. Ces dérangements sont la raison principale pour laquelle les indications de la balance restent sans aucune valeur. Nous avons l'espoir de que ces tramways seront bientôt supprimés.

L'observation directe de la déclination et de la force horizontale s'effectue au moyen d'un magnétomètre du type "Elliot". Celle de l'inclination avec un inducteur terrestre de "The Precise Instrument Co.".

Les résultats des observations absolues et ceux des régulateurs des variographes, ainsi que ceux de l'étude de la caractérisation de l'activité magnétique sont recueillis dans la publication "Anales del Instituto y Observatorio de Marina Sección 3.ª" dont la dernière édition correspond aux années 1947-1948, la suivante, se référant aux années 1949-1950, se trouve en cours d'impression.

SWEDEN

REPORT ON WORK IN TERRESTRIAL MAGNETISM AND ATMOSPHERIC ELECTRICITY SINCE THE OSLO ASSEMBLY

By Harald Norinder

Progress of the work in atmospheric electricity, terrestrial magnetism, ionospheric investigations, auroras, cosmic rays and related phenomena.

In the Swedish report to the Oslo Assembly there was given an account of plans of erecting a new geophysical research institute in the far northern parts of Sweden. The institute should be erected in an open region not too far from the Swedish town of Kiruna (67°50′, 27°26′). The local conditions were very favorable both for general geophysical investigations and meteorological observations.

A committee of geophysical specialists formed under the auspices of the Royal Swedish Academy of Science presented in January 1947 to the Swedish government a detailed plan for the new geophysical institute. The restricted economic situation in Sweden has not yet allowed a fulfillment of the plans.

While waiting for a definite solution a temporary organization of a geophysical observatory at Kiruna has been founded under the auspices of the Royal Swedish Academy of Science. The observatory is now operating on researches in terrestrial magnetism, auroras, ionosphere, cosmic rays and climatology.

The observatory at Abisko and the geophysical observatories in the Sarek region of Lappland belong also to the academy. The observatory of Abisko collaborates especially in terrestrial magnetism with the Kiruna observatory. Detailed information of organization, instrumental equipments, research programs and results is given in the subjoined Special Reports.

A new ionospheric observatory in the vicinity of Uppsala has recently been erected under the auspices of the Royal Research Institute of National Defence in Sweden. This observatory will be in full operation during the fall of 1951.

Thus Sweden has now three recording stations on ionosphere located at Kiruna, Uppsala and Göteborg. Ionospheric investigations are also carried out at Luleå, not far away from Kiruna, under the auspices of the Royal Swedish Board of Telegraphs and Telephones. An ionospheric station is also temporarily operating at the Astronomical Observatory of Saltsjöbaden, near Stockholm, which belongs to the Royal Academy of Sciences.

Investigations of different atmospheric electric elements in the lower layers of the air have not been carried through in Sweden during the past 30 years. Such investigations have been conducted for two years at Uppsala under the auspices of the Institute of High Tension Research, Uppsala University. Further information is given in a subjoined report.

Special Reports

Investigations of electromagnetic field variations caused by lightning discharges and of atmospheric electricity in the lower layers of the air carried out at the Institute of High Tension Research (Institute for Högspänningforskning) at the University of Uppsala

By Harald Norinder

The electromagnetic field variations

Instruments and methods. The variations of the electromagnetic field caused by lightning discharges have been investigated by using cathode ray oscillographic equipments of a special pattern constructed at the Institute. For localization of the lightning paths cathode ray oscillographic direction finders have been used. These instruments, specially constructed at the Institute, are provided with a sense antenna system and indicate the unipolar direction of the lightning paths.

The variations of the electromagnetic field have been taken up in two different ways. In the first way open antenna circuits in combination with aperiodic amplifiers have been operated in order to record the components of the vertical electric field. The field components were recorded with the E method. In the second way frame aerials were used to record the magnetic field components.

When distant stations were operated simultaneously the time of occurrence of the lightning discharges were controlled by time signals from the synchronized Swedish 50 periodic power system. This allowed a convenient method of synchronization at distances up to more than 1500 kilometers.

The vertical electric field components

The simultaneously operating field stations. The variations in the vertical electric field from lightning discharges were carried through with two different aims. In a first assemblage of investigations the vertical electric field components were measured within regions varying from some few kilometers up to 70 kilometers from the lightning paths which were located either by direct observations, direction finders, synoptical charts or by a combination of these methods.

In the adjacent regions two simultaneously operating stations in open field regions outside Uppsala with a distance of 17 kilometers between them have been used. The principal purpose of the investigation was to collect sufficient data to allow a classification and a statistical analysis of possible variation forms in the vertical electric field components.

At greater distances from the source two simultaneously operating stations, one in the vicinity of Uppsala, the other in the far south of Sweden with a distance of 570 kilometers between them have been used. The arrangement allowed an analysis of the corresponding variation forms of distant lightning discharges, e.g. atmospherics, up to distances of 2000 kilometers.

Magnetic field components

The variations of the magnetic field caused by adjacent lightning discharges have been measured at a special field station. Three frame aerials, two vertical and one horizontal within an angle of 90° between them allowed a simultaneous measurement of the magnetic components. In some cases it was possible to measure the corresponding magnetic field components in a subterranean protection room located in a rock in the vicinity of the Institute. The measurements allowed an evaluation of the penetrating effect of the magnetic field into the rock room. A paper on the subject is in the course of preparation.

Special investigations of atmospheric discharges

Studies of the occurrence of multiple strokes and of the total duration of lightning discharges have been carried out.

Atmospherics as produced from other electrostatically charged clouds, e.g. snow squalls, have been analyzed.

Model tests with artificial lightning discharges

In order to examine if lightning discharges showed a tendency to be attracted by conducting layers in the soil, artificial lightning discharges of the order of one million volts have been applied. Conducting layers of iron ore, humid clay or other conducting layers were placed in a test tank filled with dry sand. The inclination to be struck by artificial lightning discharges of both positive and negative polarity was investigated.

Atmospheric electricity

Researches of certain elements in atmospheric electricity have been started at the Institute after the Oslo Assembly. The conditions of the ionization in the lower layers of the air with regard both to rapid and slow moving ions have been studied. The content of radioactive particles was analyzed by a special method. The variation of the ion content with the height in the lower layers of the ground and the influence of radioactive emanation as a source of ionization have been studied. The variations of the ion content in relation to thunderstorm situations, snow squalls, snowstorms and rain showers in the air layers near the ground were investigated.

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Investigations in geophysics and cosmical physics carried out in the Department of Electronics, Royal Institute of Technology, Stockholm

By Hannes Alfvén

Cosmical electrodynamics. An attempt to trace systematically the influence of electric forces in astrophysical and geophysical problems has been published as a monograph (1). The first four chapters are of a fundamental character, the remaining three contain the applications to solar physics, magnetic storms and aurorae, and cosmic radiation.

Origin of the terrestrial and solar magnetic fields. Recent work has shown that a magnetic field in a good conductor could be amplified very much by hydrodynamic motion, and it seems reasonable that it should be possible to account for the terrestrial and solar magnetic fields in terms of some kind of magneto-hydrodynamic process (2). The possibility of finding an amplifying mechanism of this type is considered.

These problems require a theoretical study of magneto-hydrostatic fields, i.e. magnetic fields and current systems giving rise to forces which can be balanced by a pressure gradient (3, 4). It is shown that such fields can give rise to instabilities which may be favorable for an amplification of the terrestrial and solar magnetic fields.

Magneto-hydrodynamic waves can exist not only in highly conducting liquids, but also in an ionized gas with and without collisions between the particles (5, 6, 7). Transitions between magneto-hydrodynamic waves, electromagnetic waves in an ionized gas, and sound waves have been discussed theoretically. Laboratory experiments have been carried out on magneto-hydrodynamic waves in mercury (8). Experiments on magneto-hydrodynamic turbulence have been made, and work on magneto-hydrodynamic waves in liquid sodium is in progress.

Plasma resonance in radio echoes from meteor trails. A theory of radio reflections from meteor trails has been developed (9), which shows that in many cases a resonance effect will give stronger echoes for waves polarized with the electric vector normal to the trail than for waves with the opposite polarization. The effect is due to space charge induced in the boundaries of the trails. The predicted polarization effect has been verified by laboratory experiments (10), and has recently been detected in meteor echoes by Dr. J. A. Clegg at the University of Manchester. The theory may also have bearing on the interpretation of single ray fading in radio reflections from the ionosphere.

Origin of cosmic radiation. The idea proposed by Teller and Richtmyer that the cosmic radiation is a local solar phenomenon has been developed (11, 12). The amplification and properties of magnetic fields strong enough to confine cosmic radiation to the vicinity of the solar system have been discussed. The theory gives the energy spectrum and the total intensity of the cosmic radiation. The possibility has been considered that radio stars are connected with the acceleration of cosmic rays in the vicinity of other stars in the galaxy (13).

Recordings of cosmic radiation. Continuous recordings have been carried out since 1947 by 10 large GM tubes in coincidence, measuring the intensity from zenith, from 60° elevation to the north, and from 60° elevation to the south. The results show differences in the daily variation of cosmic radiation from the three directions (14). In 1951 similar equipment has been put into operation at Kiruna.

Model experiments on cosmic ray orbits. Laboratory experiments are in progress for mapping the trajectories of charged particles in a magnetic dipole field. Similar methods have been used earlier to study orbits which correspond to cosmic rays of 10^9 - 10^{10} ev (15), and it is intended to extend the measurements to higher energies and to different latitudes for the observing station. It is proposed to study about 10,000 different orbits.

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Report from the Earth Magnetic Section of the Royal Hydrographic Office (Kungl. Sjökarteverket), Stockholm, Sweden

By Nils Ambolt

The following magnetic observatories are now in operation in Sweden:

Abisko	68°21′	18°49′
Kiruna	67 50	20 26
Lovö	59 21	17 50

The Lovö observatory, which belongs to the Royal Hydrographic Office, is Sweden's geomagnetic central point and is provided with continuous-, minute point-, quick run- and storm-recorders. The Abisko observatory has continuous- and quick run-recorders. In Kiruna so far only continuous recordings are made but from autumn 1951 it is hoped that a quick run recording set also will be working.

The Abisko and Kiruna observatories belong to the Royal Swedish Academy of Science. All three magnetic observatories are scientifically managed from the Hydrographic Office. The Kiruna observatory started its work in the summer 1950. Reliable registrations are available from January 1951. The Abisko and Kiruna geomagnetic observatories are part of an organization which ad interim is taking care of geophysical problems in northern Sweden. Connected with the Kiruna geomagnetic observatory thus are observatories with panoramic ionospheric recording and recording of aurorae (supervised by Professor O. Rydbeck, Chalmers Institute of Technology, Gothenburg), with recording of cosmic radiation (supervised by Dr. K. G. Malmfors, Royal Institute of Technology, Stockholm) and with seismological recordings from modern and partly hypermodern instruments (supervised by Dr. M. Båth, Royal University, Uppsala).

These observatories form the beginning of a modern "Geophysical Institute", which it is hoped within not too many years will be established in northern Sweden. That institute should also be provided with a scientific meteorological station of first order, with aerological observations and with facilities for receiving international guests who want to carry out natural science investigations which are connected with the auroral zone, the extreme northerly position, or the close neighborhood to the alpine regions.

The Swedish geomagnetic head point net, first surveyed by Dr. G. Ljungdahl in 1928-30 and resurveyed by him in 1936-37, has again been surveyed in 1942-43 and 1948-49. The results will soon be published. A geomagnetic survey of the Gulf of Bothnia (Northern Baltic), which was begun in 1939, and which was interrupted due to the war, has been continued in 1950. The results of these two surveys which were made from the research vessel "Kompass", and were carried out as a collaborative work of the Royal Hydrographic Office, Stockholm, Sweden, and the Meteorological Institute, Helsingfors, Finland, are near completion for publication.

During the period 3-9 March 1950 the Swedish Geophysical Society arranged a geomagnetic conference with some 30 partakers from Sweden, Denmark, Finland, and Norway. Prof. J. Bartels, Göttingen, who at that very time visited Sweden, took an active interest in the meeting. In connection with the conference, instrument comparations were also carried out.

Much work during the period since the Oslo meeting 1948 has been devoted to improvement of field and observatory instruments. Many of the errors which have been discovered during this work, showed to be due to the fact that the instruments, though delivered from the best instrumental sources, still had parts which were not sufficiently non-magnetic.

Publications

1. Sven Aslund. Ergebnisse der Beobachtungen des magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1946. Kungl. Sjökarteverket, Stockholm, 1948.
2. Nils Ambolt. Ergebnisse der Beobachtungen des magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1947, 1948. Kungl. Sjökarteverket, Stockholm, 1950-1951.

Report from the Ionosphere Observatory at Uppsala under the direction of the Research Institute of National Defence in Sweden

By Martin Fehrm

Head of Radio Department
Research Institute of National Defence

About one year ago a new Ionosphere Observatory at Uppsala was established through cooperation of the following institutions:

Research Institute of National Defence in Sweden
Institute of High Tension Research, University of Uppsala
Royal Swedish Telegraph Board

After a period of trial it is intended to start with regular hourly observations of the ionosphere at the end of this year. Later on a research program will be carried out in connection with the interested parts. After preparatory work at the Institute of High Tension Research the installation has now moved to a place called Lurbo, about 10 kms south of Uppsala.

The panoramic ionosphere recorder is now being tested and has the following specifications: Frequency range, 1.4 - 16 mc/s; pulse frequency, 50 cycles; pulse power, about 10 kw; time of frequency sweep during registration, 6 min.; time of frequency sweep during panoramic records, 8 sec.

Transmitter and receiver are electronically coupled and crystal controlled in order to obtain high tuning accuracy over the whole frequency range.

Report from the Section of Geophysics of the Research Laboratory of Electronics, Chalmers University of Technology, Gothenburg, Sweden

By Olof Rydbeck

A. Wave Propagation Observatories

1. Ionospheric observatories. The Laboratory now operates two ionospheric observatories, one at the new Onsala wave propagation observatory 40 km south of Gothenburg, and the other one at Kiruna north of the arctic circle (67°50′N, 20°14.5′ E). Both observatories are equipped with panoramic ionospheric recorders of the latest type with an output power of about 20 kw. A frequency band of from 0.5 - 20 mc/s is swept in 30 seconds or less. The Onsala observatory (formerly located at Askim 10 km south of Gotheburg) is equipped with two fixed frequency recorders operating on about 3 and 6 mc/s. A number of field strength recorders are also in constant operation. The Onsala observatory is equipped with an Askania magnetometer for warning purposes. The Askania galvanometer is located in the ionospheric observatory.

The central bureau of the observatories is located in the main building of the Research Laboratory of Electronics, Gibraltargatan 5 g, Gothenburg, Sweden. Reports from the Kiruna and Onsala observatories are distributed regularly (monthly) and can be obtained upon request from the Observer-in-Charge or from the Librarian of the Research Laboratory.

The Kiruna observatory (which is operated with the support of the Royal Swedish Academy of Sciences) recently has been equipped with an auroral recorder of radar type operating on 9 m wave-length with a pulse power of 120 kw and a pulse length of about 4 microseconds. The recorder has been equipped with a rotating Yagi-array which makes one revolution per 30 seconds. The recorded display is of PPI-type and is recorded on a 16 mm Paillard-Bolex camera. Very interesting long range auroral echoes have been obtained with this recorder showing direction of approach of the disturbance, its strength and, as far as can be judged, the general type of the disturbance. Auroral echoes have been obtained up to a maximum distance of about 1000 km. A preliminary report of the results will appear shortly in the Chalmers University Transactions.

2. Microwave Propagation Observatory. This observatory is located in the pavilion of the main building in Gothenburg. Simultaneous observation of propagation characteristics of 10.3 and 1 cm waves have been carried out for a number of years and the results have subsequently been published (see attached publications list). At present only a rain recorder, operating on 3 cm wave-length, is in regular use. Preliminary results of the rain recordings have recently been published (see publications list).

3. Radio Astronomical Observatory. This observatory is also located at the Onsala observatory. Continuous solar noise recordings have been running on a wave-length of 2 m for about a year. An interferometer type aerial is used using groups of folded dipoles.

At present four Wurzburg giant light metal paraboloids are being installed at the observatory. Of these mirrors (diameter 7.5 m) three will be put up in parallactic mounts and the remaining one with vertical axis. The Wurzburgs will be used for the solar and galactic noise interferometers and for other recording purposes. A fifth Wurzburg mount (without mirror) will be used to mount Yagi-arrays for the meteor recorder.

A panoramic solar noise recorder (with quick sweep) is at present under construction and it is hoped that it will be put in operation before the end of 1952.

A high power meteor recording equipment has been in operation for about two years. Transmitter output pulse power is about 200 kw with a pulse width of about 4 microseconds. The noise factor of the receiver is about 1.36 db.

Results of observations at the Radio Astronomical Observatory are not published regularly. Copies of running series of measurements can be obtained upon request from the Observer-in-Charge.

B. Theoretical and Publications Department

This department is common for all sections of the Research Laboratory. On the geophysical side work is at present concentrated on wave propagation theory. The problem of the triple split of ionospheric waves, so often reported from our Kiruna observatory, has been studied theoretically and has been solved. It has been shown to be a strong geomagnetic resonance effect. For further details reference is made to the attached publications list.

The publications from other sections of the Laboratory (pure and applied electronics, etc.) are contained in the list of publications. Those especially interested are welcome to contact the Librarian of the Research Laboratory.

Much time has been devoted to the study of various kinds of propagation problems. Fundamental theoretical relations determining the propagation of waves in stratified media have been published in the Chalmers Transactions. (On the propagation of waves in inhomogeneous media, TCU, 1948.) At present the propagation of waves in media with random inhomogeneities is being studied by the Theoretical Department.

C. Laboratory Facilities

The Laboratory has recently moved to a new modern building with about 2000 square meter laboratory area. The building which has been especially designed for its purpose, was officially opened by H. M. the King of Sweden on June 9, 1951, when the Laboratory held its tenth anniversary. There are several guest rooms in the institute where visiting scientists are welcome.

Publications

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2. The ionospheric and radio wave propagation observatory at Kiruna, 67°50′N, 20°14.5′E. Tellus, vol. 1, No. 4, 1949.
3. The panoramic ionospheric recorder. Tellus, vol. 1, No. 4, 1949.
4. Ionospheric effects of solar flares. Preliminary reports Nos. 2 and 3. TCU 95, 1950.
5. Magneto ionic triple splitting of ionospheric waves. Proc. Ind. Acad. Sci., vol. 31, No. 2, 1950.
6. Magneto ionic triple splitting of ionospheric waves. J. Appl. Phys., vol. 21, 1950.
7. The theory of magneto ionic triple splitting. TCU 101, 1951.
8. Polar blackouts recorded at the Kiruna Observatory. TCU 103, 1951.
9. Some calculations of ray paths in the ionosphere. TCU 104, 1951.
10. Vertical recording of rain by radar. TCU 107, 1951.
11. Microwave propagation in the optical range. TCU 108, 1951.
12. A survey of recent ionospheric measurements at the ionospheric and radio wave propagation observatory at Kiruna. Arkiv för Geofysik, Kungl. Vetenskaps-akademien, Stockholm, Bd. 1, No. 11, 1950.
13. A 16 kw panoramic ionospheric recorder. TCU 109, 1951.
14. Théorie de la triple décomposition magnéto-ionique. l'Onde Electrique, February, 1951.

Report on the ore-prospecting work in northern Sweden carried out by the Geological Survey of Sweden (Sveriges Geologiska Undersökning), Stockholm

By Sture Werner

Ore-prospecting work has been directed to sulphide ores and in smaller extent to iron ores. In this work electrical and magnetic field measurements have been extensively used. The geophysical investigations have made it possible to map the extent of ore-bearing structures, to follow up important horizons in the bedrock, and to point out locations of ore-deposits.

The electrical investigations are divided between mapping of superficially situated conductors and deep surveys. Mainly electromagnetic methods are used. The mapping of superficial conductors is made with Sling-ram (verbal translation loop-frame), a method developed at the Geological Survey. The instrumental equipment consists of a transmitter and a receiver which both have a very light weight and small dimensions. The whole equipment is carried around during the measurements. The observations are made along a system of parallel lines in points 20 m apart.

Deep surveys have been made during the last two years in the Skellefte field. In one case it has shown possible to detect the occurrence of ore mineralization down to a depth of about 300 m. Work with development of depth seeking methods is continuing.

In the case of magnetic field measurements, only the vertical intensity has been determined. Without Schmidt's balance, recently an Arvela precision magnetometer (Finnish instrument) has been used for measuring feeble disturbances. Strong disturbances have been measured with a Tiberg magnetometer and also with an Arvela miniature magnetometer.

The magnetic properties of rocks and ores have been studied. An investigation of the remanent magnetization of the Swedish iron ores is continuing in collaboration with the Mining Research Board of Jernkontoret.

Report on researches of (a) isoporic zero-lines for horizontal magnetic intensity in Sweden, (b) the occurrence of time of the minimum value of the inclination in Sweden

By Kurt Molin

By using the results of the earth magnetic measurements in Sweden carried out during the period 1928-1934 (see Kurt Molin: A general earth magnetic investigation of Sweden carried out during the period 1928-1934. Part 2. Inclination Sveriges Geologiska Undersokning Ser. Ca No. 29, Stockholm, 1939, pp. 104-115), it has been possible to calculate the occurrence of the minimum value of the inclination in Sweden. The data allow a more accurate value than was obtained by earlier trial (see E. Solander, Nova Acta Reg. Soc. Sc. Upps. Ser. III, Vol. XIV - III, Uppsala, 1889).

From measurements of older points of the time of maximum H has been calculated with a parabolic formula for 55 places and a chart is prepared representing in smoothed form the isoporic zero-lines. Apart from some fluctuations of regional characteristics the movement of the isoporic zero-lines proceed from 1870 up to 1905 in a south-westerly direction towards the zero-curve given by Fisk at the epoch 1920-1925.

Publications

Kurt Molin. Contribution to the knowledge of the occurrence of time of the minimum of the inclination in Sweden. Festskrift tillágnad J. Arvid Hedvall. Göteborg 1948.

Kurt Molin. Movement of isoporic zero-lines for horizontal magnetic intensity in Sweden. Arkiv főr Geofysik Kungl. Vetenskapsakademien, Stockholm, 1951 (in print).

SWITZERLAND

At the Geophysical Institute of the Swiss Federal Institute of Technology measurements and mappings have been made on the anomalies of the magnetic vertical and horizontal intensity in the Canton Tessin. The whole Canton is regionally disturbed and the eastern end of the "Zone of Ivrea" near Locarno is marked by a large anomaly. (Publ.: Ernst K. Weber, Fritz Gassmann, Ernst Niggli und Hans Röthlisberger: Die magnetische Anomalie westlich von Locarno. Schweizerische Mineralogische und Petrographische Mitteilungen, Band XXIX, Heft 2, 1949.)

At the Hochalpine Forschungsstation Jungfraujoch, investigations on the vertical electric potential of the atmosphere and the vertical current have been carried out by Prof. Israel and his collaborators Dr. Kasimir and Dr. Wienert. (See the special report of Prof. J. Lugeon.) The Swiss Federal Telephone Administration and private industries have made investigations on the propagation of ultra short radio-waves. The research on cosmic rays is the most important field of research at the Jungfraujoch.

Mésures d'électricité atmosphérique au Jungfraujoch

Par Jean Lugeon

La Commission d'électricité atmosphérique de la Société helvétique des sciences naturelles et la direction de la Station centrale suisse de météorologie ont preté leur appui au Prof. Dr. H. Israel, éminent spécialiste pour des enregistrements du gradient de potentiel et du courant vertical de conductibilité. Ces mesures ont été effectuées pendant plusieurs mois à la Station internationale du Jungfraujoch à 3500 m d'altitude, avec la collaboration des Dr. Kasemir et Wienert. Le dépouillement des résultats et leur comparaison aux éléments météorologiques n'est pas terminé. Toutefois, M. Israel énonce déjà quelques résultats, entre autre, les variations diurnes normales du champ et du courant vertical de conductibilité semblent influencées par la convection. En été, la variation diurne doit se rapprocher du type continental, tandis qu'en automne, on ne distingue pas nettement d'influence du type océanique.

Ces observations font partie d'un programme international du à l'initiative de M. Israel, où des mesures similaires devraient etre faites parallèlement sur plusieurs sommets de la chaine des Alpes et des Pyrénées.

Zurich, mars 1951

Verzeichnis der in der Hochalpinen Forschungsstation Jungfraujoch ausgefuhrten Arbeiten uber Kosmische Strahlung, 1948, 1949, 1950

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UNION OF SOUTH AFRICA

A. PROGRESS OF WORK IN GEOMAGNETISM, 1948-1950

Report by the Officer-in-Charge, Magnetic
Observatory, Hermanus

During the period 1948-1950 the Magnetic Observatory, Hermanus, continued its activities on the lines indicated in the Transactions of the Oslo Meeting, 1948 (1).

The National Report presented at the latter Meeting, gave a tabulation of the annual mean values of the magnetic elements at Hermanus for the period 1941-1946. The following table gives the corresponding values for the three succeeding years:

Year	D	I	H	X	Y	Z	F
1947	-23°46.6′	-64°19.9′	13809	12637	-5567	-28734	31880
1948	-23 47.6	-64 22.4	13739	12571	-5543	-28642	31767
1949	-23 48.8	-64 25.8	13664	12501	-5517	-28557	31657

Field Work

The re-occupation of the 44 secular variation field stations in South Africa was completed in April 1948. In August and September of the same year, six new secular variation stations were occupied in Southern Rhodesia. The sites for the latter stations were selected by the Department of the Surveyor-General of Southern Rhodesia, who also erected the necessary non-magnetic pillars and determined the trigonometrical data. The results of the magnetic observations carried out at the field stations in South Africa and Southern Rhodesia were published in tabular form in 1949 (2). The more detailed account, which is being published by the Trigonometrical Survey Office of South Africa, is now with the printers.

In view of the rapid secular changes occurring in South Africa, the next secular variation survey has been scheduled for 1952-1953, when it is hoped to restore, or to replace, the stations which had to be abandoned in 1947-1948. A magnetic survey of the principal aerodromes in South Africa has been contemplated for some time, but has had to be postponed owing to shortage of staff.

The possibility of establishing a magnetic recording station in one of the northern provinces of South Africa, and of carrying out periodic observations on the two strategically-situated islands, Marion (46°53′S., 37°50′E) and Tristan da Cunha (37°30′S., 12°40′W), is being considered.

Magnetic Instruments and Comparison of Standards

(a) Horizontal Intensity--The accessories of the Schuster-Smith Portable Coil Magnetometer No. L62993, which has been the standard instrument for H observations at Hermanus since the CIW Magnetometer No. 17 was transferred to Elisabethville in 1944 (3), were re-standardised at the National Physical Laboratory, Pretoria, in 1948. The results were in good agreement with the values obtained at the National Physical Laboratory, Teddington, in 1935. Regular readings are also made with the Askania Standard Magnetometer-Theodolite No. 306643.

The mean difference between the two instruments during the period 1949-1950 was

1949 Coil - Schmidt = +0.6 ± 1.5 gamma
1950 " " = -0.4 ± 0.5 "

where the limits indicate the Standard deviations of the individual differences.

A visit to Hermanus in 1949 by Dr. G. Heinrichs, Director of the Elisabethville Magnetic Observatory, provided an opportunity for a comparison of the CIW Magnetometer No. 17 with the Portable Coil Magnetometer:

CIW 17 - Coil Magnetometer = +1.2 gammas

With the support and collaboration of the IATME Committee to Promote International Comparison of Magnetic Standards, a comparison was made in October 1949 - January 1950 of the horizontal intensity standards of Rude Skov (RS), Cheltenham (Ch) and Hermanus (Hr), using QHM's 29 and 58 of the Hermanus Magnetic Observatory. The results were as follows:

RS - Hr = +0.5 gammas
Ch - Hr = -2.6 "

(b) Magnetic Declination--With the transfer of CIW Magnetometer No. 17 from Hermanus to Elisabethville in 1944, the Askania Magnetometer No. 306643 was adopted as the standard instrument for declination readings at Hermanus. A comparison of these two instruments at Hermanus in July 1949 gave the following satisfactory result:

CIW 17 - Askania = -0.2′

(c) Magnetic Inclination--As from 1944, Askania Earth Inductor No. 111774 replaced CIW Magnetometer No. 17 as standard of magnetic inclination for Hermanus. A comparison of these two instruments at Hermanus in 1949 gave the following result (neglecting the correction of +0.4′ to CIW 17, based on a standardisation carried out in the U.S.A. as far back as 1932):

CIW 17 - Askania = +0.45′

In 1949 the two Askania Field Inductors gave good agreement with the Askania Standard Inductor No. 111774:

Std. Inductor - Field Inductor No. 578179 = -0.1′
Std. Inductor - Field Inductor No. 305211 = -0.2′

(d) Variometers--In 1950 the Temporary Commission on the Liquidation of the Polar Year 1932-1933 decided that the LaCour variometers which had been used for the Polar Year observations in Cape Town "be left definitely to the Hermanus Magnetic Observatory where they are now installed".

The orientation of the Askania horizontal intensity and declination variometers was checked in 1950 by an analysis of the absolute readings obtained with the Portable Coil Magnetometer. The results show satisfactory agreement with the earlier determinations (4), and indicate that the needles are correctly oriented:

$$\Delta H \text{ in gammas} = 2.36\ \Delta H_{mm} - 0.012\ \Delta D_{mm}$$

$$\Delta D \text{ in minutes} = 0.551\ \Delta D_{mm} - 0.006\ \Delta H_{mm}$$

The Askania Z-variometer was adjusted for level by the method used at Cheltenham (5), and the needle oriented into the prime vertical. Subsequent tests showed that the inclination of the needle to the horizontal is now less than 5′. A least squares analysis of absolute readings carried out with the Askania inductor in November 1950, yielded the following relation for the Z-variometer:

$$\Delta Z \text{ in gammas} = 3.92\ \Delta Z_{mm} + 0.017\ \Delta H_{mm} - 0.024\ \Delta D_{mm}.$$

It has been decided henceforth to check the performance of the variometers annually by least squares analysis of the routine absolute readings.

Precautions against Artificial Disturbance

In view of the rapid expansion of Hermanus Township, an agreement has been reached with the local Municipal Authorities that no buildings be erected within a distance of 150 yards from the boundary fence of the Magnetic Observatory.

Magnetic traverses carried out within this "neutral zone", now provide accurate control of possible future changes in the normal configuration of the magnetic field in this neighborhood. The control stations are magnetically linked with a standard reference station in the Absolute House. The terminal points of the traverse lines are marked by non-magnetic concrete beacons.

The readings indicate that the values of the magnetic elements at the reference point in the Absolute House differ slightly from the "normal" values observed at the control stations outside the building. Thus in 1949-1950 the mean discrepancies were

Reference Station - Control Station

ΔH	ΔD	ΔZ
$+2.3\gamma \pm 1.6$	$+1'.6 \pm 0.5$	$+0.6\gamma \pm 2.6$

where the limits indicate the standard deviation of the individual differences.

Hourly-value Reductions; Publication of Routine Data

At the time of writing this report (February 1951) the reduction and analysis of the hourly values are complete up to the end of 1949. The 1941-1944 volume of routine data has been published, and the 1945-1946 data are now with the printers. The typescript of the 1947-1948 volume is nearing completion.

Lunar Variations in the Magnetic Field at Hermanus

A preliminary investigation of the lunar effect in D at Hermanus has shown that there is a marked lunar-diurnal variation during the four summer months. Dr. J. Bartels has kindly undertaken a computation of L(D) by a more rigorous method, and his results (as yet unpublished) confirm that the lunar-diurnal variation at Hermanus is considerable. The investigation is proceeding.

References

1. Trans. of Oslo Meeting, IATME Bulletin No. 13, p. 218.
2. J. Geophys. Res., vol. 55, No. 1, pp. 57-64.
3. Trans. of Oslo Meeting, IATME Bulletin No. 13, p. 219.
4. Loc cit., p. 219.
5. Trans. of Edinburgh Meeting, IATME Bulletin No. 10, p. 308.

B. PROGRESS OF WORK IN ATMOSPHERIC ELECTRICITY, 1949-1951

Report by the Director, The Bernard Price Institute of Geophysical Research, University of the Witwatersrand, Johannesburg

(1) Instrumentation

(a) The Institute has developed a Ceraunometer or lightning counter to meet the need for an instrument which will automatically record the number of lightning discharges occurring within a definite radius of an observing station and which will distinguish between those discharges which pass to ground and those which take place within the cloud (Gane and Schonland, "Weather" 3, p. 174, 1948).

(b) A new form of high speed camera for the study of lightning by the photographic method has been developed and described by D. J. Malan (Rev. d'Optique 29, p. 513, 1950).

(c) D. J. Malan and B. F. J. Schonland have developed and described an electrostatic fluxmeter of short response-time for use in the study of the field-changes in the intervals between the separate strokes of a lightning discharge to ground (Proc. Phys. Soc. B, vol. LXIII, p. 402, 1950).

(2) Investigations of Thunderstorm Electrification

(a) The fluxmeter mentioned in 1(c) has been used over three summer seasons to investigate field-changes taking place in the intervals between strokes of a lightning flash to ground. The results indicate that successive strokes come from negatively-charged regions which are progressively higher and higher within the cloud and which are linked to the main channel of the discharge by junction-streamer processes which are usually, if not always, upward-moving positive streamers.

(b) This conclusion has been confirmed by other studies which yield estimates by different methods of the heights from which the leader processes start. The conclusion reached from these studies is that the first stroke of the series comes from a region which is 3 to 4 km above the ground, and hence 1 to 2 km above the cloud-base, and strokes of order 6 or 7 come from regions between 8 and 10 km above the ground.

(c) Combining the results of (a) and (b) above it has been suggested by Malan and Schonland in papers in course of publication that the separate strokes of a flash to ground arise from the intermittent discharge of a single and nearly vertical negative column of charge which extends upwards on occasion from 1 km to 7 km above the cloud base. A tentative explanation of the mechanism causing intermittent discharge has been given.

(d) Since the freezing level in these clouds is about 1.7 km above the cloud-base, the mechanism of separation of charge must be one which operates well above the freezing level, perhaps as high as 9 km above the ground.

(e) An investigation has been made by Barnard (Journal of Geophysical Research - in course of publication) of the approximate mean height of the charged regions responsible for a discharge to ground. This employed three field-measuring equipments of type 1(c) connected by radio telemetering to a central recording station. The mean height obtained was 3.2 km above the cloud-base, in agreement with 1(b) above (see Schonland and Malan, Archiv. f. Met., Geophys. u. Biokl. A, III, p. 64, 1950).

(f) The Institute is at present engaged in further studies on the spacial distribution of the charges in and below thunderclouds.

C. IONOSPHERE

Since mid 1946 observations of ionospheric characteristics have been made at Johannesburg (26°10′S, 28°5′E) and at Cape Town (34°9′S, 18°19′E) by the Telecommunications Research Laboratory of the South African Council for Scientific and Industrial Research, the recorder at Cape Town being operated by the South African Post Office.

The specifications of the equipment used are as follows:

Frequency sweep:	Nominally 0 to 20 Mc/s; usually set to 1-15 Mc/s, the lower limit being due to the aerials, the upper limit being changed from time to time to suit ionospheric conditions.
Power output:	Of the order of 1 kilowatt.
Aerials:	Vertical rhombics.
Time of sweep:	7 seconds.
Pulse length:	70 microseconds.
Recurrence frequency:	100 per second.
Receiver bandpass:	30 kilocycles per second.

Measurements are made every twenty minutes and records of hourly values are tabulated. The time used is 30° E.M.T. (G.M.T. + 2 hours). Frequencies are in megacycles per second, and distances are in kilometers.

UNITED STATES

REPORT OF THE SECTION OF TERRESTRIAL MAGNETISM AND ELECTRICITY OF THE AMERICAN GEOPHYSICAL UNION

By L. R. Alldredge, Secretary

I. General

It would be presumptuous for the secretary to attempt to summarize all of the work related to terrestrial magnetism and electricity which has been accomplished during the past three years. The detailed achievements are, of course, reported in the scientific journals and numerous abstracting services are available. It is hoped that this short report will be of some service by pointing out a few summary articles, describing briefly the work of the principal laboratories and discussing a few problems of current interest.

Dr. W. H. Bucher, President of the American Geophysical Union (AGU) appointed a committee with Dr. Harlan T. Stetson as chairman to prepare a report on Cosmic Terrestrial Relationships. The committee solicited, from a number of institutions and individuals in the United States, abstracts of recent research of Cosmic Terrestrial interest. The following topics were suggested: Solar Activity, Ultraviolet Radiation, Aurorae, Ionization of the Earth's Upper Atmosphere including ionospheric and tropospheric effects, and Meteorological Phenomena as Related to Solar Activity. Many responses were received resulting in an informative summary paper which is scheduled for publication in the August 1951 issue of the Transactions of the American Geophysical Union.

A committee on Upper Atmosphere under the Chairmanship of Dr. W. W. Kellogg was organized by the Meteorology Section of the AGU. The report of this committee contains topics of interest to the Association of Terrestrial Magnetism and Electricity. This report is scheduled for publication in an early issue of the Transactions of the American Geophysical Union.

An important publication change occurred which is of interest in this field. The Journal of Terrestrial Magnetism and Atmospheric Electricity, which was initiated by Dr. L. A. Bauer in 1896, and with which Dr. John A. Fleming was associated for about 50 years, has been continued under a new title. The new title is the Journal of Geophysical Research. Dr. Merle A. Tuve is the new Editor. The change in name was made to broaden the scope of the Journal.

There has been continued study of ionospheric problems at the Central Radio Propagation Laboratory of the National Bureau of Standards. One of the most interesting investigations deals with ionospheric winds with speeds up to 300 m/sec. Most of this work can be found in reports of the International Scientific Radio Union and will not be discussed further here.

II. Work at the Department of Terrestrial Magnetism, Carnegie Institution of Washington

H. W. Wells is studying the irregularities of ionospheric disturbances. Three stations are used placed approximately 150 miles apart. Each station consists of a high speed multifrequency ionospheric recorder mounted in a truck. Preliminary results reveal that many events are local in character and small in physical size compared to the distance between stations. Apparent earthward velocities of ion clouds range between 100 and 450 km/hr.

Several workers at DTM (Vestine, Ratcliffe, Wells and Forbush) are investigating the total ionization of the F2 region as a function of the solar zenith angle as it varies through the seasons. Data from Watheroo, Huancayo, Washington, and College, Alaska are being used in this study. Preliminary results indicate a close dependence of the F2 total ionization upon the solar zenith angle. A study is also being made of the total ionization of the F2 region during selected magnetic storms occurring since 1939.

Work is continuing on a study of the magnetization of sedimentary rocks along the Appalachian Mountains.

Researchers at DTM are studying the magnetic disturbance field during the initial phase of about 100 storms, which have occurred since 1905, to determine its relationship to the inclination of the magnetic dipole to the plane of the ecliptic.

"Earth-Current Results at Tucson Magnetic Observatory, 1932-1942" was published as Carnegie Institution of Washington Publication 175 in 1949. This volume contains individual hourly values for the 11-year period.

III. Report on the Magnetic Work of the U. S. Coast and Geodetic Survey from 1 May 1948 to 1 July 1951

The Division of Geophysics of the U. S. Coast and Geodetic Survey conducts geomagnetic surveys, operates a chain of magnetic observatories, publishes isomagnetic charts of the United States and Alaska, collects geomagnetic data from world-wide sources and compiles world isomagnetic charts to be published by the U. S. Navy Hydrographic Office. Field and observatory data are processed and published at regular intervals.

Land magnetic surveys have been confined largely to the occupation of repeat stations during the past few years. Seven widely distributed magnetic observatories and two automatic declination recording stations are maintained in continuous operation.

The Bureau has continued to cooperate with other agencies in the United States and other parts of the world in the exchange of geomagnetic data, intercomparison and standardization of magnetic instruments, assistance in technical aspects of establishing new observatories and operation of equipment for special studies.

Magnetic Observatories

Cheltenham has operated three magnetographs of varying degrees of sensitivity; international magnetic standards established by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and a cosmic ray meter for that Institution. All magnetic instruments of the Bureau and many from domestic agencies and foreign governments are standardized here.

College began operations with insensitive magnetographs in February 1948 at new site. A sensitive magnetograph was added in February 1949.

Honolulu continues with high sensitivity variometers at the site to which it was transferred in 1947.

San Juan maintains a sensitive magnetograph, hermetically sealed.

Tucson has a sensitive magnetograph, with D-variometer operating at a scale value of 0.'5 per mm. An atmospheric electric observatory is operated on a cooperative basis with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

Barrow began operation in 1949 with insensitive instruments and an 8-inch photographic tape recorder, eliminating necessity of servicing the station daily.

Automatic Declination Recording Stations at Gatlinburg, Tennessee, and Logan, Utah continue in operation with only occasional attention, recording variations in magnetic declination on slow speed photographic tape.

Magnetic Surveys. To obtain data for secular change studies, repeat stations have been occupied regularly by U. S. observers in the United States. Repeat stations are now being established in close pairs to minimize losses and to provide greater assurance of continuity in secular-change determinations. During 1950 and 1951 many repeat stations have been occupied in other American Republics and on islands of the Caribbean by the Inter-American Geodetic Survey, the results being processed by the Coast and Geodetic Survey. A record of repeat stations is shown in the table below.

Magnetic Observations by Observers of the United States Coast and Geodetic Survey and the Inter-American Geodetic Survey
From May 1, 1948 to June 30, 1951

Repeat Stations

Area	New		Old		Other Stations	Total
	Complete	D-only	Complete	D-only		
Alaska	0	0	0	0	182	182
Caribbean Area	3	0	8	0	0	11
Central America	3	0	18	0	0	21
Mexico	4	0	0	0	0	4
Pacific Islands	0	0	0	0	9	9
South America	28	0	27	0	0	55
United States	21	4	36	37	26	124
Total	59	4	89	37	217	406

Late instrumental developments and techniques include: (a) further cooperation with manufacturers in the design and construction of field and observatory magnetometers, earth inductors, and complete magnetographs; (b) development and successful operation of a visual recording magnetograph employing photoelectric and electronic amplification; (c) adjustment and standardization of magnetic absolute instruments for several foreign governments; (d) special QHM comparison observations at Cheltenham in cooperation with the IATME Committee on Magnetic Standards; and (e) development of special equipment for drawing quartz fibers for use in magnetic variometers.

The Bureau cooperated with the Department of State in conducting a program of intensive training of observers in geomagnetic operations and in processing of results. Among these observers were representatives from several of the American Republics and from the Republic of the Philippines.

In cooperation with the Pan American Institute of Geography and History, certain standards of performance for American Hemisphere magnetic surveys have been established.

Important advances have been made in airborne magnetic surveys. The total force and direction magnetometer, developed by the Naval Ordnance Laboratory, when used in connection with other special equipment and a precise astro compass, has made it possible to determine D, H, I, Z, and F in flight. Planes, suitable for long range operations over land and sea, are operated by the U. S. Air Force and the magnetic instruments are operated by Coast and Geodetic Survey observers. Continuous checks are made between special magnetic compasses and the magnetometer.

Charts and Publications. The Bureau has published isogonic charts of the United States and Alaska for 1950 and has compiled the 1950 isogonic chart of the world published by the U. S. Navy Hydrographic Office. In addition, sectional isogonic charts have been prepared for other U. S. agencies.

Semi-annual reports showing quarter-size reproductions of the magnetograms of Cheltenham, Honolulu, San Juan, Sitka, and Tucson have been issued for 1946-1948. These reports for Cheltenham and Sitka for the first half of 1949 have also been issued.

The processing of reports of magnetic observatory results giving tabulations of hourly mean values has been resumed, beginning with 1948. In this series Cheltenham results for 1948 have been issued.

Other publications on geomagnetism include "United States Magnetic Tables and Magnetic Charts for 1945," "Magnetic Declination in Texas in 1945," "Magnetic Surveys," "Magnetic Poles and the Compass," and "Magnetic Observations in the American Republics 1945-48."

The use of punch-card methods is an important technical advance in processing world wide magnetic data prior to its use by magnetic cartographers in drawing isomagnetic lines and in the reduction and tabulation of hourly values of magnetic elements as recorded at magnetic observatories. These processes were used in the compilation of the United States, Alaska, and World Isogonic Charts for 1950, and are now being used in processing current magnetic observatory reports.

IV. Report on the Magnetic Work of the U. S. Geological Survey

The U. S. Geological Survey has been very active in conducting airborne total field intensity surveys over selected parts of the United States and in other parts of the world in cooperation with the Navy. Since the start of this type of work several years ago about 325,000 traverse miles have been flown, mostly spacings of 1/4 mile to 1 mile. Among the larger areas mapped are the Adirondacks and Lake Superior iron regions and the State of Indiana.

The widespread use of aeromagnetic mapping has uncovered many cases of reversed polarization in dikes and other igneous rocks which have apparently not been overturned since emplacement.

Observations correlating magnetic changes and volcanic activity have been under way during the past two years on the island of Hawaii. Comparatively large changes in magnetic intensity were observed prior to the last major eruption of Mauna Loa in 1950, possibly caused by the rise of large volumes of magma.

V. Report of the Magnetic Work of the U. S. Navy Department

Magnetic Charts

The Navy's charting activity - the Hydrographic Office, has recently published the world isogonic charts for epoch 1950. Since the isomagnetic charts for epoch 1945 were printed a policy has been adopted whereby the isogonic charts will be printed for epoch 1950 and every five years thereafter, while isomagnetic charts for inclination (dip), horizontal, vertical and total intensities will be printed for epoch 1955 and every ten years thereafter. World coverage is accomplished as in previous editions by a world chart on the Mercator projection extending through all longitudes and from 69° south to 78° north, supplemented by north and south polar charts on the azimuthal equidistant projection.

In physical appearance the charts closely resemble the previous editions. A buff tint accentuates the land masses. The isogonic curves, generally for integral degrees and continuous over land and sea, are indicated in blue, with appropriate differentiation in drafting to show variations in kind of data depicted. A magenta overprint similarly portrays the annual secular change and provides a convenient method for extending the data to other periods near the specific epoch. Both series of curves are marked with appropriate legends designating the magnitude or rate of change. Currently operating observatories are appropriately marked. The considerable detail shown by the isogonic lines was made possible by drawing the original curves to a large scale, reducing 75 per cent for printing. Newly charted positions of the magnetic poles reflect current information, and should on no account be interpreted to mean that the earth's field has recently shifted so greatly.

The present isogonic charts for 1950 represent the cooperative and joint efforts of the Hydrographic Office and the U. S. Coast and Geodetic Survey, and were compiled from data acquired by the Survey which is now the central depository for magnetic data in this country. All available data including some 78,000 declination observations and covering the last 50 years were utilized in preparation of the curves and establishment of the rate of secular change. The compilation and reduction of data by the Coast and Geodetic Survey for these charts represents the introduction into magnetic cartography of mechanical processes, procedures and techniques. In addition to saving many man years of laborious work and making possible the reduction of all data on schedule, the plan of work provided for the systematic arrangement of all data on key-punched cards, making available an accessible and convenient file for future reference. It is fortunate indeed that at this time when such a long period has elapsed since large scale magnetic observations have been made, and those of all areas and periods must be reduced to a common epoch, that new computation and reduction techniques have been effectively established to facilitate and expedite the work.

Airborne Magnetometers

Recent developments toward the perfection of instruments, equipment and techniques for the conduct of aerial magnetic surveys offers great promise to those interested in data of world scope. Acquisition of adequate data is a matter of international concern and valued interest to all nations directly or indirectly affected by world trade and commerce. The information is needed by the scientist and technician as well as the geophysicist and navigator. Its necessity justifies the cooperative efforts of all countries. The Navy anticipates that the isogonic charts for future epochs will reflect adequate information in many areas where now only extrapolated information is possible.

The development of airborne magnetometers for determining all of the magnetic elements has been carried out by the Naval Ordnance Laboratory. A preliminary model was completed early in 1949. It was made by modifying the war time AN/ASQ-3A total field magnetometer. Angle measuring potentiometers were added to the orienting gimbal mechanism to permit the recording of the direction of the magnetic field relative to the aircraft frame. Additional equipment was built to automatically record the pitch and roll of the aircraft frame with respect to vertical and its orientation with respect to true north. This instrument has been used by the U. S. Coast and Geodetic Survey and the U. S. Air Force since 1949. The data obtained have been found to be sufficiently accurate for chart making purposes. However, it will operate only in regions in which the angle of inclination of the earth's magnetic field exceeds 45°.

A newer model which removes the latitude restriction and simplifies the data reduction is nearly complete and should be ready for flight testing in October 1951. The entire orienting detector assembly is mounted as a pendulum. The orientation angles which are recorded are, therefore, measured directly against a vertical rather than with reference to the aircraft frame. This latest model also incorporates many electronic changes including a system for automatically averaging the recorded angles over short intervals to minimize the error caused aircraft oscillations.

High Altitude Magnetic Measurements

Records of total magnetic field intensity as a function of altitude have been obtained near the geomagnetic equator. Two Aerobee rockets launched from a seaplane tender carried magnetometers to an altitude of 105 km.

One of the rockets was fired at that time of day when surface measurements showed a very small value for the diurnal variation. The field decreased with altitude in accordance with the simple dipole field, but no evidence of a current layer was obtained in the altitude range covered.

The second rocket was fired at that time of day when the diurnal variation at the surface was near a maximum. A decrease of about 4 milligauss between 93 km and 105 km was recorded. This decrease cannot be accounted for by sources inside the earth and is attributed to penetration of a current layer by the magnetometer. The details of this work have been submitted by Singer, Maple, and Bowen to the Journal of Geophysical Research for publication.

PART IV

SPECIAL REPORTS

REPORT OF COMMITTEE ON SELECTION OF SITES OF NEW OBSERVATORIES FOR TERRESTRIAL MAGNETISM AND ELECTRICITY

By Jno. A. Fleming, Chairman

Many of the recommendations made by the predecessor of our Committee (the Committee to Consider Existing and Desirable Distribution of Magnetic and Electric Observatories for the Better Co-ordination of Work and Publications of Existing Observatories), as reported at the Lisbon Assembly in 1933 (Bull. 9, Internat. Ass'n. Terr. Mag. Elect., pp. 107-113, especially maps on p. 111), have now been realized. There are still, however, some recommended locations where observatories to supplement the world net are much needed. Researches since 1933 indicate, in several cases, that our Association should take all possible steps to insure that the past recommendations be acted upon favorably. Examples of special research concerned are shown by (a) the report of Chairman Egedal of our Committee 11 to Promote Observations of Daily Variation of the Horizontal Magnetic Force between the Geographic and Geomagnetic Equators (see pp. 286-290), and (b) the development of interrelations between geomagnetic and ionospheric phenomena. Our Committee urges that resolutions stressing the importance of establishing magnetic, electric, and ionospheric observatories in the neighborhood of the following localities, all substantially as listed at the Lisbon Assembly in 1933, be prepared for adoption by the whole Union at the Brussels Assembly in 1951.

Recommended Additions to World Net of Observatories

Nairobi (British East Africa)--The British East African Meteorological Department at Nairobi is interested in the establishment of a meteorological, ionospheric, and geomagnetic station there, according to advice received from Professor B. F. J. Schonland, Director of the Bernard Price Institute of Geophysical Research at Johannesburg, South Africa. It may be noted that Resolution 7 at our Oslo Assembly in 1948 (see Bull. 13, p. 538) endorsed Resolution 14 adopted at the Brussels meeting of the Joint Commission on the Ionosphere in 1950 on the desirability of an ionospheric station at Nairobi. The present Director of the British East African Meteorological Service is Wing Commander D. A. Davies (Box 931, Nairobi, Kenya, East Africa).

Cape Comorin (India)--Committee 11 has reported on the desirability of a station at Tinnevelle, India; this is a location not greatly removed from Cape Comorin, which was indicated as an appropriate locality for a world-net station. Unless it is thought that the renewal of operation of the Kodaikanal Observatory in June 1949 would meet the need, our Committee recommends, subject to agreement of Committee 11, that a suitable resolution be prepared for a permanent station at Tinnevelley.

Belem (Brazil)--The Committee recommends that representations be made to the Government of Brazil on the great desirability of establishing a permanent station in the region of Belem (Tatuoca), which was the site of a Polar Year station during 1933-34, in order to improve the world net. Perhaps the Director, Observatorio Nacional, Rua General Bruce, 586 S. Cristovan, D. F., Brazil, under whom the Vassouras Observatory operates, would be the proper contact.

Tahiti (Pacific Ocean)--This observatory was destroyed by fire in 1947. While Dr. J. Coulomb, Director of the Institut de Physique du Globe, reports there is no hope of an observatory there for a long time, it is recommended that the Association prepare a resolution urging its early replacement as one of the world net of magnetic observatories originally recommended.

New Caledonia (Pacific Ocean)--Dr. Coulomb also advises that a new observatory is planned at Nouméa in New Caledonia. As one of the proposed localities originally designated it is recommended that a resolution urging the early establishment of this proposed observatory be adopted.

Easter Island (Pacific Ocean)--Apparently no provision has been made for an Easter Island observatory. A resolution on this matter addressed to the Government of Chile seems desirable.

Magallanes (Chile)--This is a locality originally indicated for the world net and was occupied by a temporary observatory during a part of the International Polar Year of 1932-33. There has recently been received from Dr. L. Slaucitajs, Head of the newly established Department of Terrestrial Magnetism and Atmospheric Electricity of the Astronomical Observatory of the National University of La Plata, word that plans are being made for the establishment of a magnetic observatory in southern Argentina. This would doubtless be an excellent location to replace the one at Magallanes, for which there seems little or no chance. It is recommended that a resolution supporting this project in southern Argentina be made by the Association.

Miscellaneous Notes on Functioning Observatories

The Magnetic Observatory Teoloyucan (Mexico) resumed measurements of horizontal intensity early in January, 1949, thus completing full functioning.

The electrification of the Southern Railway has now made the Abinger Observatory site unsuitable and it is planned to remove the magnetic work to the west of England as also the activities of the entire Greenwich Observatory. The new site is at Herstmonceux in Sussex, and the British Admiralty hopes that the work will be transferred within the next few years.

With the view of studying both short- and long-term changes in the earth's magnetic field in Northern Canada and therefore the movements of the North Magnetic Pole, a second magnetic observatory has been established in the Canadian Arctic in addition to the one at Baker Lake (Bull. 13, p. 87), namely, at Resolute Bay during the summer of 1948. Recording instruments of the electrical type are being used and have been sufficiently tested so that records now being obtained are beyond the experimental stage. Ionospheric equipment is also operated at both stations.

The Bureau of Mineral Resources, Geology, and Geophysics of the Ministry of National Development of the Commonwealth of Australia, reports operation of magnetic observatories at Watheroo, Toolangi, Macquarie Island, Heard Island,

and the construction of a major geophysical observatory at Port Moresby, Papua. Development and research of a Bureau is done at the Geophysical Laboratory which has been established in Melbourne. Other activities include geophysical investigations in the sub-Antarctic and Antarctic areas.

J. Coulomb advises that the Observatory at El-Abiod Sidi-Cheikh (Algeria) is now in operation although there are some difficulties which remain to be solved before continuous records will be available. The Observatory at Beni-Abbès has been quite irregular in operation and may only be considered as an auxiliary station. The building of a new observatory at Médéa near Algiers is now planned and Dr. Grenet, Director of the Institut de Météorologie et de Physique du Globe de l'Algérie would welcome international approval for this station; Dr. Grenet expects to have first-class equipment there, as at the other station at Tamanrasset. The Office de la Recherche Scientifique Outremer has built an observatory at M'Bour near Dakar (French West Africa) where recording with Mascart instruments was to begin in January, 1951; la Cour instruments have been ordered for this station.

A new observatory at Bangui in French Equatorial Africa is planned but no date can be assigned for its beginning. Another project, but a much more doubtful one concerns a possible station at Lomé (Togoland). Both Bangui and Lomé are in the region recommended by Dr. Egedal.

The following notes have been supplied regarding recent developments at the Coast and Geodetic Survey by Captain E. B. Roberts, Chief, Division of Geophysics:

(1) The new Barrow Observatory mentioned in the former report (Bull. 13, p. 249) as being under construction has been in operation since May 31, 1949 (see J. Geophys. Res., 55, p. 104).

(2) There is some prospect for transferring the activities of the Cheltenham Magnetic Observatory to a new site on Government-owned land near Fredericksburg, Virginia.

(3) Some consideration is being given to the establishment of a new magnetic observatory in the northwestern part of the United States.

(4) A new magnetic observatory has been established at Houston, Texas, by the University of Houston, with the advice and assistance of the Coast and Geodetic Survey. For the time being it will not be possible to obtain regular absolute observations, but the variation apparatus is complete and is operated on a full-time schedule. Records will be turned over to the Coast and Geodetic Survey.

(5) The Coast and Geodetic Survey continues to operate its two declination recording stations, one at Gatlinburg, Tennessee, and one at Logan, Utah (Bull. 13, p. 223).

No doubt Chairman Egedal of Committee 11 will have definite proposals to present at Brussels and our Committee is inclined to await the consideration of such proposals before making a definite recommendation for the establishment of another observatory in equatorial regions other than the suggestions above made.

The Planning Committee on Geophysics appointed by the Government of India has recommended the re-establishment of a magnetic observatory in or near Dehra Dun.

As previously reported, the Sodankylä Observatory in Finland was completely destroyed in the autumn of 1944; that Observatory has now been reconstructed and an official inauguration was held on September 2, 1950, although magnetic recording had been resumed on January 1, 1946. The Central Meteorological Office at Helsinki is preparing for the establishment of a new magnetic observatory near Helsinki. This observatory will give a better distribution of magnetic data in the gap between the Lovö Observatory in Sweden and the Sloutzk Observatory of USSR.

Information regarding Japanese observatories has been supplied by Dr. S. Imamiti as follows:

(1) Kakioka--The work at Kakioka Observatory (Bull. 13, pp. 179-181) has been subjected to some changes since 1948. (a) Magnetic work. The Memanbetsu Magnetic Observatory (lat. 43°.9 N, long. 144°.2 E), a branch station of the Kakioka Magnetic Observatory, was started November 1949, in place of the temporary observatory at Ikutora (lat. 43°.2 N, long. 142°.6 E) and has done provisional work on geomagnetism since May, 1950. The normal routine observations on geomagnetism are expected to begin in January, 1952; the variation house was completed in November, 1950, and it is planned to complete the absolute house in September, 1951, and at the Kakioka Magnetic Observatory, a visually recording magnetometer designed by T. Kuboki is now operated as a sub-routine recording of the horizontal intensity and declination, and is used for the ionospheric disturbance warning. A sine-galvanometer is planned for the Kakioka Observatory and this plan is in close cooperation with a Special Committee in the Science Council of Japan. (b) Earth-current observations at Miyakonojo and Morioka were discontinued in November 1949. At Kanoya (lat. 31°.4 N, long. 130°.9 E) long-base and short-base systems began operation in January, 1948, and at Memanbetsu a short-base system began operation in January, 1950. Regular observations of earth-resistivity began in January, 1950, at Kakioka and provisionally in December, 1950, at Haranomachi (lat. 37°.6 N, long. 140°.9 E). (c) Observations of atmospheric-electric potential were begun at Memanbetsu in January, 1950, using a Benndorf self-recording electrometer.

(2) The Aso Magnetic Observatory (lat. 32°.9 N, long. 131°.0 E) of Kyoto University made absolute observations with a Nippon-Suirobu type magnetometer and variations of the magnetic field were recorded by unifilars for horizontal intensity and declination with scale-values of 2.7 γ/mm and 0'.43/mm. Vertical-intensity variations are recorded by a Watson type of metallic ribbon suspension with scale-value at 4.2 γ/mm on a time-scale of 18.3 mm/hour for each element.

(3) Mitsui Magnetic Observatory (lat. 34°.7 N, long. 139°.0 E) of the Mitsui Institute of Marine Science made absolute observations with a Nippon-Suirobu type magnetometer and with unifilars to record horizontal intensity and declination with scale-values of 1.21 γ/mm and 0'.778/mm on time-scales of 19 mm/hour. Recording of vertical intensity is temporarily stopped.

(4) The Onagawa Magnetic Observatory (lat. 38°.4 N, long. 141°.5 E) of Tohoku University made continuous recordings of dX/dt, dY/dt, and dZ/dt by the induction method using a coil and high permeability alloy for the north, west, and vertical components of the geomagnetic field.

(5) The Magnetic Laboratory of Tokyo University (lat. 37°.2 N, long. 140°.2 E) obtained recordings as at Onagawa.

(6) At the Central Institute of Radio Waves magnetic observations were obtained at the Branch Station at Wakkanai Observatory (lat. 45°.4 N, long. 141°.7 E) for the three components of horizontal intensity and declination by unifilars and vertical intensity by a Watson-type magnetometer. Absolute observations are made by a Nippon-Suirobu type magnetometer.

(7) At the Katsuura Magnetic Observatory (lat. 33°.6 N, long. 135°.9 E) under the Hydrographic Division of Marine Safety Agency, absolute observations only were made by a Nippon-Suirobu type magnetometer.

Mobile Observatories

The work of Committee 11, as reported by Chairman Egedal, illustrates the need of the early adoption of a standard type mobile observatory. Such an observatory should provide recordings of all three magnetic elements. It is understood that both the United States Coast and Geodetic Survey and the Department of Terrestrial Magnetism and Electricity of the Carnegie Institution of Washington both have mobile-types of magnetic and ionospheric observatories although they may not yet be fully satisfactory. There are possible a number of researches which would be advanced were such mobile observatories available. For example, the study of local changes in diurnal-variation phenomena within limited distances of a permanent observatory would be useful in deciding upon changes in diurnal-variation features with varying distances from a central recording point.

Canada's first mobile ionospheric observatory was put into operation on August 23, 1948, by the Defence Research Board on the railroad to Churchill. The new observatory, housed in a converted railway coach, is expected to be a vital link in an international chain of stations supplying information essential to the development of radio communication and radio navigation in the north. One round trip will be made every three months in each of the four seasons of the year.

Our Committee has not found it possible to hold assembled meetings of its four members. Its various discussions have been satisfactorily effected by airmail correspondence which has permitted exchange of thoughts and comments by all members within eight or ten days.

Washington 5, D.C., U.S.A.
March 30, 1951

SUPPLEMENT TO REPORT OF COMMITTEE ON SELECTION OF SITES OF NEW OBSERVATORIES FOR TERRESTRIAL MAGNETISM AND ELECTRICITY

Lisbon, 15 March, 1951
(No. R115/1324)

Dr. J. A. Fleming, Chairman
Committee on the Selection of Sites of
New Observatories for Terrestrial Magnetism
and Electricity, I.A.T.M.E.

Dear Dr. Fleming:

In order to improve the Portuguese contribution to the knowledge of the geomagnetic field, the establishment of new magnetic observatories in the African territories of Angola and Mozambique, near Luanda and Lourenzo Marques, respectively, is under consideration. This problem, as you know better than myself, involves considerable expense and therefore any steps taken should be based on the assumption that the program should include other branches of geophysics.

So, I am thinking of taking advantage of the reorganization of the Meteorological Services of Angola and Mozambique (which have been placed under technical superintendency of the National Service in Lisbon) to ask for a special grant to cover the cost of establishing a geophysical section (including terrestrial magnetism and seismology) as an annex to each of the meteorological observatories already in existence at Luanda and at Lourenzo Marques. I should like to have your opinion about this project, and any other information you may think of as being useful for this purpose.

Thanking you in advance, I remain my dear Colleague,

Yours sincerely,

H. Amorim Ferreira, Director,
Servico Meteorologico Nacional

This letter was received subsequent to the Committee's report dated March 30, 1951. The Committee submits the following remarks:

Neither of these localities is included on the maps presented at the Lisbon Assembly. The Committee believes, however, that well-operated magnetic, electric, and ionospheric observatories at these two locations would be most desirable. Luanda is the site of an observatory set up many years ago to honor an eminent geomagnetician of Portugal in the early 19th century, but this station has been for many years more or less inoperative. Our Committee, therefore, feels encouragement to the Director of the National Meteorological Service of Portugal should be given at the Brussels Assembly through a suitable resolution.

Washington 5, D.C., U.S.A.
April 4, 1951

REPORT OF THE AURORAL COMMITTEE

By Carl Störmer, Chairman

From the period 1948-1951, since the meeting in Oslo, reports have been collected from countries and persons engaged in making observations and doing research work on the polar aurora. These reports are given below.

Canada

A. Auroral Research at the University of Saskatchewan

1. A new type of auroral recorder is in operation. It sweeps the sky from horizon to horizon along a geomagnetic meridian once each five minutes. Alternate sweeps with a filter transmitting a narrow band of wave-lengths centered on 5577A and another centered on 5200A serve to distinguish the auroral light from moonlight.

2. Spectral features are being studied with two spectrographs, one a grating instrument with first-order dispersion of about 40 A/mm and the other a single-prism instrument with interchangeable glass and quartz optics. Three high light-gathering spectrographs are under construction. Each instrument will use a plane-grating and a flat-field Schmidt camera.

3. Equipment has been constructed for measuring relative changes of selected auroral radiations, using photomultiplier and lead sulphide cells.

4. Studies of reflections of radar waves of 3 and 6 meters wave-lengths are under way.

5. A detailed study has been made of the Chesterfield parallactic photographs and the Coppermine, Chesterfield, and Cape Hopes Advance visual data obtained during 1932-33. The results have still to be prepared for publication.

B. Auroral Research by the Radio Physics Laboratory, Defense Research Board of Canada

1. Visual observations of aurora are made regularly at a number of the high-latitude ionospheric stations.

2. A study of these observations indicates the presence of two zones of maximum occurrence of auroral light, one near Churchill (58.8°N, 94.2°W) and the other about 3° of latitude farther south. During periods of increased ionospheric and magnetic activity, aurora increased in occurrence and in the width of the zone, particularly toward the south.

C. Other studies

1. Dr. G. M. Shrum, University of British Columbia, is attempting to correlate auroral observations in the Northern and Southern Hemispheres.

Great Britain

AURORAL FREQUENCY, BRITISH ISLANDS, 1948, 1949, 1950

By W. B. Housman

The figures below give the number of nights (twilight to dawn) for each month when aurora was seen. Fifty-six observers at sixty-three places have contributed reports from all over the British Islands, from Skye to Guernsey in latitude, and from Ipswich to Nenagh (Eire) in longitude.

	1948	1949	1950	Total
Jan.	3	3	1	7
Feb.	0	3	4	7
Mar.	2	7	4	13
Apr.	1	1	1	3
May	2	2	0	4
June	0	0	0	0
July	1	0	1	2
Aug.	0	1	5	6
Sept.	3	4	6	13
Oct.	10	12	9	31
Nov.	8	10	10	28
Dec.	2	2	8	12
	32	45	49	126

These displays were classed thus:
3) Horizon glow with no activity.
2) Active forms, limit at zenith.
1) Active north and south of zenith, corona.

Of these classes there were:

Class 3	56	nights
Class 2	61	,,
Class 1	9	,,
Total	126	,,

Of the 9 in class 1, the dates were:

1949 Jan 24/25	1950 Feb 20/21
,, 25/26	Aug 7/8
Oct 14/15	,, 19/20
,, 15/16	Oct 28/29
Nov 19/20	

For dates of all and other details refer Journal B. A. A., as under: Vol. 58, No. 7, Vol. 59, No. 5, Vol. 60, No. 1, Vol. 60, No. 8, and Vol. 61, not yet published.

NOTE: All the above observations were visual. No radar reports included.

OBSERVATIONS OF THE AURORA BOREALIS BY RADIO METHODS AT THE JODRELL BANK EXPERIMENTAL STATION OF THE UNIVERSITY OF MANCHESTER

By G. S. Hawkins

1. Apparatus

Several aurora displays have been studied at Jodrell Bank by the reflection of radio energy from the associated regions of ionization. In the experimental work five equipments have been used, each consisting of an aerial system, pulsed transmitter and receiver, as described in Table 1. A cathode ray tube with range-intensity presentation was used in the Radiant Survey Apparatus, and echoes were photographed on a film moving at right-angles to the range scale. In all other cases a range-amplitude time base was used, and echoes recorded by ciné photography.

Table 1

Equipment	6 meter	Radiant survey	4 meter	Long pulse	8 meter
Wavelength	6.5 m	4.2 m	4.2 m	4.2 m	8.4 m
Peak power of transmitter	30 Kw	5 Kw	20 Kw	25 Kw	20 Kw
Pulse length	15 μs	8 μs	8 μs	1000 μs	8 μs
Pulse recurrence frequency	50	150 double	150	9	50
Bandwidth of receiver	1/2 Mc/s	1/2 Mc/s	1/2 Mc/s	2 Kc/s	1/2 Mc/s
Minimum detectable signal	7×10^{-14}w	7×10^{-14}w	7×10^{-14}w	3×10^{-16}w	7×10^{-14}w
Azimuth of aerial beam E of N	0° and 180°	292°	movable	movable	90°
Elevation of beam	15° and 45°	8.5° and 27°			10°
Horizontal half-amplitude beam width	±45°	±5°	±8°	±8°	±17°
Vertical half-amplitude beam width	±4° ±14°	±6° ±4°	±12°	±12°	±7°
Aerial gain over half wave dipole	4	160	40	40	50
Latitude of Jodrell Bank	53°14′N				
Longitude of Jodrell Bank	2°18′W				

2. Results obtained with each equipment

(i) 6 meter equipment. Diffuse and discrete radio echoes from the aurora were first obtained on this equipment on 1947 August 15-16[1]. The echoes coincided with the appearance of auroral rays in the northern sky and a diffuse glow in the zenith, but the correspondence between individual echoes and the visible phenomena could not be explored because of the broad beam of the aerial.

(ii) Meteor survey apparatus. Both diffuse and discrete echoes have been observed, as shown in Figs. 1a,b. On 1949 October 15-16 data were obtained from a team of visual observers which associated the diffuse echo with auroral arcs and diffuse luminous surfaces and the discrete echoes with rays[2]. An irregular type of echo has since been obtained from auroral curtains, and there are other types of echoes which have not yet been identified, but which orrur with aurora echoes. A continuous photographic record has been obtained since 1949 September, during which time 19 aurorae have been studied. The diurnal distribution of these aurorae, Fig. 2, shows a maximum frequency at 1830 hrs. and 0100 hrs. local time. The afternoon maximum has not been previously observed, and was caused mainly by quiescent diffuse echoes, indicating homogeneous arcs. The night time maximum is displaced by two hours from the visually determined maximum[3], but the number of observations may not be great enough to attach any significance to this. In Fig. 3, the occurrence of aurorae has been plotted using Carrington's synodic series of solar rotations. This confirms a marked 27-day recurrence, and indicates that the

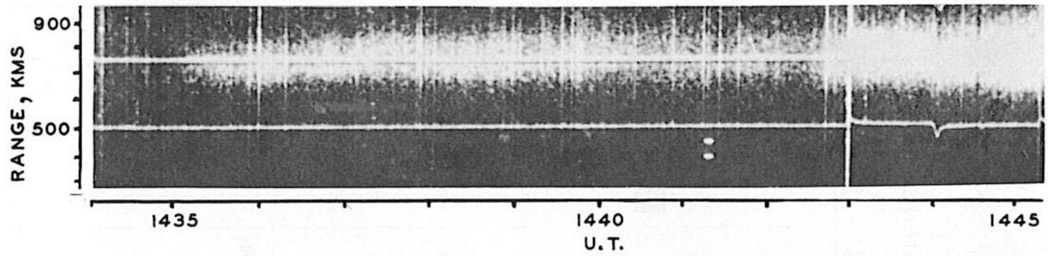

Fig. 1a--Diffuse aurora echoes, August 19, 1950

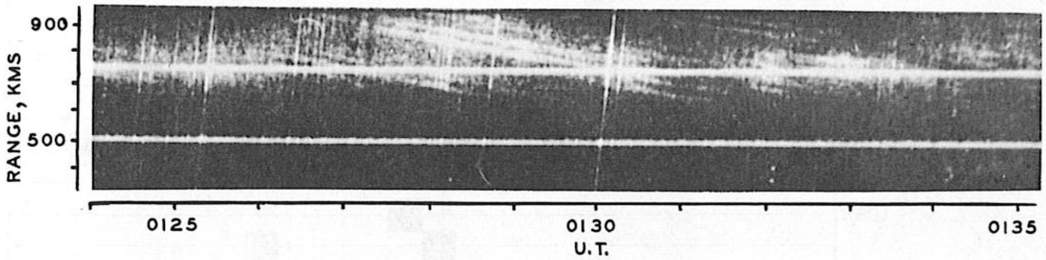

Fig. 1b--Discrete aurora echoes. Double echo is due to double pulsing of the transmitter, August 8, 1950

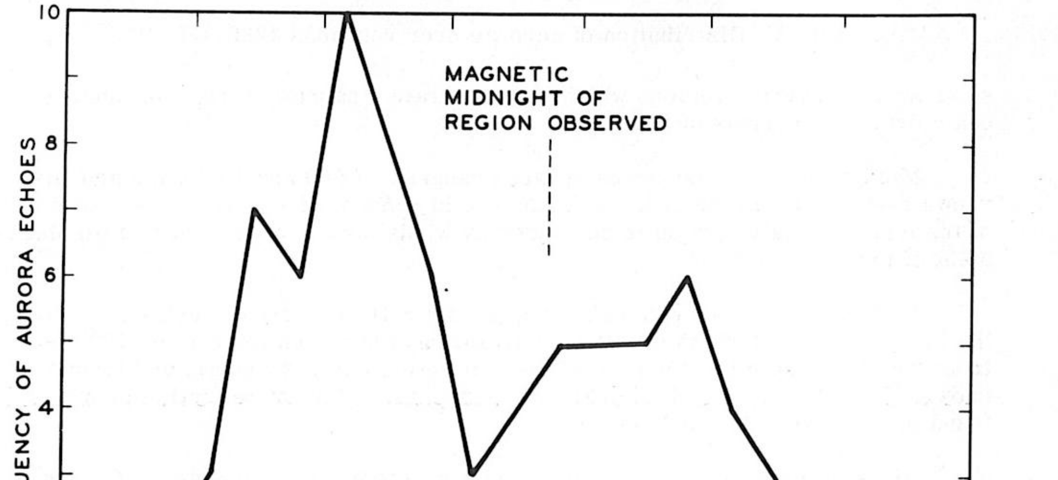

Fig. 2--Diurnal distribution of aurorae

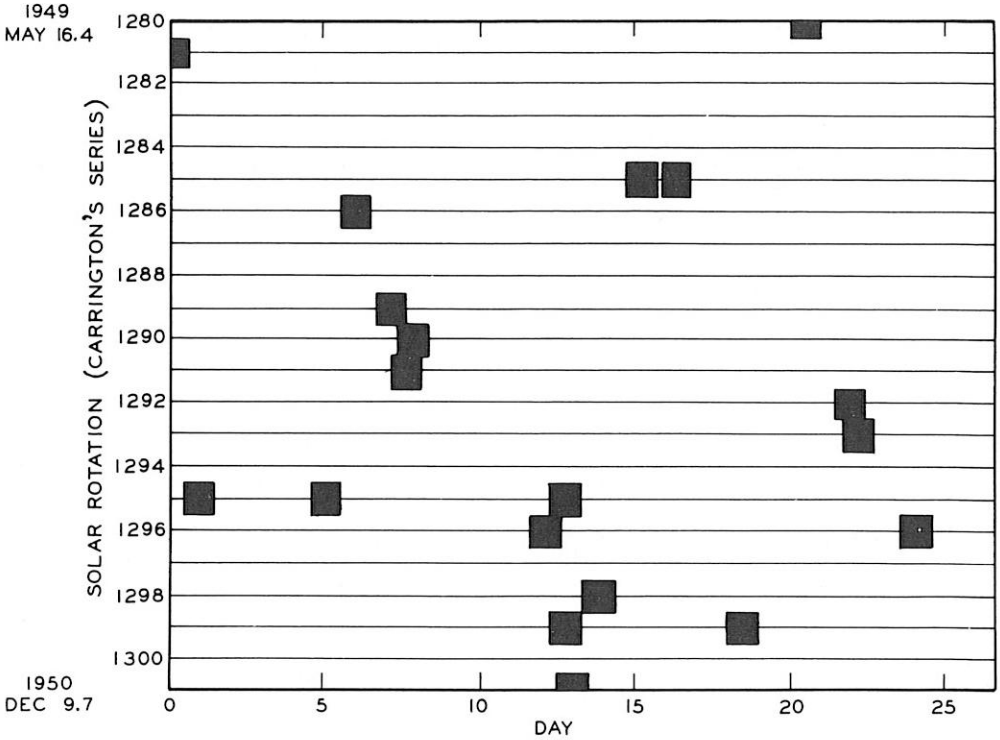

Fig. 3--Distribution of aurorae over rotations 1280-1301

solar surface carries regions which may generate a narrow, aurora-producing beam over long periods of time.

Most echoes have occurred between ranges* of 500 and 1000 Kms and have shown range drifts of the order of 1 Km/sec in random directions. The movement of the ionization is too rapid to be caused by winds, and is attributed to a displacement of the ionizing agent.

By treating the discrete echo as a partial reflection from a cylinder of ions, the lower limit of electron density in auroral rays has been found to be 10^6 electrons/cc. The same treatment predicts that reflection is specular, and from a knowledge of the range and inclination of a ray, the height of reflection points is found to be between 100 and 300 Kms.

(iii) 4 meter equipment. Diffuse and discrete echoes were obtained on this equipment during the great aurora of 1950 August 18-20[4], as shown in Fig. 4. A ciné film revealed rapid amplitude fluctuations in both types of echoes, the diffuse echo appearing as enhanced receiver noise. The association of discrete echoes and auroral rays was confirmed by scanning the sky with the movable aerial:- echoes only being obtained when rays were located in the aerial beam.

(iv) Long pulse equipment. During the aurora of 1950 February 20-21, this equipment was used to detect a corona which had been reported over Edinburgh[5]. Discrete echoes were obtained along the correct azimuth and at ranges of 300 to

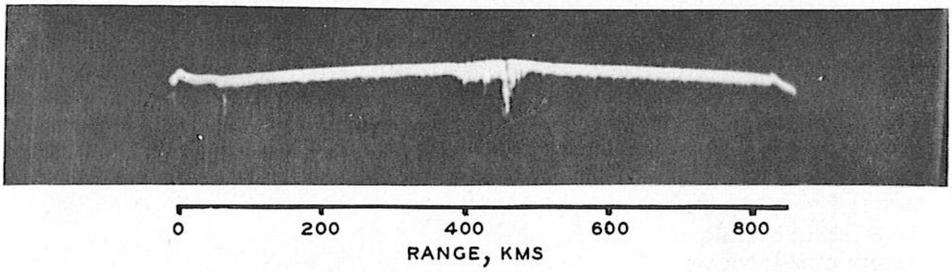

Fig. 4--Diffuse and discrete echoes, August 19, 1950

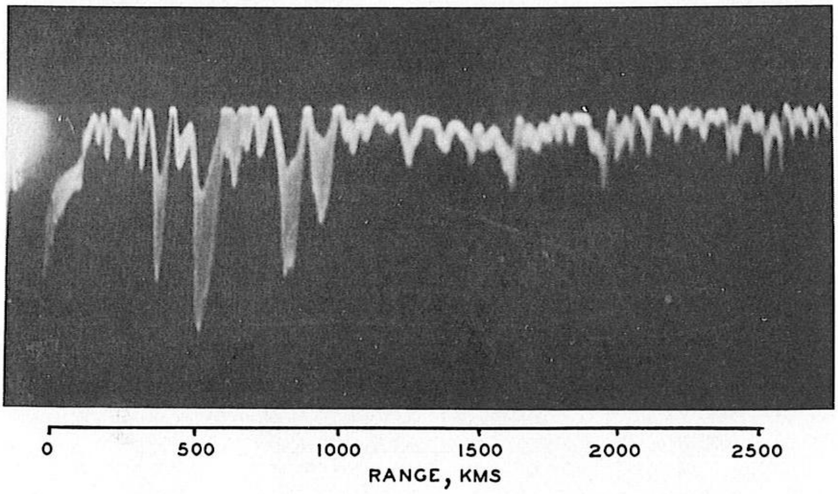

Fig. 5--Discrete echoes, February 20, 1950

1000 Kms, as shown in Fig. 5. The spread in amplitude of the echoes is due to a fluctuation impressed from the receiver.

(v) 8 meter equipment. On a wavelength of 8 m echoes have been observed[6], but correlation with aurorae formations has not been established. On 1947 October 7-8, two days before a visible display, discrete and diffuse echoes were observed at ranges between 2500 and 3500 Kms, using a northerly pointing dipole. By adjusting the height of the aerial the apparent reflecting centers were localized at an elevation of less than 30°. Subsequent observations have been made with the aerial directed along azimuth 90°, and again diffuse echoes have been obtained at a range of 3000 Kms, showing no marked correlation with aurorae. Direct reflection would imply ionization at abnormal heights, greater than 700 Kms, and it seems more likely that the echoes are "ground clutter" produced by skip reflection.

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* Owing to the pulse recurrence frequencies used, these ranges are ambiguous in that the beginning of the time base corresponds to integral values of 1000 Kms. In the aurora of 1950 February 20-21 ranges were shown to be less than 1000 Kms, and subsequent echoes have been assumed to lie in this region.

Jodrell Bank Experimental Station
University of Manchester
1951 January 22

The Netherlands

AURORAL OBSERVATIONS IN THE NETHERLANDS, 1948, 1949, 1950

The dates of auroral observations are given below:

1948 March (15); August 8, 9; November 20, 24, 25; December 25.
1949 January 24, 25, 26, 27* ; February 3, 4* , 16; March 9, 21, 22* ; May 3, 4* ; June (7); October 14, 15, 27.
1950 January 24; February 20; August 19, 20, 21* ; October 3.

( ) dubious cases.
* a.m. observations only.

New Zealand

NEW ZEALAND AURORAL WORK, 1948-1951

The Carter Observatory acts as a collecting center for observations of the Aurora Australis in the Southern Hemisphere. In New Zealand there are three hundred voluntary observers who report any displays seen. Cloud cover reports, as well as the existence or otherwise of aurorae on every clear night, are made by thirteen meteorological stations, by arrangement with the Meteorological Bureau. All these observers are distributed over the whole country.

In Tasmania, the Astronomical Society has formed an efficient band of observers reporting all displays seen. The Government Astronomer at Perth reports any observations made in the southern part of Western Australia.

Reports are also received from Campbell, Macquarie and Heard Islands. The first station is under the control of the New Zealand Meteorological Bureau, and the others form part of the organization of the Australian National Antarctic Expedition.

Work was completed in 1950, in the installation of Professor Störmer's auroral cameras at the meteorological stations at Taieri (lat. 45°51'S., long. 170°22'E.), and Invercargill (lat. 46°25'S., long. 168°19'E.). These are connected by telephone. While the photographic work is additional to normal heavy meteorological duties, preliminary trials show that results of considerable value should be obtained when the occasion arises. Several excellent single station photographs have already been obtained. It should be noted that very fine photographs have been obtained at Heard Island by the observers using a Contax camera.

For the benefit of all observers reporting to the Carter Observatory, a Manual for Visual Observations of the Aurora Australis (Astronomical Bulletin No. 29) was published in 1949.

The Observatory has only a small staff, and auroral work is only one of its several activities. To handle the amount of material already collected and still being received therefore requires an efficient office system. Much time has therefore been spent in devising simple but quick methods in extracting auroral information as it is received. This forms the basis of all preliminary reports such as are published in the Cosmic Relations Bulletin and the Aurora Australis Circulars.

Time has not been available for routine work on the analysis of each display as outlined in a Proposed Auroral Index-Figure (Terrestrial Magnetism and Electricity, Dec. 1947) but a few preliminary trials have shown that the method holds much promise. It is hoped that the method will be used in the immediate future when a complete revision of all auroral data on hand will be made.

Using such preliminary data as are available, Mr. D. M. Garner of this Observatory has made a study of the auroral frequency and its correlation with sunspots. This shows the lag of auroral on solar maximum, as well as the indication of seasonal maxima on the equinoxes. A point of interest, however, is the doubt as to the real seasonal character, when comparison with detailed solar observations are made.

Norway

ON AURORAL SPECTROSCOPY AND PROPERTIES OF THE IONOSPHERE

By L. Vegard

1. At the Oslo Meeting of the International Union of Geodesy and Geophysics a report and some papers[1] were given on investigations carried out up to that time by the writer and collaborators, dealing with the physics of the ionosphere revealed through spectral analysis of aurorae and twilight, and with the relations between ionospheric and solar phenomena.

The writer was also called upon to suggest lines for further research[2], and for the present report it is of interest to call attention to the following five points:

Point 10: For the study of the composition and state of the ionosphere it is very important that the large number of weak lines and bands, which are known to be present in the auroral spectrum, should be accurately measured and identified. For this purpose it is essential to have spectrographs which have at the same time a much greater light power and dispersion than those used up to the present.

Point 11: The great variability of the intensity distribution within the auroral spectrum indicates variations of the composition and state within the ionosphere and probably also in the properties of the solar radiations producing the aurorae and causing the ionospheric changes, and the variability effects should be correlated with solar processes. For such investigations it is essential to obtain distinct spectrograms with the smallest possible time of exposure, and it is essential to use spectrographs of extremely high light power, of moderate dispersion, but which give very sharp lines.

Point 12: Particular interest is attached to the appearance of the hydrogen lines and the yellow sodium line from aurorae and night sky, and the variations and possible Doppler effect which may be shown by these lines.

Point 19: Measurements of the temperature of the upper atmosphere as defined by the rotational energy of nitrogen molecules should be measured from auroral spectrograms corresponding to auroral streamers of great altitude and from sunlit aurorae.

Point 15: The screening height and the upper limit for the intensification of the sodium D-line should be determined as accurately as possible by using spectrographs of high light power provided with means for an accurate determination of height and azimuth of the collimator axis, and means for an exact determination of the intensity of the D-line as a function of time.

These suggestions may be said to express the aim and purpose of most of the auroral and ionospheric investigations carried out by the writer and collaborators since the Oslo Meeting.

2. New Spectrographs

A big spectrograph meeting the demands mentioned in point 10 was built, in accordance with my specifications, by the French firm Société Générale d'Optique, under the leadership of Dr. J. Cojan. This instrument (I) combines a considerable dispersion with the fairly great light power (F: 1,2). The length of the spectrum between 3900-7000 Å is about 30 mm. The dispersion in the various spectral regions is indicated in table I.

Table I

Wavelength	Dispersion	
	Sp. I (F: 1,2)	Sp. II (F: 0.65)
4000	40 Å/mm	77 Å/mm
5000	99 ,,	205 ,,
6000	188 ,,	395 ,,
7000	308 ,,	650 ,,

The spectrograph was mounted in a well isolated wooden box, where the temperature can be kept constant by means of an automatic regulator. The instrument was well corrected for errors and gave remarkably sharp lines throughout its whole spectral range.

During the winter months from January to March 1950, the instrument was used at Oslo. In July 1950 it was taken to Tromsoe and placed on the observation platform of the Auroral Observatory.

For the study of the variations of the spectral composition of the auroral luminescence as mentioned in point 11, a big Cojan-spectrograph (II) was obtained from the same French firm in the autumn of 1950, and is now equipped for auroral work at the physical institute of the Oslo University. The light power (F: 0.65) is nearly four times that for the spectrograph (I), but as seen from table I the dispersion is much smaller. The instrument is to be placed at the Tromsoe Observatory next summer.

3. Results of Observations from Tromsoe

During the winter seasons 1947-48, 48-49, and 49-50, auroral spectrograms were taken with four of the spectrographs which were previously used at Tromsoe and which will be denoted by (A, B, Q, α).

With the big glass spectrograph (B) we took auroral spectrograms with very long exposures in order to detect and measure as many lines as possible. The following two spectrograms (a and b) showed a great number of lines and band:

(a) Exposed from 9.10.47 to 7.2.48 with an effective time of exposure of 36 h.
(b) Exposed from 15.11.49 - 16.1.50 (effective time of exposure 21 h).

A spectrogram was taken from aurora exposed to sunlight with the big glass spectrograph (A) to obtain the N_2^+ band 4278, with a density suitable for temperature measurements.

Spectrograms were taken from the upper and from the lower part of the auroral streamers with the quartz spectrograph (Q) in order to measure the temperature at different altitudes within the ionosphere.

Auroral spectrograms were also taken with a small spectrograph (α) for the study of variability effects, and a considerable number of twilight spectrograms were taken for the study of the excitation and height of the sodium responsible for the yellow D-doublet.

Most of these observations have been dealt with in a paper: "Continued Investigations on the Spectra of Aurora and Twilight and the Ionospheric Temperature," by L. Vegard, E. Tønsberg, and G. Kvifte[3].

Among the results we may call attention to the following: From the spectrogram (a) taken with spectrograph (B) about 80 lines were detected and measured, some of which were not previously observed.

The results from spectrogram (b) (15.11.49 - 16.1.50) are not yet worked out. It is of interest to notice that the H_β line on both spectrograms was too weak to be distinctly seen.

Temperature Observations

The results of the temperature measurements are summarized in table II.

Table II

Spectro-graph	Numbers of spectrograms	Mean temperature	Conditions of observation
A	11	-44.2 C	Lower limit
Q	8	-45.0 C	" "
Mean	19	-44.6 C	Lower limit
Q	2	-56.0 C	Upper limit
A	2	-36.5 C	Sunlit aurora
Q	2	-53.0 C	" "
Mean	4	-44.8 C	Sunlit aurora

It appears that the measurements up to the present have given no indication of any increase of ionospheric temperature with increasing altitude or when the aurora is in a sunlit atmosphere.

Twilight Observations

As shown in previous papers (4,5,6) the solar light, which is essential for the excitation of the yellow sodium line in twilight is absorbed by the lower part of the atmosphere. The screening height (H_s) as well as the upper limit (H_w) for the sodium layer, mainly responsible for the enhancement of the sodium line in twilight, are determined from the points of time τ_z and τ_h, when the sodium line apparently disappears at two different points of the sky, e.g., in the zenith and in a direction near the horizon. For each direction the time τ is determined by means of a series of spectrograms taken in rapid succession, until the D-line disappears. From the time τ_z and τ_h the values of (H_s) and (H_u) were calculated.

Such series of spectrograms were taken at Tromsoe in October 1942 and from January until March 1946. An improved method for determining (τ) was developed and used. The values (H_s) and (H_u) were determined for each evening, and they showed only small variations probably due to inevitable errors. For the eleven evenings, for which observations were made, we got the following mean values:

$$H_s = 34.9 \text{ km}$$
$$H_u = 99.3 \text{ ''}$$

The thickness (d) of the sodium layer mainly responsible for the yellow line in twilight was determined by a method recently proposed by the writer[7]. The thickness thus determined varied between 23 and 31 km, with an average of 27 km.

In order to increase the accuracy, we intend to use spectrographs of greater light power, provided with means for an exact determination of the direction of the collimator axis.

4. Results from Observations at Oslo

At Oslo the writer in collaboration with G. Kvifte took spectra of aurora and twilight with a glass spectrograph with the great light power (F: 0.95) and a fairly good dispersion. This observational material has been worked out, but is not yet published.

We may, however, mention the following results: In February and March 1949 two successful auroral spectrograms were obtained on infra-red sensitive plates showing 17 bands and lines in the interval from 7000 to 8860 Å. Of these, nine had not at that time been previously observed. Intensity measurements showed that these infra-red bands were comparatively strong. The infra-red bands were to be referred to nitrogen.

During the years 1943, 46, 48, and 49, twilight spectrograms were taken for the determination of (H_s), (H_u) and the thickness (d) of the effective sodium layer. The directive of the collimator axis was carefully measured and the times τ_z and τ_h were determined by measuring the intensity of the D-line photometrically.

The values of H_s, H_u, and (d) were measured separately for each evening. A summary of the results is given in table III.

Table III

Year	H_s km	H_u km	d km	Number of evenings
Mean 1943	37.5	108.1		2
" 1946	36.3	102.0	32	7
" 1948	39.6	102.9	22	3
" 1949	41.4	107.5	27.2	26
Total mean	40.7	106.4	27.7	38

The values found are a little smaller than those first found, but they agree well with the assumption, that the effective ultraviolet radiation is absorbed by the atmospheric ozone.

We have also made extensive studies of the intensity variations of the D-line. In spite of great irregular fluctuations our intensity measurements indicate, on an average, that the D-line has an intensity maximum in the winter. Details will be given in a paper which we intend to publish in Geofys. Publ., Oslo.

5. Results Obtained With the New Spectrograph (I) at Oslo

From a brilliant aurora, which appeared at Oslo during the night of February 23-24 last year, we obtained with the new spectrograph (I) a very heavily exposed spectrogram showing a great number of very sharp lines and bands with structures, many of which were weak and had not been previously detected. The spectrogram, which was taken on a Kodak 103 a T plate, had a spectral range from ca 6300 to 3880 Å.

In spite of the fact that the exposure only lasted for a few hours, the spectrogram was much more heavily exposed than the one which was taken with the old spectrograph (B) from 9.10.47 - 7.2.48, with an effective time of exposure of 36 hours. Some preliminary results have already been published[8].

In these publications I have given the wavelength values of 114 lines and bands which could be distinctly seen on the negative.

By taking photometric curves of great magnification along two parallel lines across the spectrogram, multiplets and a great number of faint lines could be detected. Most of the lines detected and measured in this way are no doubt real.

Thus the total number of lines and bands observed and measured on this single spectrogram covering the spectral region (6300-3880) amounts to about 400. Before this spectrogram was taken, the total number of known auroral bands and lines in the greater region from (8860-3100) only amounted to 170.

The sharpness of the lines and the considerable dispersion secured a greater accuracy of the wavelength measurements and a more reliable identification. As seen from table IV, a great number of lines may be referred to neutral or singly ionized atoms of oxygen and nitrogen.

Table IV

Number of Auroral Lines which may be Referred to Neutral or Singly Ionized O- and N-atoms

Symbol	Number
OI	42
OII	129
NI	115
NII	120

Hydrogen and Sodium Lines

On this spectrogram the sodium D-line and the $H\beta$ - and $H\gamma$ -lines appeared, but the latter were broad and diffuse. The broadening must be due to Doppler effect, and a closer inspection of $H\beta$ shows that the "unmoved" $H\beta$ -line would have been situated near the middle of the broadened line. The intensity curve is nearly symmetrical relative to the maximum, which shows merely a small displacement towards shorter waves relative to the unmoved line.

This is explained by the fact that the axis of the instrument the whole time was directed towards the same point of the sky and that this axis was nearly perpendicular to the magnetic lines of force. The broadening of the line in the way described thus shows that a great deal of the hydrogen atoms (protons) entering into the atmosphere, turn around the magnetic lines of force, and as it is likely that some of them for a moment are moving perpendicular to the lines of force, the maximum velocity of the protons is determined approximately from the maximum Doppler-displacement by means of the equation:

$$V_m = \frac{\Delta\lambda_m}{\lambda} C$$

As $\Delta\lambda_m$ is found to be about 20 Å, this gives $V_m = 1234$ km/sec.

More Accurate Temperature Determination

The rotational components of the R-branch of the negative nitrogen band 3914 were distinctly separated, which involves a more accurate determination of the ionospheric temperature. The temperature determinations gave the following results:

$$T_m = 219.9\ K = -53.1^\circ C$$
$$T_K = 217.9\ K = -55.1^\circ C$$

where T_m is derived from the position of the intensity maximum of the R-branch and T_K from the intensity distribution, which is supposed to follow Maxwells law.

Auroral Bands

With regard to the bands appearing in the auroral luminescence, it was found that in addition to the nitrogen bands previously observed (from N_2^+: the first negative group, from N_2: the 1st and 2nd positive group and the Vegard-Kaplan bands), this spectrogram showed for the first time that the 1st negative group of oxygen originating from O_2^+ appeared in the auroral spectrum.

Some weak lines may even possibly be referred to the Goldstein system from N_2, the Schuman-Ringe-system from O_2, and the β-bands from NO, but these identifications need further confirmation.

The final results derived from this spectrogram from Oslo are soon to be published by the writer and G. Kvifte.

6. Spectrograms Taken with the New Spectrograph (I) at the Tromsoe Observatory

Up to the date of this report, the following successful spectrograms were obtained at Tromsoe:

T_1. A spectrogram on a panchromatic plate (Kodak 103 a E). Exposure from 10.11 - 13.12.1950. Effective exposure time 5 hours.

T_2. Spectrogram on infra-red sensitive plates (Kodak I N) exposed 1.1 - 12.1.1951. Effective time 6.5 hours.

T_3. Spectrogram on same sort of plate as (T_2) exposed for 2 hours on the 16th of January 1951.

In the region of short waves (e.g. for $\lambda < 5577$) these three spectrograms were weaker than the Oslo spectrogram in this region, but as the lines and bands are very sharp and the intensity relations between lines differ from those of the Oslo spectrogram, also this part of the Tromsoe spectrograms give results of interest.

It is, however, the great number of lines and bands appearing in the long wave region which call for the greatest interest. The Tromsoe spectrograms have not yet been carefully studied and the results are not published, but to give an idea of the value of these spectrograms we may mention the following facts:

In the long wave part of spectrogram T_1 between 5577 and 6690 Å, 27 sharp lines and bands with structure comes out very distinctly and some are overexposed. Bands of the first positive group of nitrogen and the first negative group of oxygen appear.

The sharp atomic lines belong to the spectra of OI, NI, and NII. The sodium D-line is masked by a band of the first positive N_2 group and is at any rate relatively weak.

The spectrograms T_2, T_3 show about 19 lines and bands in the infra-red interval 7000-8850. The bands and lines are sharp, well separated, and quite strong. Among the sharp atomic lines we find the OI lines (7772 and 7995) and the NI line 8216.

As known from earlier measurements, a number of lines in the infra-red belong to the first positive group of nitrogen. But in addition a number of bands appear, which A. B. Meinel[9] recently has referred to a band system $A^2\pi - x^2\Sigma$ originating from N_2^+.

Finally, it should be mentioned that the Tromsoe spectrograms show separation of the rotational components of the R-branch and give consequently good conditions for temperature measurements.

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Oslo
October 2, 1951

REPORT ON WORK ON AURORA IN SOUTHEASTERN NORWAY DURING 1948, 1949, AND 1950

By Carl Störmer

In the three years 1948, 1949, and 1950 the following stations for photographing aurora have been in action: Askim, Vålåsjö, Holmestrand, Kongsberg, Lillehammer, and Oslo (triple station). The aurora was observed the following nights:

1948: Jan. 21-22, Feb. 5-6, 15-16, 24-25, 27-28, March 1-2, 8-9, 9-10, 12-13, 13-14, 26-27, 29-30, April 10-11, 13-14, May 7-8, Aug. 4-5, 13-14, 28-29, Sept. 1-2, 2-3, 15-16, 16-17, 29-30, Oct. 2-3, 3-4, 7-8, 17-18, 19-20, 20-21, 21-22, 22-23, 23-24, 24-25, 25-26, 26-27, 27-28, Nov. 6-7, 7-8, 8-9, 9-10, 17-18, 20-21, 22-23, 24-25, Dec. 4-5, 21-22, 23-24, 25-26, 26-27.

1949: Jan. 9-10, 12-13, 24-25, 25-26, 30-31, Feb. 3-4, 6-7, 17-18, 21-22, 23-24, March 1-2, 2-3, 3-4, 14-15, 16-17, 17-18, 18-19, 22-23, 28-29, 30-1 May, 3-4, Aug. 4-5, 18-19, Sept. 1-2, 12-13, 27-28, Oct. 5-6, 6-7, 7-8, 14-15, 21-22, 22-23, 23-24, 27-28, 28-29, Nov. 1-2, 10-11, 15-16, 19-20, 23-24.

1950: Jan. 14-15, 20-21, 23-24, 24-25, 26-27, 27-28, 28-29, Feb. 3-4, 7-8, 10-11, 17-18, 20-21, 22-23, 23-24, March 6-7, 11-12, 14-15, 21-22, 27-28, 31-1 April, 1-2, 3-4, 4-5, 5-6, 6-7, 14-15, 19-20, 20-21, May 6-7, 10-11, Aug. 7-8, 19-20, 20-21, 28-29, Sept. 3-4, 5-6, 8-9, 10-11, 16-17, 20-21, 23-24, 24-25, Oct. 3-4, 4-5, 12-13, 16-17, 17-18, 18-19, Nov. 19-20, 24-25.

For details, see the yearly aurora reports in: Annaire Astronomique et Meteorologique, Camille Flammarion, publié par l'Observatoire de Juvisy, 1949, 1950 et 1951.

The aurora stations were in action during 36 nights. The results are seen in the following table. The headings have the following meaning: I is the number of successful photographs from 1 station, II, III and IV are the number of successful sets from 2, 3 or 4 stations taken simultaneously for determining height and position.

1948	Date	I	II	III	IV
February	15-16	36	9	42	25
March	13-14	34	30	3	
,,	29-30	5			
April	13-14	1	6		
May	7- 8		4	4	1
September	15-16	39	35		
October	21-22	51	3	7	38
,,	22-23	16			
,,	23-24	16			
,,	27-28	6			
November	22-23	1			
December	25-26	45			

1949	Date	I	II	III	IV
January	12-13	27	6		
,,	24-25	159	9	13	6
February	3- 4	40			
,,	6- 7	115	10		
,,	17-18	20	6	6	4
March	2- 3	45			
,,	3- 4	3			
,,	17-18	53			
,,	22-23	9	11		
May	3- 4		1	4	
October	14-15	9	14	1	
,,	20-21	7			
,,	23-24	19	6	19	
,,	27-28	75	44	33	10
,,	28-29	27			
November	15-16	53	34	8	

1950	Date	I	II	III	IV
February	20-21	13			
,,	23-24	21	23	58	19
March	6- 7	10			
,,	27-28	20			
August	19-20	82	22	28	4
,,	20-21	6			
September	3- 4	29	26	22	
October	18-19	30	3	3	11

In all about 2970 successful photographs, among which 670 sets for determining height and position of the aurora.

Of this material a series of pictures have been measured out. Of special interest are the measurements of the great aurora on 15-16 Sept., 1948, 24-25 Jan., 14-15 Sept., 27-28 Oct., 1949, 23-24 Feb. and 19-20 Aug., 1950.

The measuring of aurora photographs begun in 1923 and now amounting to about 37,850, among which about 8400 sets for measuring height and position, has been continued. Results of statistics of more than 12,000 heights from the material 1911-1944 has been published in the papers No. 2, 3 and 4 given at the end of this report. From later years many plates have been measured but nothing published as yet.

During this period, four auroral cameras with accessories have been loaned to Antarctic expeditions, viz: 2 cameras to the French expedition Victor to Adelie land, and 2 cameras to the English-Swedish-Norwegian expedition to Queen Maud's land. It is to be hoped that these two expeditions might bring home a rich collection of auroral photographs from the two regions lying on opposite sides of the Antarctic continent.

Theoretical Work

The two last papers, No. VII and VIII, of the extended calculations of orbits of electric particles in the field of a magnetic dipole, have been published. See the bibliographic list.

Together with the former papers I to VI on the same subject, published in 1918, 1936, and 1947, these give all the numerical work on these trajectories, made since 1905 by the author and his numerous assistants, a work amounting to about 18,000 hours.

As a new printing of the Photographic Atlas of Auroral Forms was very much needed, the Auroral Committee has obtained from "The Temporary Commission for the Liquidation of the Polar Year 1932-1933" a grant of 5000 Norwegian crowns to print 250 new copies of this Atlas; they will be printed during the spring of 1951.

Published papers on aurora in 1948, 1949, and 1950.

1948 1. Auroral Activity in Southern Norway from the Middle of August to the Middle of October 1947. Nature, Vol. 111, p. 208.
2. Statistics of Heights of Various Auroral Forms from Southern Norway, Second Communication, Terr. Mag. and Atmos. Electr., Washington, Vol. 53.

1949 3. Étendue verticale des rayons d'aurore boréale dans les parties de l'atmosphère à l'ombre et au soleil, Comptes Rendus, Paris, Vol. 228.
4. Quelques résultats des observations et des mesures photogrammétriques d'aurores boréales dans la Norvège méridionale depuis 1911, Chalmers Tekniska Hogskolas Handlingar, No. 90.
5. Resultats des calcules numériques des trajectoires des corpuscules eléctriques dans le champ dien armant elementaire VII. Trajectoires par l'origine a Faisceaux supplementaires. Det Norske Videnskaps-akademis Skrifter 1949, No. 2.

1950 Same title. VIII, Trajectoires periodiques et trajectoires dans leur voisinage, Ibid 1950, No. 1.

Besides these papers, annual reports on aurora have been published in Annuaire Astronomique 1949, 1950, and 1951, mentioned above.

APPENDIX TO THE REPORT FROM THE AURORAL COMMITTEE

By Carl Störmer

A. Distribution of auroral cameras belonging to the Committee.

Two Astrocameras loaned to Professor Gartlein, Cornell University, U.S.A., sent back and are deposited in the Astrophysical Institute, Oslo, for use at the auroral stations in Norway.
One Astrocamera in use at my station at Askim.
Two Astrocameras in use at the auroral observatory, Tromsö.
One Astrocamera in use at my station at Lillehammer.
One Astrocamera in use at my station at Kongsberg.
Two Astrocameras loaned to Professor Currie in Saskatchewan, Canada.
One Astrocamera used by Dr. Paton in Edinburgh.
Two Astrocameras sent back from Copenhagen are loaned to M. Mayand to be used on the expedition Victor to Adelie land in the Antarctic
Two Astrocameras, one used in Oslo and the other at my station at Vålåsjö, loaned to the Norwegian-English-Swedish Antarctic expedition to Queen Maud Land
One Meyer-Camera, formerly at my station at Vålåsjö, now sent back to Oslo.
One Meyer-Camera loaned to Dr. Paton in Edinburgh.
Moreover one Astrolens placed in a private cino-camera in use at the station in Oslo.

B. Distribution of pocket spectroscopes. The 14 pocket spectroscopes mentioned in the Transactions of the Oslo meeting, p. 294, are distributed as follows:

Two to the Antarctic Norwegian-Swedish-English expedition to Queen Maud's land.
One to Dr. Paton, Edinburgh.
Five at my aurora stations in Oslo, Askim, Holmestrand, Kongsberg, and Lillehammer.
Three to my assistants in Oslo and to myself.
Three deposited at the Astrophysical Institute.

C. Distribution of Auroral Atlases, Supplements, Star Maps and Covers, Auroral Atlases and Supplements.

During the period the following have been sent:

One Atlas and one Supplement to Director Housmann, England.
Two Atlases and two Supplements to the Norwegian-English-Swedish Antarctic expedition.
Ten Atlases and ten Supplements to Director Thomsen, Wellington, New Zealand, who is starting extended work on the southern light.
One Atlas and one Supplement to Institut d'Astrophysique, Paris.
One Atlas and one Supplement to Prof. Mitra, Calcutta.

Star Maps:

Two sets of the southern sky sent to the Norwegian-English-Swedish expedition.
Two-hundred sets of the southern sky sent to Director Thomsen, Wellington, New Zealand.

Covers:

Two covers to the Antarctic Norwegian-English-Swedish expedition.

Account for Auroral Cameras, Atlases, etc.
(All amounts are in Norwegian crowns)

Voucher	Date	Item	Received	Paid	Balance	Remarks
	1948					
	Sept. 1	Cash			1068.58	See my report in Trans. 1948, p. 295
1	" 24	Tveter work		16.21	1052.37	
2	Oct. 8	Wischmann work		21.00	1031.37	
3	"	Postage		2.50	1028.87	
4	"	"		2.50	1026.37	
5	"	"		2.50	1023.87	
	1949					
6	Feb. 16	Johansen reparations		7.50	1016.37	
7	"	Olsen reparations		10.50	1005.87	
8	Jan. 26	Stornaes reparations		30.00	975.87	
9	Apr. 26	Brynildsen tripod		40.00	935.87	
10	" 29	Postage and insurance		40.80	895.07	To expedition "Victor"
11	Dec. 15	Postage		56.35	838.72	

Voucher	Date	Item	Received	Paid	Balance	Remarks
	1950					
12	Feb. 4	Postage		2.50	836.22	
13	" 8	Postage		2.50	833.72	
14	July 29	Transportation		26.00	807.72	
	Dec. 6	To the Aurora Atlas	5000		5807.72	From the Temporary Commission for the Liquidation of the Polar Year, 1932-33
	" 6	Commission		4.50	5803.22	

Scotland

OBSERVATIONS OF AURORA IN SCOTLAND

Since the last report the photographic station at Newburgh has been transferred to Abernethy (56°20′01″N., 3°18′38″W.) and a new station with a Meyer camera has been established at Rosneath, Dunbartonshire (56°00′32″N., 4°48′00″ W.).

Watch was kept at Abernethy on each night until 11 p.m.; when aurora developed later, warning was given by telephone by the night observers at the Meteorological Office, Leuchars and the Royal Observatory, Edinburgh.

During the period, aurora was observed on the following nights. A stroke below the date, thus Jan. $\underline{2}$, signifies that luminosity did not extend above an elevation of 20° over the N. horizon on the night of January 2-3. A stroke above the date figure signifies that activity extended beyond the zenith. Brackets are used to indicate that the observation is doubtful, either because the luminosity was observed through cloud or because of bright moonlight or, in summer, twilight.

	1948	1949	1950
January	$\underline{2}$ $\underline{3}$	$\underline{18}$ $\overline{24}$ $(\overline{25})$	$\underline{1}$ $\underline{13}$ $\underline{14}$ $\underline{15}$ $\underline{16}$ $\underline{17}$ $\underline{20}$ $\underline{21}$ $\underline{22}$ $\overline{24}$
February	(5) $\underline{14}$ (15)	$\underline{3}$ 21	$\underline{4}$ $\underline{5}$ $\underline{7}$ $\underline{8}$ $\underline{9}$ $\underline{13}$ $(\underline{15})$ $(\underline{18})$ 19 $\overline{20}$ $\underline{21}$ $\underline{22}$ 23
March	$\underline{15}$	$\underline{1}$ 17 $\underline{18}$ $\underline{20}$ $\underline{21}$ $\underline{22}$ $\underline{23}$	$\underline{4}$ $\underline{5}$ $\underline{10}$ $\underline{11}$ $\underline{14}$ $\underline{15}$ $\underline{19}$ $\underline{21}$ $\underline{22}$ $\underline{23}$ $\underline{24}$ $\underline{26}$ $\underline{27}$ $\underline{31}$
April	Nil	$(\underline{8})$ $(\underline{10})$	$\underline{1}$ $\underline{2}$ 3 5 $\underline{6}$ $\underline{7}$ $\underline{11}$ $\underline{17}$ $\underline{18}$ $\underline{21}$ $\underline{23}$ $\underline{2}$
May	15	3 $\underline{5}$ $\underline{12}$	Nil
June	Nil	Nil	Nil
July	5 (7)	(23)	$\underline{24}$
August	14	$\underline{3}$ $\underline{18}$ $\underline{29}$	7 $\underline{14}$ $\underline{16}$ $\overline{19}$
September	$\underline{1}$ $\underline{15}$	$\underline{1}$ $\underline{25}$ $\underline{26}$ $\underline{27}$	(3)
October	$\underline{3}$ (8) 15 18 $\underline{21}$ $\underline{22}$ $\underline{26}$	(7) (8) $\overline{15}$ $\underline{16}$ 22	$\underline{2}$ $\underline{14}$ $\underline{15}$ $\underline{18}$ $\underline{19}$ $\overline{28}$
November	$\underline{4}$ $\underline{6}$ $\overline{20}$ (30)	$\underline{2}$ $\underline{5}$ $(\underline{7})$ $\underline{14}$ 19 $\underline{21}$	$\underline{4}$ $\underline{5}$ $\underline{9}$ $\underline{10}$ $\underline{11}$ $\underline{16}$ $\underline{24}$
December	$\underline{5}$ $\underline{25}$ 30	$\underline{3}$ $\underline{4}$ $\underline{5}$ $\underline{6}$ $\underline{7}$ $\underline{9}$ $(\underline{11})$ $\underline{15}$ (17) (21) $\underline{22}$ $\underline{23}$ $\underline{26}$ $\underline{28}$ $\underline{29}$	$\underline{12}$ $\underline{13}$

The cloudiness of Scottish skies makes simultaneous photography at two or more stations extremely difficult. Though photography was possible and was successfully carried out at one or more stations on nineteen nights, simultaneous photography at two stations was achieved on only four nights and at three stations on two nights. On no occasion did cloud allow simultaneous photography at all four stations.

The arrangements for photography of quiet arcs according to a prearranged time scheme proposed by Professor Störmer was continued.

Luminous night (noctilucent) clouds were photographed on two occasions, July 10-11, 1949, and July 24-25, 1950. The latter display was particularly brilliant and extensive and was accompanied in its early stages by a diffuse auroral arc with sunlit rays.

Photographs with some preliminary measurements have appeared in the Observatory (June 1949), the Meteorological Magazine (December 1949), and the Proceedings of the Physical Society B (December 1950). Measurement of the plates is proceeding. The continuation of this work has been made possible by a grant of £140 from the Gassiot Committee of the Royal Society, London.

Sweden

AURORA OBSERVATIONS WITH AN INFRARED TELESCOPE

By Ernst-Åke Brunberg

Preliminary investigations have been made during February-March 1950 in order to find out whether the intensity of the infrared region of the aurora was sufficient to permit observations.

The telescope used was a German infrared telescope (IR K 15 - 0.85) with a filter cutting off the spectrum below 7000 Å. It was found that the telescope was quite useful and that the appearance of the aurora was the same as seen visually. Stars of the third magnitude were distinctly visible.

In the telescope was mounted a cross wire, which appeared as luminous lines. The brightness of the lines could be varied by varying the current to a lamp illuminating the cross. In this way it was possible to make a rough comparison of the intensity of stars and the aurora on the 23rd of February, 1950.

Once in the twilight an aurora could be observed with the telescope 30-45 minutes before it could be seen with the naked eye. With the infrared telescope it seems possible to study the aurora even at sunset or a little afterwards.

Department of Electronics
The Royal Institute of Technology
Stockholm, Sweden
February 12, 1951

United States of America

LABORATORY STUDIES RELATED TO THE PHYSICS OF THE UPPER ATMOSPHERE

By Joseph Kaplan

In my 1948 report to the Association of Magnetism and Terrestrial Electricity, U.G.G.I., I called attention to my discovery that the afterglow spectrum of pure O_2 consisted exclusively of bands from the v' = 0 level of the forbidden $^1\Sigma$ - $^3\Sigma$ atmospheric system of O_2. I pointed out then that this afterglow spectrum could be interpreted as giving us information regarding the Chapman reaction,

$$O^3P + O^3P + M \rightarrow O_2' + M'$$

and that the discovery of the oxygen afterglow presented more definite evidence regarding the results of that reaction than any previous experimental work he had done.

Independently, Meinel (1949, 1950) discovered that the (O,1) O_2 band of the $^1\Sigma$ - $^3\Sigma$ system was a prominent feature in the infrared spectrum of the night airglow. The (O,O) emission band is very intense in the afterglow and it must also be very intense in the atmospheric stratum in which the radiation originates. It is not observed since the great mass of atmospheric O_2 in the v'' = 0 level completely reabsorbs this radiation.

As a result of Meinel's discovery and investigation of the Kaplan-Meinel O_2 band in the night airglow, and my hypothesis that its excitation in the laboratory followed the Chapman mechanism for atomic oxygen recombination in the upper atmosphere, I suggested that the level of origin of this radiation was below 100 km. It is now interesting to note that the most probable height of the O_2 emission is given as 80 km. I recently proposed the term "chemosphere" to designate the atmospheric regions in which such reactions as the recombination of oxygen atoms take place frequently enough to give rise to chemiluminescence and to the production of significant amounts of molecules such as O_3, OH, NO, NO_2, etc.

The discovery by Meinel (1950) that the molecule OH gives rise to prominent features in the photographic infrared night airglow spectrum, and the determination of 70 km for the height of the OH emission, led me to intensify the study of discharge and afterglow spectra in O_2 and in O_2-N_2 mixtures, and to extend these to O_2-H_2O, He-O_2, He-O_2-H_2O and O_2-H_2O-N_2 mixtures. The results of these studies will be described very briefly in this report.

1. Results in Pure O_2

The spectrum of the electrical discharge showed the (O,O) and (O,1) Kaplan-Meinel bands and the OI multiplets 8446A and 7774A. These OI lines have been observed in auroral spectra by Meinel. The O_2 bands only are observed in the afterglow. Extremely long exposures fail to bring out more than a trace of the (1,O) band. It should be noted that we will describe many different discharges and afterglows in this report and yet in none of these, as well as in the night airglow, do Kaplan-Meinel bands originating on v'$>$ 0 ever show up. This shows that one should look to this fact as one of the clues to the mechanism of excitation.

The proposed mechanisms for the excitation of these bands in the discharge and in the afterglow are as follows:

a. $O^3P + O^3P + M \rightarrow O_2\ {}^1\Sigma\ (v' = 0) + M$

b. $O^3P + O_3 \rightarrow 2O_2\ {}^1\Sigma$

Reaction (a) releases the energy of dissociation of O_2 (5.09 ev) and reaction (b) releases 4.05 ev, which is more than enough to excite each of the oxygen molecules to the ${}^1\Sigma$ level and to account for the excitation of the Kaplan-Meinel bands.

A reaction

c. $O_2\ {}^1\Sigma + O^3P + M \rightarrow O_3 + M + 61$ kcal

probably plays an important part in the production of ozone at the levels of emission of the Kaplan-Meinel bands.

2. O_2 Containing Very Small Amounts of N_2

The Kaplan-Meinel bands were first observed in emission in the laboratory by Kaplan. This observation was made in afterglows in oxygen containing small amounts of nitrogen. These afterglows are much more intense than those observed in pure oxygen, and their spectra are more complicated than those observed in pure oxygen. There is strong emission in the visible and in the photographic infrared due to NO_2, and I have suggested that these bands may be important contributors to the visible night airglow spectrum. The spectrum of the exciting discharge obtained on IN plates is very much like that in pure oxygen.

The proposed mechanisms for the excitation of the O_2 and NO_2 bands in the discharge and afterglow are:

a. $NO + O_3 \rightarrow NO_2 + O_2 + 1.87$ ev

b. $NO_2 + O \rightarrow NO + O_2 + 2.03$ ev

c. $NO + O + M \rightarrow NO_2 + M + 2.74$ ev

d. $N + O_3 \rightarrow NO + O_2 + 4.24$ ev

The important roles of NO, O_3 and O are to be noted, and also that reaction (a), (b) and (d) release enough energy to excite the Kaplan-Meinel bands, while reaction (c) will excite NO_2 in the visible.

The following reactions are suggested as sources of NO_2 NO and N in both the laboratory and the chemosphere.

e. $N_2 + O_3 \rightarrow NO + O_2$

f. $NO + O^1D_2 \rightarrow N^4S + O_2\ {}^1\Sigma(v' = 0)$

g. $NO + O^1S_0 \rightarrow N^2D + O_2\ {}^1\Sigma(v' = 0)$

Reaction (e) is exactly balanced energetically. Reaction (f) releases 1.76 ev and since $O_2{}^1\Sigma$ requires 1.62 ev, this reaction should produce a nitrogen atom and an excited oxygen molecule. Reaction (g) releases 3.99 ev and the excitation of the N^2D and $O_2{}^1\Sigma$ requires a total of 3.99 ev. Because of this remarkable resonance, reaction (g) may be one of the very important basic mechanisms in the upper atmosphere.

It is suggested that the reaction

$$\text{h. } N^4S + N^2D + M \rightarrow N_2A^3\Sigma + M$$

may account for the excitation of the Vegard-Kaplan bands in the night airglow, and that the following reactions (i) and (j) will be responsible for the presence of the Heirberg bands in the night airglow spectrum.

$$\text{i. } O^1D_2 + O_3 \rightarrow O_2 + O_2 + 6 \text{ ev}$$

$$\text{j. } O^1S_0 + O_3 \rightarrow O_2 + O_2 + 8.24 \text{ ev}$$

The energy required for the $A^3\Sigma(v' = 0)$ level of O_2, which is the initial state of the Heirberg bands is 4.41 ev and that required for the $v' = 0$ level of the Kaplan-Meinel bands is 1.62 ev. The sum of these is 6.03 ev. Once again there is a remarkable resonance.

3. O_2-H_2O Mixtures

Many attempts to excite the Meinel OH bands in O_2-H_2O mixtures have been unsuccessful. These studies were followed by ones in which we employed discharge tubes containing 20 mm of helium and sources of oxygen and water vapor. These will be described in the following.

4. He-O_2-H_2O Mixtures

The spectrum of the electrical discharge in He-O_2 mixtures in which 20 mm He was present, and variable quantities of O_2 up to one or two mm were added, is like that in pure O_2, with the addition of some HeI lines. The afterglow spectrum also is like that in pure O_2. The intensity of the Kaplan-Meinel bands increases as the partial pressure of O_2 decreases, until a maximum is reached at very low O_2 concentrations.

Neither the discharge nor the afterglow in He-H_2O mixtures produces the Kaplan-Meinel bands or the infrared lines of OI. If one starts with a mixture of roughly equal parts of O_2 and H_2O, the spectra are like those observed for O_2-He mixtures, with the remarkable difference that the maximum Kaplan-Meinel band intensity in the afterglow is now very much greater than in He-O_2 or in pure O_2 afterglows. In fact, one obtains an enhancement of the intensity similar to the one described for O_2-N_2 mixtures. When the condition of the tube, i.e., partial pressures of oxygen and hydrogen, is such as to yield this maximum, the discharge spectrum consists of the OI lines, Kaplan-Meinel bands and the Balmer series.

Under the conditions described above for the maximum O_2 band intensity, the afterglow spectrum now shows additional bands which appear to belong to several systems. It appears to be highly probable that the Meinel OH bands are included in these.

The reactions which are responsible for the excitations in $He-O_2$ mixtures are the same as those in pure O_2. In the $He-O_2-H_2O$ mixtures the Bates-Nicolet reactions must take place, i.e.

$$\text{a. } H + O_3 \rightarrow OH + O_2 + 3.3 \text{ ev}$$

$$\text{b. } OH + O \rightarrow H + O_2 + 0.74 \text{ ev}$$

Bates and Nicolet (1950) and Herzberg (1950) have suggested that reaction (a) is responsible for OH excitation in the upper atmosphere, since this reaction provides energy enough to excite the OH levels of vibrational quantum number 9, but not enough for $v'' = 10$ or greater. Meinel observed no bands originating on v'' greater than 9. I would like to add to the remarks of Bates and Nicolet that the remarkable enhancement of the Kaplan-Meinel bands in my $He-H_2O-O_2$ afterglows suggests that reaction (a) is responsible for both OH and O_2 excitation. In fact, the energy in $OH(v'' = 4)$ is 1.64 ev and that of $v' = O$ in the $^1\Sigma$ state of O_2 is 1.62 ev; giving a total of 3.26 ev. Hence a division of the energy between OH and O_2 should also be a very efficient process. Other processes should decide the energy between the vibrational levels of the ground electronic states of O_2 and OH. I feel that the interesting role of H_2O in increasing the Kaplan-Meinel band intensity, and in bringing out new spectra, is strong evidence that Bates and Nicolet, and Herzberg, are correct in their proposals of (a) as the mechanism for OH excitation.

5. $O_2-H_2O-N_2$ Mixtures

Some exploratory studies of the afterglow spectra which are produced when small amounts of H_2O and N_2 are added to O_2, show promising results. In the first of these, the afterglow spectrum showed an enhancement of some of the new features reported for $He-O_2-H_2O$ mixtures. I feel that both in the laboratory and in the upper atmosphere, N_2 plays a very important part in the excitation mechanisms, and that further studies will be fruitful.

Conclusion

Perhaps the two most striking features of this brief note are the importance of ozone in the basic mechanisms that have been proposed, and the remarkable way in which night airglow spectra can be duplicated in the laboratory. I am also convinced by these studies that some important modifications may have to be introduced into our descriptions of ozone production and distribution in the atmosphere. It seems very reasonable to propose that the metastable O_2 molecule, which is responsible for the Kaplan-Meinel bands, must play an important part in the ozone problem. Much careful quantitative laboratory work now remains to be carried out as a result of the remarkable changes that recent work has brought into the afterglow picture. Of particular interest here are the reactions involving vibrating nitrogen molecules in the ground electronic state, i.e.

$$N_2 + O_3 \rightarrow NO + O_2$$

which is exothermic, and the reactions in which NO and metastable oxygen atoms interact, giving us N^4S and N^2D as described above.

These reactions may provide us with the mechanism whereby the Vegard-Kaplan bands, the Meinel OH bands, and the Kaplan-Meinel bands can originate in the same general region of the upper atmosphere.

References

No detailed references to the literature are presented here because of the availability of an excellent review and bibliography in the article on The Spectrum of the Airglow and the Aurora, by A. B. Meinel, Reports on Progress in Physics, XIV, Physical Society, London. The reader is referred to this review for all references.

University of California
Los Angeles, California
January 1951

REPORT ON AURORAL STUDIES IN THE RED AND INFRARED REGIONS FROM 1948 TO 1951[1]

By A. B. Meinel

The auroral studies by the author at the Lick Observatory and the Yerkes Observatory were made possible by the construction of a grating spectrograph of high wavelength resolution and light gathering power. The dispersive element consisted of a large transmission grating of 300 lines per mm, supplied by Professor R. W. Wood. This grating exhibited a maximum energy concentration of the order of 80 per cent in the first order at 8000A. The camera consisted of a flat field design by the author, having a focal length of 136 mm and a speed of F/0.8, thereby producing a dispersion of 250 A/mm.

One auroral spectrogram obtained on August 7, 1948, at Lick Observatory[2] showed for the first time the presence of strong permitted lines of OI at 7774A and 8446A and of NI at 8684-8714A. In both cases the transitions arise from the lowest energy levels above the ground configuration metastable levels. This observation was subsequently confirmed by Petrie[3].

Auroral studies were continued at the Yerkes Observatory starting in 1950. Spectra obtained by the author[4] of the auroral storm of August 18 and 19, 1950, showed that the group of emissions to the red of the (2,0) band of the first positive system of N_2 are not due to high-vibrational transitions of the $\Delta v = 1$ sequence of this system. This attribution has long been questioned by Bates, Massey, and Pearse[5].

Six bands appeared to belong to two sequences of this new band system as evidenced from their similar appearance. Although two of these bands are superimposed on first positive bands of N_2, their characteristic doublet structure can readily be distinguished.

The analysis of the six bands showed that this band system originates from the long-missing $A^2\Pi$ state of N_2^+. The molecular constants derived from these $A^2\Pi$-$X^2\Sigma$ bands of N_2^+ have been published[4].

Spectra of this auroral storm also showed several additional permitted OI and NI lines that were too weak to be identified from the Lick auroral spectrum. Of special importance is the $3s^4P$ - $3p^4P^o$ multiplet of NI near 8216A[6]. Since the 8680A multiplet of NI is strongly blended with the intense (2,1) band of the first positive system of N_2, the identification was not conclusive. The 8216A multiplet, on the other hand, occurs in a region free from other emissions. This transition has seven components distributed from 8184.8A to 8242.3A. The multiplet as observed in the aurora by the author shows maxima at 8186.6A, 8216.3A and 8243.0A, corresponding in wavelength, as well as intensity, to the three groups of lines of the $3s^4P - 3p^4P^o$ transition of NI. The presence of permitted NI emissions in the aurora is therefore established beyond any doubt.

During this same auroral storm, spectra were obtained of the $H\alpha$ region[7]. The spectra obtained at 90° from the magnetic zenith showed the familiar broadened but undisplaced $H\alpha$ profile. Spectra from the magnetic zenith, on the other hand, showed that the $H\alpha$ emission was asymmetrically displaced to the violet. Since the $H\alpha$ emission on these spectra was much stronger than the adjacent N_2 bands, it was possible to obtain accurate profiles for $H\alpha$. The violet wing of $H\alpha$ at 1/10th the maximum ordinate extended 71A to the violet of λ 6563A, corresponding to a velocity of approach of 3300 km/sec. The maximum ordinate was displaced 450 km/sec to the violet.

These observations, made with respect to the geomagnetic coordinates, finally have provided an unambiguous evaluation of the nature of auroral hydrogen. The velocity profile cannot indicate a real velocity spread of the incident protons because of their simultaneous arrival in the auroral zone. The profile can only be interpreted as being due to the deceleration of the incident protons by the atmosphere. We can therefore state that the velocity of the protons before entering the upper atmosphere was greater than 3300 km/sec. This velocity is in excess of the velocities deduced from the time delays between solar activity and auroral storms. It is quite likely that the protons provide an ample energy source to explain the primary mechanisms operative in producing the auroral spectrum.

The association of these proton beams with different types of aurorae is not clear. While homogeneous arches showed $H\alpha$ very strongly, flaming aurorae did not. The presence of $H\alpha$ probably depends upon whether the observed auroral structure is the result of a primary or a secondary process.

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REPORT OF COMMITTEE ON MAGNETIC SECULAR VARIATION STATIONS

By E. H. Vestine, Chairman

The Committee has continued its activities since the time of the Oslo meetings in 1948, with a membership including Mr. J. Egedal, Dr. J. A. Fleming, Mlle. S. Kalinowski, Mr. T. H. O'Beirne, Dr. N. V. Pushkov, Dr. J. M. Rayner, and Dr. E. H. Vestine (Chairman).

In many nations moves have been taken to improve instrumentation for magnetic surveys. Older magnetometers have been discarded and replaced with new ones, though most surveys are still being undertaken with instruments which have seen many years of service. Magnetometers for use in aircraft have been designed and tested, and should provide estimates of secular change of modest accuracy from repeat flights over ocean areas in future years, in some areas.

The Committee has not arrived at comments and recommendations additional to the eight items submitted at Oslo in 1948, which are as follows:

(1) In order that information on secular change required for constructing world and other isomagnetic charts be more efficiently and effectively available, it is recommended that each country maintain or establish whenever feasible frequently occupied magnetic repeat stations not less than 1000 km apart, counting each magnetic observatory as one repeat station. The positions of stations of adjacent countries should be noted in defining locations. These stations will be those with most advantageous coverage and permanence of site selected from existing repeat stations throughout the area, and that they be designated International Repeat Stations. Where feasible, it is recommended that they be reoccupied about once every two years while operating a portable recording magnetograph for from one to several days, at or near the site, giving the reduction to mean of a Greenwich day.

(2) It is further recommended that both the observed and reduced results be promptly forwarded in duplicate to two central bureaus of the IUGG's Association of Terrestrial Magnetism and Electricity, one designated for the Western Hemisphere and one for the Eastern Hemisphere, so that the results for these special repeat stations would be currently available to those in need of data for construction of isomagnetic charts or for other purposes.

(3) In view of serious present deficiencies in our knowledge of secular change over the oceans the Committee urges that the Admiralty complete the non-magnetic ship "Research" so that magnetic observations at sea may be undertaken at the earliest possible time. It is further urged that attention be given to establishing new stations at islands of the oceans, or the frequent reoccupation of existing stations on such islands, by the various governments responsible.

(4) It is further urged that emphasis be placed upon the probable permanence of such selected sites of stations, and that these sites be adequately marked so that their probable utility may be assured for several decades.

(5) It is likewise urged that there be established at least one secondary station near the main station to ensure continuity of values referred to the main station site, should the latter site later be lost. Areas of marked local disturbance should be avoided, if possible, and special care exercised where local disturbance is unavoidable.

(6) It is recommended that repeat stations additional to the International Repeat Stations be occupied as in the past, even though it may not be necessary or possible in practice to there execute measurements at such frequency intervals of time, and that their results be likewise forwarded promptly in duplicate to one of the two central bureaus.

(7) It is urged that final reduction from mean of day to mean of year, and to a suitably specified norm for the sunspot cycle, be executed at a central bureau, the results of such reductions to be available to those in need of these results.

(8) The Committee requests the Committee on Observational Technique to consider and make specific recommendations to the end that there be attained a form of portable magnetograph or magnetographs for recording time variations in declination, horizontal intensity, and vertical intensity for use at or near repeat stations.

Item (3), which is of outstanding importance, and deals with the need for non-magnetic ships to provide magnetic surveys over the oceans, requires greater emphasis today than in 1948. The present deficiencies in our knowledge of secular change over the oceans is now even more acute than at the time of the Oslo meetings in 1948. It has been stated that aeromagnetic surveys can be conducted more expeditiously and at less cost than ocean surveys. Though this will be true in certain areas, the members of this Committee are of the opinion that air and sea surveys are to some extent complementary and that both are needed. The sea surveys, in particular, will give more accurate information about secular change than air surveys; further, there are ocean regions to which it is most improbable that air surveys would be extended. Accordingly, this Committee has no alternative but to reaffirm the statement of its predecessor in 1948, and strongly urges that the British Admiralty complete the non-magnetic ship "Research" so that magnetic observations at sea may be undertaken at the earliest possible time. The Committee is also pleased to learn of the interest in the building of such a ship in Argentina.

Several members of the Committee have considered that it may be feasible to make magnetic observations at sea by towing the airborne three-component magnetometer in a non-magnetic "fish." Such a "fish" could then be used in magnetic surveys of selected ocean areas by ships which are magnetic.

The Committee is much gratified to learn that 40,000 miles of profiles giving three components of the magnetic field in North American and some adjacent ocean areas have been obtained in air surveys. The Committee urges that such flights be extended to all accessible ocean areas practicable at the earliest possible time, as well as to land areas, especially in southern Asia and in Africa.

A short summary of magnetic survey activities of various agencies responding to our request for information is given below, and extends the summary submitted by the Committee at Oslo in 1948.

Africa

East Africa--The Director of the East African Meteorological Department, Nairobi, reports that they hope to obtain equipment both for establishing a magnetic observatory and to carry out magnetic surveys. It is now nearly ten years since magnetic surveys at a few stations were made in Uganda, Kenya, Tanganyika, and Seychelles.

Union of South Africa--Dr. A. M. van Wijk, Observer-in-Charge, Magnetic Observatory, Hermanus, reports that 48 secular variation stations in South Africa and Southern Rhodesia were occupied during 1947-48. The next survey in this area of very large secular change is scheduled for 1952-53. Consideration is being given to the important matter of establishing secular variation stations on two islands, Marion (46°S, 38°E) and Tristan da Cunha (38°S, 13°W).

Mauritius--Director E. G. Davy notes that the Royal Alfred Observatory, Pamplemousses, Mauritius, has continued to function.

Asia

Ceylon--Director D. T. E. Dassanayake, Colombo Observatory, Department of Meteorology, writes that a survey of about 20 repeat stations is planned in the next few years. In the meantime, the Survey of India has agreed to include several stations in Ceylon in its five-year cycle of repeat observations.

China--The Academia Sinica obtained 104 stations in southern and southwestern China in years up to and including 1947.

India--S. K. Pramanik, Deputy Director General of Observatories (Climatology and Geophysics) reports as follows:

1. The magnetic observatory at Kodaikanal, which had been closed down in 1923, has been restarted in 1949 (Director - Dr. A. K. Das), and H, D, and Z are being photographically recorded. It is proposed to restart soon the magnetic observatory at Dehra Dun which was closed down in August 1943.

2. Alibag, Kodaikanal, Tinnevelly, Guntakal, Bangalore, Galle, Mandapam, Tanjore, Parambur, Arkonam, Cannanore, Birur, Dharwar, Cumbum and Bezwada were reoccupied in 1950, under the direction of Mr. B. L. Gulatee.

3. (a) Observations on the daily variation of H were made in June-August 1950 with QHM at four places in Southern India and one in Ceylon, 15°.2'N, 77°.4E, 13°.0'N, 77°.6'E, 8°.7'N, 77°.6'E, and 6°.0'N, 80°.2'E, in the region between and near the magnetic and geographic equators, under the direction of Mr. B. L. Gulatee.

(b) Observations at three other places, 8°.1'N, 77°.5'E, 8°.7'N, 77°.7'E, and 9°.2'N, 77°.5'E, with QHM and BMZ on the diurnal variation of H and Z, in Southern India, in the region near and between the magnetic and geographic equators, have been taken in February and March 1951, under my direction.

Indonesia--Dr. F. H. Schmidt, Acting Director, Meteorological and Geophysical Service, Djakarta (Batavia), reports that in Indonesia observations at the observatory of Djakarta are being continued, with some field measurements at several places. A new observatory is being started in Lembang, near Bandung. Suitable equipment is on hand and surveys will be continued when personnel is available.

Japan--Dr. Kiyoo Wadati, Director of the Central Meteorological Observatory, submitted a report by Dr. S. Imamiti, Director of the Kakioka Magnetic Observatory.

Observatories in operation include Kakioka, Aso, Mitsui, Katsuura, Wakkanai, Onagawa, and Memanbetsu. The Geographic Survey Institute undertook surveys using a new type magnetometer designed by I. Tsubokawa.

Land magnetic surveys in Japan included observations at Rebun Island in 1948, near several volcanos, and routine magnetic stations on the various islands. The Hydrographical Division of Marine Safety undertook measurements at 31 stations distributed over the whole of Japan using a Nippon Suirobi magnetometer. The Geographic Survey Institute hopes to complete 70 stations covering Japan by the end of 1951.

Secular changes perhaps associated with volcanos and earthquake areas are being sought from some hundreds of observations using magnetic field balances.

Lebanon--Dr. P. Delpeut reports that secular changes are observed in D, H, and Z at the magnetic observatory of Ksara, and lists monthly means for the year 1949.

Republic of the Philippines--Director Andres Hizon writes that a new magnetic observatory was established at Muntinlupa, Rizal, in the latter part of 1950. The Ruska variometers and magnetometer were donated by the U. S. Coast and Geodetic Survey. Repeat station work is planned during the next three years.

Thailand--Major General Lahaw Bhumilak, Director, Royal Survey Department of the Army, submitted results for ten stations in Thailand, and mentions that some of these are currently being reoccupied.

A survey party in the field is planned for each year up to 1953-54. An index map submitted shows an excellent and adequate distribution of stations.

Australasia

Australia--J. M. Rayner, Chief Geophysicist, Bureau of Mineral Resources, Geology and Geophysics, has given a summary statement on the magnetic survey of Australia, 1948-51, which is included in the Australian National Report. Magnetic observatories are operated at Watheroo, Toolangi, Macquarie Island, and others are nearing the operating phase at Heard Island and Port Moresby in Papua. There are also plans to establish a magnetic observatory on the Antarctic Continent.

Repeat stations in the Australian zone are to be reoccupied in the latter part of 1951.

Aeromagnetic surveys have been begun for total magnetic intensity, and measurements of three components are planned later.

New Zealand--H. F. Baird, Director, Magnetic Survey, Christchurch, indicates in a detailed report that they will continue to reoccupy about 20 repeat stations per year in New Zealand, and hope also to make measurements at oceanic islands to the north. A new magnetometer has been purchased for use in this work.

Good results are being obtained using an airborne total force magnetometer. A number of traverses over New Zealand have been flown.

Operation of the observatories at Christchurch, New Zealand, and Apia, Samoa, has been continued.

Europe

Czechoslovakia--The Director, Central Institute for Physics, has submitted a summary by Dr. Jan Bouska indicating positions of ten secular variation stations, including magnetic observatories at Hurbanovo and Strba. It is also mentioned that the observatory at Pruhonice started its work in 1946. At field stations measurements are made every two years.

Denmark--Dr. Helge Petersen, Director, Danish Meteorological Institute, indicates that measurements were made at all Danish secular variation stations in 1950. Field observations were made in 1948 and 1949 at stations about 4 km apart for horizontal and vertical intensity, and about 8 km apart for declination.

Measurements will be continued in future years.

Eire--A land magnetic survey was made during 1950.

Finland--E. Sucksdorff states that 26 stations were reoccupied in 1948 and 1949 with 31 stations on the Gulf of Bothnia in 1950 between latitudes 60°.5 and 65°N, and longitudes 17° and 24°E, in cooperation with the Swedish Hydrographic Office. This field work will be continued in 1951 and ensuing years.

A new magnetic observatory, Nurmijarvi, at latitude 60°.5N, longitude 24°.7E, will be built in 1951.

France--Dr. J. Coulomb, Director, Institut de Physique du Globe, reports that it is planned during 1951 to reoccupy the 11 repeat stations established in 1947, with a new station in Corsica, perhaps with a complete survey of the island, as soon as possible.

Germany--Dr. F. Errulat, Chief of the Division of Geomagnetism, Wingst Observatory, refers to the publication, Bock, Burmeister, and Errulat, Magnetische Reichsvermessung 1935.0, Teil 1, Abhandlungen des Geophysikalischen Instituts Potsdam, Nr. 6, Berlin, 1948. He notes that seven of these stations in northwestern Germany were reoccupied in 1948 by O. Meyer (Deutsche Hydrographische Zeitschrift, volume 3, 1950). Measurements were also made from ships along the German coast.

Published values of secular change at Wingst have been given to 1949.0.

Great Britain--Sir H. Spencer Jones, Astronomer Royal, states that some 50 magnetic stations for declination were occupied in 1948, under the direction of Mr. T. H. O'Beirne. These stations were selected from those occupied by Walker in his magnetic survey of 1913-14.

Measurements of secular change are continuing at Abinger, Eskdalemuir, and Lerwick.

He also states some development work for equipment to record three components of the field in air surveys has been carried out.

The question of a magnetic resurvey of Great Britain is still under consideration.

H. W. L. Absalom, Meteorological Office, indicates that declination was measured with a Wingfield Standard Compass at the 50 stations mentioned above. The observations were reduced to epoch by means of the three observatories.

Norway--Dr. K. F. Wasserfall, Magnetic Bureau, Bergen, states that since 1936 measurements at about 100 secular variation stations, mostly by Commander Rolf Kjaer, of Norges Sjokartverk, under Prof. Dr. B. Trumpy, have been made. Since 1945 these measurements have been made yearly, and about 900 secondary stations added.

A preliminary chart for declination for epoch 1950.5 will be constructed as well as detailed charts for D, H, and Z for 1946.5, with secular variation for 1951.5.

A study of secular change at Oslo, 1820 to 1948, has been made and published in the Journal of Geophysical Research, 1950.

Netherlands--Dr. J. Veldkamp, Director of the Geophysical Department of the Royal Netherlands Meteorological Institute, De Bilt, states that a magnetic survey of the Netherlands was completed in 1949. Results were obtained at 392 stations, including about 20 measurements in the Wadden Sea. This work was published early in 1951, together with magnetic charts.

Poland--Mlle. Kalinowska, Geophysical Observatory, Swider, states that a new magnetic survey was undertaken in 1947, including repeats at 41 stations of earlier surveys. In 1949, five stations of 1947 were reoccupied. It is expected that a permanent set of secular variation stations will be established in the nearest future. New magnetic charts for 1955 will be issued.

Continuous measurements of D, H, and Z at Swider Observatory also provide determinations of secular change.

Portugal--Director J. C. Merais, Geophysical Institute, Coimbra University, writes that three Askania variometers are being installed shortly at Coimbra, and that absolute observations will be continued as in the past with old equipment pending expected receipt of new equipment soon. A map of the Iberian Peninsula in cooperation with a Spanish cartographer is contemplated.

H. Amorim Ferreira, Director, National Meteorological Service, Lisbon, states that measurements at about 400 stations in Portuguese territory of the Peninsula will be made, in connection with the survey of the Spanish territory undertaken in 1952 to 1957 by the Instituto Geografico y Catastral, Madrid.

A program for the geomagnetic survey of the Portuguese islands in the North Atlantic is under consideration, including a net of secular variation stations.

In February 1952 measurements will be made at the island S. Tomé with opportunity to do work also at Principe, as well as in Spanish Guinea.

The Meteorological Services of Angola and Mozambique have been placed under the National Service in Lisbon. It is foreseen to establish permanent geomagnetic observatories near Luanda and Lourenzo Marques as controls for magnetic surveys in these two Portuguese territories of Southern Africa.

Spain--Rev. Antonio Romaña, S. J., Ebro, states that studies by Mr. C. Gaibar have been made on the secular variation of the local magnetic constant and on the law of propagation of isoporic foci.

Turkey--Dr. H. Kemal Erkman, Kandilli Observatory, National Ministry of Education, states that Osman Sipahioğlu and Doğan Taner have obtained measurements of D, H, and I at five stations. The values controlled by the observatory at Istanbul and reduced to 1951.0 were submitted. Next year observations at at least 20 stations in Western Anatolia will be taken. This work is a necessary preliminary to the construction of a new magnetic chart of Turkey.

Yugoslavia--Professor Radovan Vernić, Vice-Director, Geophysical Institute Zagreb, writes that a survey of 62 stations along the Adriatic and islands was undertaken in 1949 for declination. A chart for the Adriatic was elaborated for 1950.0 with the aid of values at the Fürstenfeldbruck Observatory in Bavaria as control. The results will be published soon in Prirodslovna istrazivanja Jugoslavenske akademije znanosti i umjetnosti u Zagrebu (Investigations in Natural Sciences of the Yugoslav Academy of Arts and Sciences at Zagreb).

During 1951 repeat measurements at some ten stations are contemplated, and especially those of Kesslitz occupied in 1907. In order to complete a survey of Yugoslavia, an observatory at about latitude 45°25′N, longitude 18°10′E is planned.

North (including Central) America

Canada--R. Glenn Madill, Chief, Division of Terrestrial Magnetism, Dominion Observatory, Department of Mines and Technical Surveys, states that 51 repeat stations on land were reoccupied during 1948 to 1950. The stations were in latitudes 45° to 80°N and longitudes 52° to 120°W. The reoccupation of repeat stations throughout Canada will be continued, especially in high magnetic latitudes. Operation of the Meanook and Agincourt observatories was continued.

Canal Zone--One reoccupied station by Inter-American Geodetic Survey.

Costa Rica--Two reoccupations and one new station in 1949 by Inter-American Geodetic Survey.

Cuba--One reoccupation in 1949 by Inter-American Geodetic Survey, and four reoccupations, one new station, 1950.

Dominican Republic--Two reoccupations, one new station by Inter-American Geodetic Survey, 1950.

Greenland--Determinations of secular change were continued including operation of magnetic observatories at Thule and Godhavn.

Guatemala--Three reoccupations by Inter-American Geodetic Survey, 1949.

Haiti--One old and one new station by Inter-American Geodetic Survey, 1950.

Honduras--Three old, one new station by Inter-American Geodetic Survey, 1949.

Nicaragua--Five new, one old station in 1949.

Panama--Two old stations, 1949.

Salvador--Two old stations, 1949.

United States--The Committee has been most interested to learn from K. T. Adams, Acting Director, U. S. Coast and Geodetic Survey, Department of Commerce, that about 40,000 miles of airborne magnetic surveys have been completed over the United States and adjacent ocean areas. The flight data, comprising all elements, furnish practically continuous profiles spaced at intervals that provide fair coverage. It is anticipated that these surveys will be extended to other areas within the next two years, particularly over ocean areas where present data are very old.

The following summary of land observations by the U. S. Coast and Geodetic Survey is given:

	Work done						Work contemplated							
	1948		1949		1950		1951		1952		1953		1954	
Country	old	new	old	new	old	new	old	new	old	new	old	new	old	new
United States	33	16	48	11	7	0	5	-	25	-	40	-	40	-
Alaska	3	0	3	0	3	0	3	-	3	-	20	-	3	-
Hawaii	1	0	1	0	1	0	1	0	1	0	1	0	1	0
Puerto Rico	1	0	1	0	1	0	1	0	1	0	1	0	1	0

The U. S. Coast and Geodetic Survey has made recommendations on technical aspects of the work of the Inter-American Geodetic Survey in some other Republics of North, Central, and South America.

W. T. Laidly, Chief, Engineering Division, United States Lake Survey, U. S. Army, reports 86 stations occupied for declination in the vicinity of the Great Lakes of Canada and the United States.

South America

Argentina--Olaf Lutzow-Holm, Chief, Geophysical Observatory, Pilar (Cordoba) mentions surveys by his service which had occupied 177 stations up to 1942, 11 stations in 1944 in the interior of Argentina with 15 new stations along the coast, previous to issuing D-, H-, Z-, and I-charts for 1944.0. In 1948, 15 old and four new stations were occupied.

After 1949 the magnetic surveys were supervised from Buenos Aires. Director General Captain C. Monasterio, National Meteorological Service, writes that 34 stations were occupied in 1949 and four in 1950.

Projected for the future is the occupation of nine stations near the border between Argentina and Brazil, as well as other cooperative work with adjacent countries. In Argentina 20 additional stations in each of the provinces Corrientes and Mendoza are planned.

A list of stations occupied in 1948, 1949, and 1950 was enclosed, together with a map of Argentina showing locations of stations occupied in each of the surveys since 1908.

The Committee is pleased to learn that the National Meteorological Service of Argentina is anxious to obtain a non-magnetic ship for survey work and hopes that the necessary financial support for this worthy project will be forthcoming.

Brazil--Director Lelio I. Gama, National Observatory, states that secular change values are obtained at the Vassouras Magnetic Observatory and will be available at the new observatory being set up near Belem, Pará.

A survey of the frontier of Brazil and Argentina is planned in cooperation with the National Meteorological Service of Argentina.

The Inter-American Geodetic Survey plans to occupy 12 old and 12 new stations in 1951, and five old and five new stations in 1952.

Columbia--Director Jose I. Ruiz, Augustin Codazzi Geographical Institute of Columbia writes that observations of declination were made at the base station Pléyadas on a nearly monthly basis since 1948, and sends values for four old and eight new stations in Columbia obtained during 1950.

Construction and installation of a new magnetic observatory will provide values of secular change at Isla de la Laguna de Fúguene.

Chile--It is reported that the Inter-American Geodetic Survey contemplates observations at eight old and four new stations in 1951.

Ecuador--One old and one new station occupied in 1950.

Peru--Six old and five new stations in 1949, and seven old, four new stations in 1950.

Dr. A. Giesecke, Director, Geophysical Institute of Huancayo, reports that 14 stations in a north-south chain across Peru and its neighbors, Ecuador and Columbia, were obtained for horizontal intensity in 1950-51.

The magnetic observatory at Huancayo has continued to provide values of secular change near the magnetic equator.

REPORT OF COMMITTEE ON MAGNETIC CHARTS

By E. H. Vestine, Chairman

The Committee has continued the work of the two previous committees: (1) Committee on Magnetic Charts--Organization of the Work, and (2) Committee on Magnetic Charts - Methodology. The Committee has not seen fit to alter or add to the recommendations submitted at the Oslo meeting.

On organization of work these were as follows:

(1) That all magnetic observations on sea, land, or in the air should be collected in at least one central bureau, which would place the material at the disposal of those who desire to use it for practical or scientific purposes. The Committee recommends that one of these central bureaus be the United

States Coast and Geodetic Survey, and is pleased to learn that the United States Government has authorized such activity by the Coast Survey for this purpose.

(2) That observing organizations should be asked to cooperate by communicating the results of all magnetic observations on sea, land, or in the air, with as little delay as possible, to the central bureaus. Original data should be furnished whenever possible.

(3) That observations are urgently needed, especially over all the oceans, in Africa, and in the north and south polar regions.

(4) The Committee stresses the importance of the work possible of performance by the non-magnetic ship R.R.S. Research and urges that it be outfitted and assigned to magnetic observations at sea at the earliest possible time.

(5) That countries with air facilities and equipment for making magnetic observations by air take immediate steps to coordinate and plan efforts to secure data over the oceans to supplement the work of the Research, and also to secure magnetic-survey data by air over the various land areas of the earth.

The Committee wishes to stress again (1) the importance of the work possible of performance by the non-magnetic ship R.R.S. Research, and urges its use in magnetic observations at sea as soon as possible, and (2) urges the extension of air magnetic surveys now begun in North America and Australia to various ocean and land areas of the world as soon as possible.

The Committee finds that world magnetic charts are being constructed in accordance with previously recommended schedules. The importance of a free interchange of data for this purpose is stressed. However, the primary and glaring deficiency is the lack of magnetic values over the oceans for more than 20 years. It is pleased to report that these deficiencies in Arctic and North Atlantic areas are being rapidly removed by current air surveys.

REPORT OF THE COMMITTEE ON REGISTRATION OF GIANT PULSATIONS

By J. Olsen, Chairman

Resolution 5, adopted at the Oslo meeting of the Association of Terrestrial Magnetism and Electricity (IATME Bull. 13, p. 537) stressed the importance to the studies of giant pulsations of the continuous operation of quick run magnetographs at Tromsø, Abisko, and Sodankylä. At that time all quick run magnetographs had been discontinued at these places and unfortunately it has been possible to reestablish only one up to now - namely Abisko starting on January 1, 1949. It is hoped, however, that a quick run set will be reestablished at Sodankylä during the latter part of this year. At the same time it has been planned to move the quick run set from Abisko to the new Institute for Geophysical Research at Kiruna, 84 km farther south.

Some information about the giant pulsations which have occurred in the arctic part of Scandinavia from 1948 through 1950 may be of interest. The number of giant pulsations recorded at Abisko (quick run magnetograph), Sodankylä, and Tromsø (15 mm/hour recorder) during this period have been 10, 14, and 9, respectively. Three of the Abisko giant pulsations were recorded simultaneously at Sodankylä (distance from Abisko 340 km) and four of the Abisko giant pulsations were simultaneous with giant pulsations at Tromsø (145 km). One giant pulsation was common to all three stations. Out of five giant pulsations recorded at Abisko during the last 18 months, four were recorded simultaneously at Kiruna (15 mm recorder).

The great number of coincidences seem to show that if all four stations were supplied with quick run magnetographs they might be of great importance for the study of giant pulsations. As mentioned above, a quick run set will be established at Sodankylä this year and Dr. N. Ambolt, Kgl. Sjökarteverket, Stockholm, communicates that it may be possible to continue the quick run registration at Abisko if the necessary equipment for a quick run installation at Kiruna could be placed at disposal from the Polar Year stock. At the same time Director E. Tönsberg, Tromsø, has declared his willingness to run a quick run magnetograph if a set of variometers could be provided, as the appropriate recorder is already available. It is suggested, therefore, that the Association place the necessary equipment for one quick run station (Kiruna) and an extra set of variometers (Tromsø) at the disposal of this Committee, provided that such equipment can be obtained from the stock of Polar Year instruments.

The Committee has had no expenses during the period 1948-1951 and the £350 placed at the disposal of the Committee has not been drawn. The Committee suggests that it should be continued and expresses the hope that the Association will also in the future be willing to support investigations relating to giant pulsations.

Charlottenlund

REPORT OF COMMITTEE ON METHODS OF OBSERVATORY PUBLICATION

By J. Bartels, Chairman

1. Purpose of the Committee. The publication of observatory results has been discussed by Captain Elliott B. Roberts in his report for the Oslo Meeting (Oslo Trans. pp. 319-321, discussion pp. 17 and 19). At that Meeting a new Committee No. 10 on Centralization and Standardization of Records was established to study the proposed selection of key observatories and the establishment of Central Bureaus. This leaves to our Committee No. 6 the topic of observatory yearbooks.

2. Members appointed at Oslo: J. Bartels (Chairman), J. A. Fleming, E. B. Roberts, E. Selzer, B. Trumpy.

3. Actual observatory practice. Since the contents of yearbooks has been standardized by recommendations set forth clearly in previous reports, by Ch. Maurain (Trans. Washington Meeting, pp. 265-267, and by E. B. Roberts, Oslo Meeting, cited above), it seemed a proper task for the Committee to inquire from the observatories whether they follow those recommendations. Accordingly, a Circular was sent in February 1951 to Directors of institutions publishing yearbooks of magnetic observatories, citing the IATME recommendations, and asking:

(1) For which years since 1935 have you published magnetic yearbooks? (2) In what way do you deviate from the recommendation ...; in particular, do you publish tables of hourly values for three magnetic elements? (3) If you do not publish hourly values, please indicate why, lack of funds or of personnel, or other reasons. (4) Which are your plans for future years? Any further comments will be welcome.

The response was gratifying, both with regard to promptness of answers as well as to the great numbers of observatories putting those recommendations into practice. The following list of observatories, arranged in the order of geographical latitude, summarizes the answers regarding the most important item, tables of hourly values (hourly means).

Meaning of abbreviations: Year 47 = 1947, pu = published, ip = in press, ca = calculated, pl = planned.

Tromsö 48 pu, 49 ip. Godhavn 41 pu. Sodankylä 39 pu, 48 ca. College 48 ip. Dombas 52 pl. Lerwick 37 pu. Lovö 47 pu. Sitka 36 pu, 48 ip. Rude Skov 49 pu. Eskdalemuir 37 pu. Manhay 50 pu. Chambon-la-Forêt 48 pu. Nantes 48 ca. Castellacio 37 pu. Istanbul-Kandilli 47 pu. Ebro 46 ca. Coimbra 41 pu. Toledo 50 pl. Cheltenham 48 pu. San Fernando 48 pu, 49/50 ip. Kakioka 35 pu, 36-51 pl. Ksara 48 ca. Tucson 38 pu, 48 ip. Zo-se 40 pu, 44 ca. Tamanrasset 48 ca. Honolulu 38 pu, 48 ip. Teoloyucan 49 ca. Alibag 39 pu, 40/44 ip. San Juan 36 pu, 48 ip. Batavia 36 pu. Elisabethville 45 pu. Huancayo 47 pu. Apia 47 pu, 48 ip. Tananarive 48 ca. Vassouras 45 pu. Watheroo 44 pu, 47 ca. Pilar 35 pu. Hermanus 46 pu, 48 ip. Amberley 36 pu, 37/45 ip.

Several directors sent detailed statements regarding their plans; in order to avoid duplication, these are not repeated here since this matter will be contained in the respective national reports. Also, interesting suggestions of Dr. E. Selzer regarding early publication arrangements seem to be matter for Committee No. 10.

4. Future work of the Committee. With the progress of science, the question of observatory yearbooks will need attention and revision of recommendations.

If complete tables of hourly means are published, it might be queried whether some of the routine computations (such as daily variations) based on those tables might not be dispensed with, for observatories with long series, in order to reserve the labor saved for speeding up the publication of arrears. This has, for instance, been done by G. Fanselau for Niemegk, with a yearbook giving nothing but the hourly means for 1939-1944.

The ideal type of yearbook will be that planned by the U. S. Coast and Geodetic Survey, a combination of their present HV and MG series, to contain hourly values and complete reproductions of magnetograms, to start with data for 1950.

REPORT OF THE COMMITTEE TO PROMOTE INTERNATIONAL COMPARISONS OF MAGNETIC STANDARDS

By V. Laursen, Chairman

The Committee is happy to report that the program of international comparisons carried out during the period 1948-1951 by means of QHM-magnetometers belonging to the Association, has been met with a general and most encouraging inter est in all quarters having to do with the operation of magnetic observatories. All observatories which have so far been invited to take part in the comparisons have at once expressed their readiness to cooperate in the proposed program, the observations have in all cases been made with extreme care, and the results have been presented in the form recommended by the Committee.

During the period under review six of the QHM-instruments belonging to the Association have been placed at the disposal of the IATME Committee to promote daily observations of horizontal force between and near the geographic and magnetic equators, so that only a limited number have been available for the comparison work. The Central Bureau of the Association has accepted, however, a proposal that when desirable the Committee may use also other QHM's for its comparison work, and a most valuable comparison has, in fact, been carried out by means of the QHM's 29 and 58, belonging to the Hermanus Observatory, South Africa.

The following comparisons have been completed during the period 1948-1950:

(a) Comparisons by means of QHM-magnetometers Nos. 90, 91 and 92 between the observatories of Rude Skov (Denmark), Pilar and La Quiaca (Argentina), Huancayo (Peru) and Cheltenham (U.S.A.).

(b) Comparisons by means of QHM-magnetometers Nos. 33, 51 and 52 between the observatories of Rude Skov, Amberley (New Zealand), Apia (Western Samoa), Toolangi and Watheroo (Australia).

(c) Comparisons by means of QHM-magnetometers Nos. 29 and 58 (property of the Hermanus Observatory (South Africa)) between Hermanus, Rude Skov and Cheltenham.

(d) Comparisons by means of QHM-magnetometers Nos. 90, 91 and 92 between the observatories of Rude Skov, Abinger (England), Eskdalemuir (Scotland) and Lerwick (Shetlands).

Two additional comparisons were initiated during the period, but have not yet been completed:

(e) Comparisons by means of QHM-magnetometers Nos. 34 and 50 between the observatories of Rude Skov, South Orkneys (Argentina), Pilar, La Quiaca, Huancayo and Cheltenham.

(f) Comparisons by means of QHM-magnetometers Nos. 33, 51 and 52 between the observatories of Rude Skov, Ebro (Spain), Chambon-la-Forêt (France) and Witteveen (Netherlands).

The results of the comparisons so far completed have been very satisfactory. It has been gratifying to note the high degree of accordance that exists between the standard values at quite a number of observatories well distributed over the world, but the Committee considers it of equally great value that at several observatories the comparison observations have revealed minor discrepancies which have given rise to a closer study of the local standards, and in several cases to a readjustment of the instruments used.

The Committee has to admit that the comparisons mentioned above have taken much longer time than expected. This is due mainly to the facts that the first comparison circulations have included observatories in the most remote parts of the world, and that some of the participating observatories have deemed it useful to retain the QHM's for a longer period, thereby obtaining more extended series of control observations. At some places it has been difficult to provide an appropriate theodolite base for the QHM-measurements, and the Committee has acquired, therefore, three of the special divided circles, designed in Copenhagen for use with the QHM. It is intended that these circles, when necessary, should be sent with the QHM's used for comparison observations.

The Committee wishes to express its appreciation of the cooperation of the United States Coast and Geodetic Survey. Through its Division of Geomagnetism the CGS has taken a most active part in the comparison program by letting the Cheltenham Observatory carry out frequent calibrations of the Association instruments. Although for practical reasons the Rude Skov Observatory has been chosen as the primary base for the comparisons it is only natural that all observers taking part in the work have been very interested in the results of the direct comparisons between Rude Skov and Cheltenham. The Committee is happy to accept a recent suggestion from the CGS that such direct comparisons should, if possible, be carried out every year.

In the following summary the observed differences between standard values of horizontal force at the participating observatories have been given. The results have been specified for each instrument used and generally referred to Rude Skov, it being supposed that the QHM's adjusted at Rude Skov represent the Rude Skov standard value. The standard values of the horizontal force at Rude Skov are based on absolute determinations made by means of the great Bamberg theodolite, No. 1973. The constants for the measurements of H date back to 1890 but were controlled in 1947, and it may be of interest to quote here the results of official comparisons previously made at Rude Skov:

1908, Sept.	Rude Skov - Pavlovsk	= -9.3γ	Obs.	Dubinsky
1922, July	,, ,, - C.I.W.	= 3 γ	,,	Parkinson
1927, Nov.	,, ,, - Potsdam	= -4.4γ	,,	Venske
1929, Sept.	,, ,, - Sodankyla	= -4 γ	,,	Keranen

Cheltenham

(Standard values based on Sine Galvanometer No. 1)

1948, April	QHM 33 - Cheltenham	= 3.8γ*	
	QHM 51 - Cheltenham	= 2.5γ	
	QHM 52 - Cheltenham	= 2.6γ	
	Mean		3.0γ
1949, Dec.	QHM 90 - Cheltenham	=-0.2γ	
	QHM 91 - Cheltenham	=-2.6γ	
	QHM 92 - Cheltenham	= 1.0γ	
	Mean		- 0.6γ
1949, Dec.	Rude Skov - Cheltenham (QHM 29)	= 4.3γ	
	Rude Skov - Cheltenham (QHM 58)	= 1.9γ	
	Mean		3.1γ

Hermanus

(Standard values based on the Portable Coil Magnetometer (Schuster-Smith type). Regular comparisons are made between the Portable Coil Magnetometer and the Askania Standard Magnetometer-theodolite).

1949, Nov.	Rude Skov - Hermanus (QHM 29)	= 0.5γ	
	Rude Skov - Hermanus (QHM 58)	= 0.4γ	
	Mean		0.4γ

Pilar

(Standard values based on the Dover-Kew Magnetometer)

1949, June	QHM 90 - Pilar	= 2.0γ	
	QHM 91 - Pilar	= 2.3γ	
	QHM 92 - Pilar	= 0.9γ	
	Mean		1.7γ

La Quiaca

(Standard values based on the Dover-Kew Magnetometer)

1949, July-Aug.	QHM 90 - La Quiaca	=-31.2γ	
	QHM 91 - La Quiaca	=-29.8γ	
	QHM 92 - La Quiaca	=-30.9γ	
	Mean		-30.6γ

* In accordance with the result of recent investigations concerning the induction coefficients of the QHM-magnetometers, several of the differences given in the following summary have been subject to a slight modification since they were first presented at Brussels.

Huancayo

(Standard values based on C.I.W. Magnetometer No. 10)

1949, Sept.	QHM 90 - Huancayo	= 14.0γ	
	QHM 91 - Huancayo	= 17.7γ	
	QHM 92 - Huancayo	= 18.6γ	
	Mean		16.8γ

Amberley

(Standard values based on QHM-magnetometers Nos. 21 and 22, received from Copenhagen in 1937)

1949, Mar.-Apr.	QHM 33 - Amberley	=- 3.4γ	
	QHM 51 - Amberley	=- 4.9γ	
	QHM 52 - Amberley	=- 5.5γ	
	Mean		- 4.6γ

Toolangi

(Standard values based on a Kew Pattern Magnetometer modified on the lines of the Indian Survey type)

1949, July	QHM 33 - Toolangi		=-23.3γ
	QHM 51 - Toolangi		=-23.0γ
	QHM 52 - Toolangi		=-23.5γ
		Mean	-23.3γ
1950, Mar.-Apr.	QHM 33 - Toolangi		=-34.5γ
	QHM 51 - Toolangi		=-29.7γ
	QHM 52 - Toolangi		=-33.6γ
		Mean	-32.6γ

Watheroo

(Standard values based on C.I.W. Magnetometer No. 7)

1949, Nov.-Dec.	QHM 33 - Watheroo		= 11.0γ
	QHM 51 - Watheroo		= 8.9γ
	QHM 52 - Watheroo		= 5.3γ
		Mean	8.4γ

Abinger

(Standard values based on the Schuster-Smith Coil Magnetometer)

1950, May	QHM 90 - Abinger		= 3.4γ
	QHM 91 - Abinger		= 5.0γ
	QHM 92 - Abinger		= 3.9γ
		Mean	4.1γ
1950, Nov.	QHM 91 - Abinger		= 5.6γ
	QHM 92 - Abinger		= 5.7γ
		Mean	5.6γ

Lerwick

(Standard values based on the Portable Schuster-Smith Coil Magnetometer No. L. 45434)

1950, June	QHM 90 - Lerwick		= 2.6γ
	QHM 91 - Lerwick		= 2.9γ
	QHM 92 - Lerwick		= 4.1γ
		Mean	3.2γ

Eskdalemuir

(Standard values based on the Schuster-Smith Coil Magnetometer. Occasionally also a Kew Magnetometer (No. 60 or No. 140) is used for determining H)

1950, July-Sept.	QHM 91 - Eskdalemuir	= -6.0γ
	QHM 92 - Eskdalemuir	= -6.2γ
	Mean	-6.1γ

It is recommended that the comparison program should be extended to include a greater number of observatories. It is also recommended, however, that the comparisons should be repeated from time to time, so that it may be established whether the standard values used at the different observatories are sufficiently stable. Among the observers taking part in the comparisons already completed there has been a general interest for a repetition of these comparisons after some time.

At present the Committee is planning a repetition of the comparisons between Rude Skov, Amberley, Apia, Toolangi and Watheroo. Another comparison will be carried out between Hermanus, Elisabethville (Belgian Congo), Manhay (Belgium) and Rude Skov.

Meteorological Institute
Charlottenlund, Denmark

REPORT OF COMMITTEE ON OBSERVATIONAL TECHNIQUE

By H. E. McComb, Chairman

1. At the 1948 meeting of the IATME, the Committee on Observational Technique was continued. The comments and recommendations of the former Committee (page 336, Transactions of the Oslo Meeting, 1948) are again emphasized and/or recommended for further consideration. Additional comments and recommendations follow.

2. Standardizations and Comparisons:

(a) QHMs. The elastic after-effects in quartz fibers should be given further study and consideration, especially since these instruments are now being used for international comparisons. (See Transactions of the Washington Meeting, p. 284, 1939.) It is recommended that observing procedures be so standardized that errors due to temperature effects and elastic after-effects be eliminated in so far as possible.

3. Zero-Corrected Instruments:

(a) The importance of adjusting instruments for measuring declination and inclination so that the corrections do not exceed the standard error of a single observation is stressed again by the Committee. (See Transactions of the Washington Meeting, p. 532.)

4. Mobile Observatories:

(a) The development and use of mobile observatories to supplement absolute observations at repeat stations becomes increasingly more important in secular change studies, especially in areas far removed from a fixed observatory. The only alternative seems to be to make long series of eye-reading observations covering several 24-hour periods. It is quite obvious that where secular change is small, precise values of that change cannot be evaluated from a few observations only.

5. Suspension Fibers:

(a) The Committee feels that extensive researches on the properties of quartz fibers (and other types of suspensions) should be undertaken and that standard methods of production, annealing, aging, and manipulation of such fibers or suspensions be published.

(b) It has been suggested that platinum-iridium filaments (as used in the torsion balance) might be a satisfactory substitute for quartz.

(c) The use of alignment charts for estimating the proper dimensions of elements entering into the moving parts of magnetic variometers is highly recommended. Charts of this kind are useful also in many other phases of magnetic computational work.

6. Visible Recording:

(a) The operation of visible recording magnetographs employing photo electric controls has been reasonably successful and furnishes a means of appraising magnetic conditions at the moment. The system is recommended for base observatories or other stations where it is important to know magnetic conditions at once so that work programs may be scheduled effectively.

7. Airborne Magnetometers:

(a) The airborne magnetometer has been so effective in geophysical work that it is now standard equipment with many agencies. A total field and direction magnetometer recently developed promises to be the solution of the problem of obtaining adequate data in otherwise inaccessible areas, for use in providing data for construction of large scale magnetic charts.

Washington, D.C., U.S.A.
June 1, 1951

APPLICATION OF ALIGNMENT CHARTS TO THE DESIGN OF MAGNETIC VARIOMETER SUSPENSION SYSTEMS

By H. E. McComb, United States Coast and Geodetic Survey

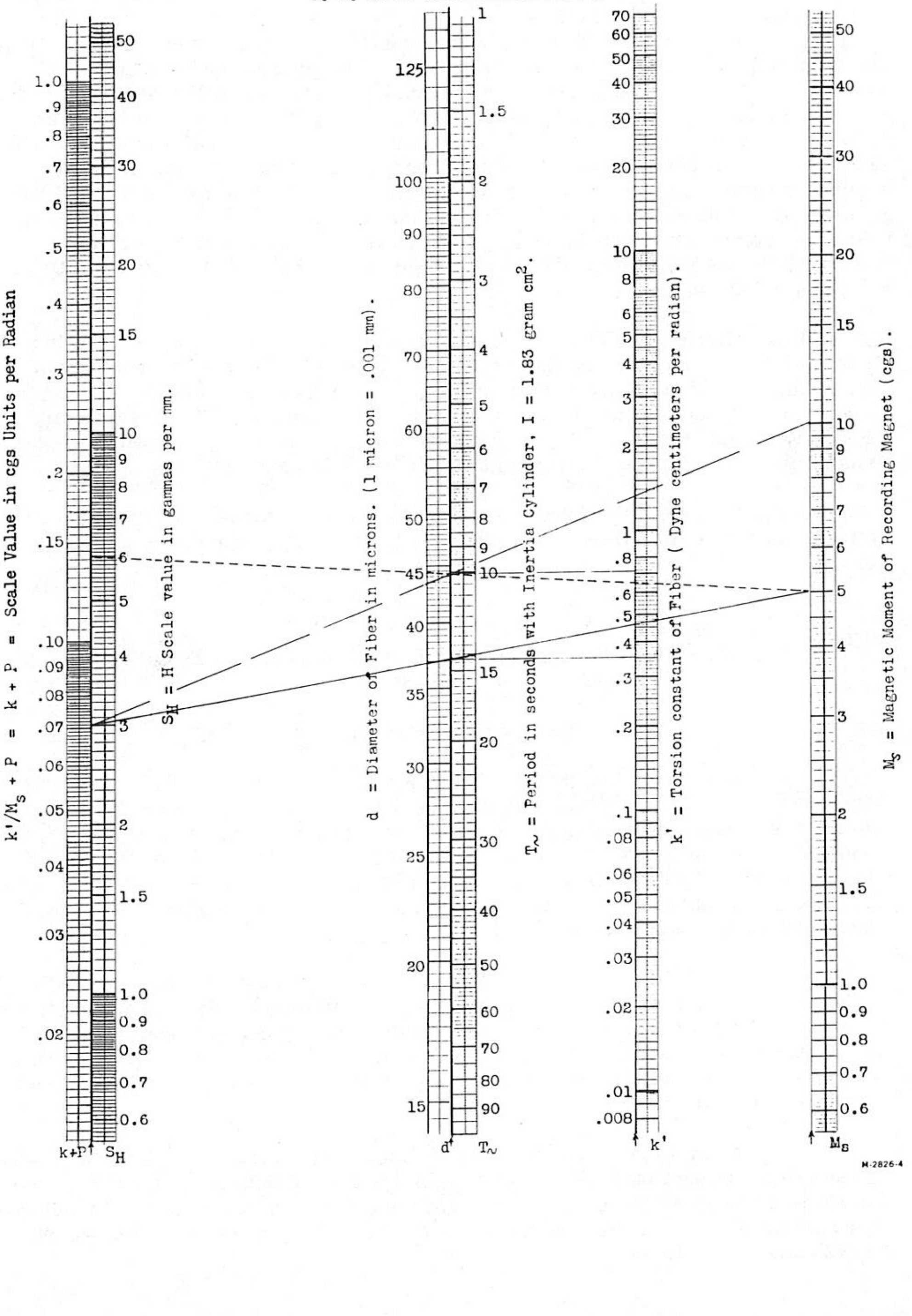
1. H-Scale Value: The scale value of a unifilar H-variometer is given by $S_H = (k+P)\epsilon \times 10^5$ gammas per millimeter of ordinate, in which

S_H = H-scale value,
$k = k'/M_S$,
k' = torsion constant of quartz fiber,
M_S = magnetic moment of recording magnet,
ϵ = optical lever = $1/2L = 1/2360 = .000424$ for this nomogram,
L = optical distance from variometer lens to recorder drum, in mm.

ALIGNMENT CHART FOR H-SCALE VALUES

(Horizontal Intensity Variometers)

U. S. Coast and Geodetic Survey



2. Suppose we wish to make S_H = 3.00 gammas per millimeter and we have a recording magnet M_S = 5.0 cgs units. In Fig. 1 draw a line from 5.0 on M_S-scale to 3.0 on S_H-scale. Find 37.2 on d-scale. Select a fiber approximately .037 mm (37 microns) in diameter and 15 centimeters effective length and determine period of inertia weight (Moment of Inertia = 1.83) when suspended on this fiber. If its period (time of 1 cycle) is 14.3 seconds (T-scale), this fiber will give S_H = 3.0 when M_S = 5.0 for length = 15 cm. Suppose we find T = 10.1 instead of 14.3. Draw line from 5.0 on M_S scale, thru 10.1 on T-scale and produce to S_H-scale. This shows that d = 44.1 microns and S_H will be 6.0 gammas per millimeter. To reduce S_H from 6.0 to 3.0 apply an E-W field of .07 cgs units (7000 gammas) to M_S and directed opposite to M_S. This field can be supplied by a control magnet mounted east or west (magnetic) of M_S and directed opposite to M_S. (A control magnet having a magnetic moment of 80 cgs units will have a field of approximately 7000 gammas at a distance of 13.2 cm from its center.) To obtain estimated control field from nomogram--find 0.141 on (k+P)-scale opposite 6.0 on S_H-scale; also find 0.071 on (k+P)-scale opposite 3.0 on S_H-scale. Then 0.141 - 0.071 = 0.070 cgs units = 7000 gammas.

3. An alternate method ot reducing scale value from 6.0 to 3.0 is to increase M_S from 5.0 to 10.0 and avoid use of control magnet. This is at once apparent from nomogram. A third choice would be to keep selecting fibers until one of suitable dimensions has been found which will give S_H = 3.0 when M_S = 5.0 but this might be a long and tedious process. A fourth choice would be to select a small fiber and reduce its length until the approximate scale value is obtained.

4. Similar alignment charts will be found useful in designing suspension systems for insensitive D-variometers and for many other purposes in geomagnetic work.

REPORT OF COMMITTEE ON CHARACTERIZATION OF MAGNETIC DISTURBANCES

By J. Bartels, Chairman

1. Purpose of the Committee: The magnetograms obtained by the observatories give valuable information on various natural phenomena of interest in geophysics as well as in other fields, such as solar physics, cosmic ray studies, and ionospheric physics. The Association, besides encouraging individual observational and theoretical work, has set up the Committee to coordinate and organize international cooperation with the aim to providing suitably uniform abstracts from the magnetic time variations.

In planning this work - which, for its success, depends essentially on the voluntary contributions from observers all over the world - the Committee takes care to recommend no routine work that might possibly detract from more fruitful research. In this respect, it may be said that the scaling of K-indices will have helped many an observer to appreciate more fully the complexity and the physical meaning of magnetograms.

Through our Committee, the Association receives from the observatories a considerable amount of excellent data. Our thanks are due to all those who have helped to bring about the success of the scheme of characterization, by which our Association supplies several branches of science with fundamental data for research and applications.

2. Previous action: Our Committee continues the work formerly assigned to various bodies. Its name recalls the well-known measure of magnetic activity, "Caractère magnétique", or International Magnetic Character-Figure (here called Ci), published by the "Commission on Terrestrial Magnetism and Atmospheric Electricity" of the "International Meteorological Organization" (IMO), until May 1937, when it came under the auspices of the IATME. With the same Commission of the IMO, the IATME had set up a "Joint Committee on methods and codes to adequately describe magnetic disturbances and perturbations" (Reports by J. A. Fleming, Edinburgh Trans., pp. 222-234; Washington Trans., pp. 286-291; Oslo Trans., pp. 341-342). The tasks of that Joint Committee were, in 1948 (Oslo Trans., p. 21), transferred to the "Committee on three-hour-range indices for magnetic characterization" established in 1939 (Washington Trans., pp. 27-29; Report by A. G. McNish, Oslo Trans., pp. 339-341), finally named "Committee on characterization of magnetic disturbances (CCMD)".

The Kon. Nederlandsch Meteorologisch Instituut at De Bilt has, since the start of the daily character-figures Ci in 1906, served as the center for the organization and publication, including the selection of international quiet and disturbed days; Dr. G. van Dijk's name will always be connected with that long series. After his death in 1940, our colleagues at Washington in the Department of Terrestrial Magnetism of the Carnegie Institution and the U. S. Coast and Geodetic Survey assumed the responsibility of carrying on that work. IATME Bulletins Nos. 12 (C+K 1940-46) and 12a (1947) prepared by H. F. Johnston, with W. E. Scott and Miss E. Balsam, are described in McNish's report at Oslo.

3. Members appointed at Oslo: J. Bartels (Chairman), J. Egedal, H. F. Johnston, E. Lahaye, H. Spencer Jones, E. Sucksdorff, J. Veldkamp.

4. Current work since the Oslo Meeting: IATME Bulletin No. 12b (C+K 1948) was prepared by H. H. Howe and Evelyn K. Weisman at the U. S. Coast and Geodetic Survey, with the use of punched-card machines.

With the beginning of the year 1949, Dr. J. Veldkamp (De Bilt) took over the current work. He reports as follows:

> "The collection of the magnetic activity figures and disturbance phenomena for the years 1949, 1950 and 1951 was undertaken by the Geophysical Section of the Royal Netherlands Meteorological Institute, De Bilt, Holland. Nearly all stations sent their character figures and disturbance phenomena promptly in the beginning of each month by air mail, so that a preliminary report about K- and C-activity during the previous month could be available at the end of each month. The monthly reports were published in the CRPL-F series (Ionospheric Data) issued by the Central Radio Propagation Laboratory, National Bureau of Standards, Washington. Current tables were distributed quarterly among the cooperating observatories and interested persons, along with data on sudden commencements (s.c.) and solar-flare effects (s.f.e.). These quarterly reports were also published in the Journal of Geophysical Research.
>
> "The final results for the year 1949 were published in IATME Bulletin No. 12c (Geomagnetic Indices K and C, 1949, by J. Bartels and J. Veldkamp, Washington, 1950). This Bulletin contains K-indices and C-figures from 37 and 42 observatories, respectively, mean values by months and by years, magnetically selected days (5 and 10 quiet days and 5 disturbed days by

month), tables of sudden commencements of magnetic storms and tables of solar-flare effects.

"The report for the year 1950 was published as Bulletin No. 12e."

The efficient help afforded to the Committee, in publication and other matters, by Dr. J. W. Joyce, Director of the IATME Central Bureau, is gratefully acknowledged.

As the result of a joint action of the Temporary Commission on the Liquidation of the Polar Year (J. A. Fleming, President, and V. Laursen, Executive Officer), IATME Bulletin No. 12d appeared, with lists of K-indices for the two years 1932 and 1933, including the 13 months, August 1932 to August 1933, of the Second International Polar Year.

5. Character-Figures and K-indices: Regarding the characterization of magnetic activity, the Committee recommends:

For local and regional measures: The three-hour-range indices K from individual observatories.

For the earth as a whole: The planetary three-hour-range indices Kp.

For the characterization of days, a new planetary character-figure Cp has been proposed, based entirely on Kp; in an advance print from IATME Bulletin No. 12e, discussing the old character-figure Ci and the new Cp (on the basis of data for more than 12 years), the conclusion was reached that Cp appears to meet the requirements of the IATME for an adequate and homogeneous continuation of the series of Ci. The advance print was widely circulated in May and June 1951 to all observatories and individuals likely to be interested

Most of the comments received were favorable, but Prof. J. Coulomb gave arguments warning against an immediate adoption of Kp and Cp, and proposed a further trial period of six years. In a Circular Letter of July 8, 1951, Prof. Coulomb's note was communicated, with comments, to the members of the CCMD and to members of the Executive Committee. A decision will be reached at the Brussels Meeting, and recommendations will be laid before the IATME when this CCMD report will be discussed. H. F. Johnston, one of our members, has conducted an inquiry about the practice of character estimation, the results of which will also be discussed.

It may be repeated that the concentration of the IATME on K, Kp, and Cp, concerns the international work only. Special work on magnetic activity done at individual groups of stations, such as the Norwegian storminess, the Sodankylä hourly ranges, the Niemegk second K-indices, etc., will always be welcome.

Since 1949, the CCMD has collected data on sudden commencements (s.c.) and solar flare effects (s.f.e.). It appeared that the number of s.c.'s reported was much higher than anticipated. Beginning with January 1951, Dr. Veldkamp's report distinguished three kinds: (1) Sudden commencements followed by a magnetic storm or a period of storminess (s.s.c.); (2) s.c.'s of polar or pulsational disturbances (p.s.c.); and (3) other impulses. Further experience and synoptic studies are desirable. For studies on s.c.'s and s.f.e.'s, use of sensitive quick-run recorders and/or of instruments recording the time derivatives of the magnetic variations are recommended (see cit. 10 in section 9).

Hourly indices of activity, based on ranges, have for some years been under discussion in the Committee, without definite conclusions. Hourly ranges are available for the Polar Year for a number of stations mentioned in Bulletin No. 12d. It would be desirable if a few polar observatories would continue to study this question. Dr. Sucksdorff, who advocates such studies, proposes to mark, in the yearbooks, disturbed hourly intervals by underlining them, or by using different lettering. This is equivalent to hourly indices of activity with two grades only. Observatories wishing to provide hourly indices are asked to please communicate with Dr. Sucksdorff.

The measurement of K-indices is not difficult in regions not too far from the auroral zones, say, down to 50° geomagnetic latitude. In lower latitudes, the correct diagnosis of non-K-variations (Sq+L) needs special care; an optional alleviation is therefore recommended, namely, to combine, for such stations, the lower grades of activity (K=0,1,2) into one step K=Q.

6. Available series of K-indices: The bibliography (section 9) indicates sources containing K and Kp. Kp and Cp are available for the Polar Year 1932-33, and from 1 January 1940 to date. For the years 1937-1939, Kw may be used, e.g. in the 27 day diagrams published in IATME Bulletin No. 12, pp. 15-17; the derivation of Kp and Cp for 1937-1939 will be possible as soon as K-indices for Meanook and Agincourt are available. Two long series of K-indices for years before 1937 have been published: for Potsdam since 1900 in IATME Bulletin No. 12b, for Abinger since 1939 in Bulletin No. 12c. A further extension of the Abinger series is contemplated. The Committee recommends such work. A complete list giving references to K-tables, by stations, will be prepared for Bulletin No. 12f; please notify the Chairman of Errata found in Bulletins 12 to 12e.

7. Studies on ERC and W: The Committee may ask the IATME to be authorized to make preliminary studies regarding two projects requiring the cooperation of equatorial observatories: To derive a current measure of the intensity of the so-called equatorial ring-current (ERC), and a current measure of solar wave-radiation based on the amplitudes of the solar daily variation Sq.

As an improvement on the old u-measure of activity, ERC would be of interest to workers on the aurora and on cosmic rays, while W has been shown to be most closely connected with sunspot-numbers. The increase of W with the appearance of sunspots seems to be due to ionizing radiation of a nature differing from that emitted by the spotless sun (see cit. 9 in section 9).

8. Publications: The IATME Bulletins Nos. 12, 12a, ... 12e provide the final results, year by year, and data for previous years as they become available. Fast information is provided by monthly preliminary reports on C+K issued by the De Bilt center and quarterly reports, also reprinted in the Journal of Geophysical Research. Final Kp-indices are available before the end of the following month. Monthly issues of diagrams showing Kp in the usual notescript arranged in 27-day solar rotation intervals are distributed to interested institutes.

Twenty-seven day recurrence patterns of the international character-figures for the years 1884-1950, and of Kp for 1932-33 and 1940-50 have been published by Bartels (cited as 6 in section 9).

The Committee welcomes re-publication of the data contained in its publications, if the source is mentioned.

9. Bibliography on publications sponsored by, or issued with the consent of, the IATME, CCMD, and other papers related to the work of the CCMD.

IATME Bulletins:

No. 12b. "Geomagnetic Indices, K and C, 1948". By H. Herbert Howe and Evelyn K. Weisman. With a Preface by J. A. Fleming, and two appendices by J. Bartels: "Three-hour-range indices, K, for Potsdam-Seddin-Niemegk, 1900-1936", and "The standardized index, Ks, and the planetary index, Kp". 120 pp., Washington, 1949.

No. 12c. "Geomagnetic Indices K and C, 1949". By J. Bartels and J. Veldkamp. With a Preface by S. Chapman. 138 pp., Washington, 1950.

No. 12d. "Geomagnetic K-Indices, International Polar Year, August 1932 to August 1933". Edited by J. Bartels. With a Preface by Jno. A. Fleming. 53 pp., Washington, 1950.

No. 12e. "Geomagnetic Indices K and C, 1950". By J. Bartels and J. Veldkamp. With a Preface by S. Chapman, a discussion of J. Veldkamp on six solar-flare effects, and a paper by J. Bartels, "An attempt to standardize the daily international magnetic character figure".

A few of the Circular Letters of the CCMD have been reprinted in the Journal of Geophysical Research, namely: 54 (1949) 196-198 (establishment of C+K-center at De Bilt); 55 (1950) 222-223 (on Joint Action of the Temporary Commission on the Liquidation of the Polar Year 1932-33 and the CCMD re K-indices for 1932-33).

Preliminary monthly reports on K and C, and quarterly reports including data on s.c. and s.f.e. issued by J. Veldkamp, De Bilt (see report).

Other publications:

1. Bartels, J., and Veldkamp, J. "International data on magnetic disturbances, first quarter, 1949". J. Geophys. Res., vol. 54 (1949) 295-299, and following issues, quarterly.
2. "Erdmagnetische Kennziffern Kp". Monthly issues of diagrams showing Kp in the usual note-script arranged in 27-day solar rotation intervals. The diagrams show data for the last three or four rotations in order to exhibit recurrence tendencies. They are prepared immediately after the final Kp-indices for the preceding month have been computed, and they are supplemented, up to the day of completion, by the latest Ks-indices from the observatories Wingst and Göttingen. First issue in December, 1950. About 140 copies distributed by mail through Geophysikalisches Institut der Universität Göttingen; further copies included as monthly supplements in the "Zehntägiger Nordwestdeutscher Witterungsbericht", issued by Meteorologisches Amt, Hamburg. See Note in J. Geophys. Res., vol. 56 (1951) 138.
3. Scott, W. E. "Principal magnetic storms". Quarterly lists in J. Geophys. Res.
4. Newton, H. W., and Finch, H. F. "Solar activity and geomagnetic storms, 1950". The Observatory, vol. 71 (1951) 45-47, and previous years.
5. Sucksdorff, E. "Die erdmagnetische Aktivität in Sodankylä, 1914-1934". Veröff. Geophys. Obs. Finnische Akad. Wiss. Nr. 25. 68 pp. (1942); "Ergänzende Daten", Nr. 26, 15 pp. (1948).

6. Bartels, J. "Tägliche erdmagnetische Charakterzahlen 1884-1950 und Planetarische dreistündliche erdmagnetische Kennziffern Kp 1932-33 und 1940-50". Abhandl. Akad. Wiss. Göttingen, Math. Phys. Kl., Sonderheft. 29 pp., Göttingen, Vandenhoeck and Ruprecht, 1951.
7. Ferraro, V. C. A., Parkinson, W. C., and Unthank, H. W. "Sudden commencements and sudden impulses in geomagnetism: Their hourly frequency at Cheltenham, Tucson, San Juan, Honolulu, Huancayo, and Watheroo". J. Geophys. Res., vol. 56 (1951) 177-195.
8. Critchton, J. "The K-index of geomagnetic activity at Eskdalemuir, 1940-47". J. Geophys. Res., vol. 54 (1949) 275-276.
9. Bartels, J. "Typische tägliche Gänge der erdmagnetischen Feldkomponenten in Potsdam und ihre Bedeutung". Z. f. Meteorol., vol. 5 (1951) 236-239.
10. Meyer, Otto. "Über eine besondere Art von erdmagnetischen Bay-Störungen". D. Hydrogr. Z. Hamburg, vol. 4 (1951) 61-65.
11. Howe, H. Herbert. "The u-measure of magnetic activity". With remarks by J. Bartels. J. Geophys. Res., vol. 55 (1950) 153-160.
12. Bartels, J. "Results on geomagnetic K-indices for the International Polar Year 1932-33". J. Geophys. Res., vol. 55 (1950) 427-435.
13a. Newton, H. W. "Sudden commencements in the Greenwich magnetic records (1879-1944) and related sunspot data". Mon. Not. R. Astr. Soc., Geophys. Suppl., vol. 5 (1948) 159-185.
13b. Newton, H. W. "Geomagnetic crotchet occurrences at Abinger, 1936-46, and allied solar and radio data". Mon. Not. R. Astr. Soc., Geophys. Suppl., vol. 5 (1948) 200-215.
14. Fanselau, G. "Über die sogenannten zweiten erdmagnetischen Kennziffern". Z. f. Meteorol., vol. 3 (1949) 236-240; current diagrams of first and second K-indices for Niemegk Observatory in Z. f. Meteorol., vol. 5 (1951).
15. Numerous publications of K-indices by observatories in yearbooks and otherwise. Also in journals, such as: J. Geophys. Res., vol. 56 (1951); J. Atmosph. Terr. Physics, vol. 1 (1951); Z. f. Meteorol., vol. 5 (1951); Geofisica pura e applicata, Milano, vol. 18 (1951); Ionospheric Data (CRPL-F-Series) issued by Central Radio Propagation Laboratory, National Bureau of Standards, Washington; Sonnen-Zirkular, Veröff. Fraunhofer-Inst. Freiburg i. Br. (K. O. Kiepenheuer); Catalogue of disturbances ... , Ionosphere Res. Committee, Science Council of Japan, Tokyo.

<u>Topics for discussion</u> by Committee on Characterization ... (CCMD) proposed for the Brussels meeting:

1. Hints for scaling K-indices, and optional use of K=Q.
2. International recognition of Kp-indices.
3. Discussion on daily characters, transition from Ci to Cp.
4. Future of characters 0, 1, 2,
5. Hourly characters.
6. Discussion on s.c., s.s.c., p.s.c., sudden impulses.
7. Proposals to take up ring-current studies and measures of wave-radiation. Instrumental requirements.
8. Numbering of solar rotations.
9. Membership.

APPENDIX TO REPORT OF THE COMMITTEE ON CHARACTERIZATION OF MAGNETIC DISTURBANCES

Hints for Scaling K-indices

By J. Bartels

1. Introduction. These hints are intended for a skilled magnetic observer who is able to discern in his magnetograms the following phenomena:

(1) The effect of solar wave-radiation W: - the quiet daily variations, strongest in non-polar regions;

(2) The effect of solar particle-radiation P: - magnetic activity, or disturbance, strongest near the auroral zones.

The K-index is introduced to measure the intensity of certain P-effects (K-variations) at your station, in a scale of 10 grades, K = 0 to 9 for each of the 8 intervals 00...03, 03...06, ..., 21...24 Universal Time, which may be referred to as Eighths, E1 to E8 of the Greenwich day.

It is possible to instruct an intelligent, non-scientific computer to make preliminary K-scalings, but all his results should be carefully checked by a trained observer, especially the lower grades of K, which are more difficult to scale than those for more disturbed intervals. Care should be taken that no change in K-scaling occurs due to temporary absences of the chief observer, or to changes of personnel. The professional requirements for K-scaling are definitely higher than for the scaling of hourly means; but the time required is less, not more than one or two hours per month.

2. Variability of (Sq + L). The first step is to gather information about the quiet daily variations at your station. It is a superposition of the solar diurnal quiet variation, Sq, and of the lunar daily variation, L. Both parts have systematic changes with season, sunspot-number and--in the case of L--the moon's position. These changes are most apparent from a study of average results from long series of observations. There are, however, also distinct changes, due to a more or less irregular variability of Sq and L, which are of the same order of magnitude as the regular changes. The best way to gain the necessary experience with respect to the total variability of (Sq + L) is to provide yourself with a model stock of tracings of your magnetograms for as many quiet days as available. It is suggested that you select, from the list of quiet intervals given in Table I, a sufficient number of intervals showing the day-time swing in your magnetograms (say, between 03 and 21 local time), and make tracings, grouped in six bi-monthly divisions according to the sun's position, say, Dec. + Jan., Nov. + Feb., Oct. + Mar., Sept. + Apr., Aug. + May, June + July. This collection will provide you with the information necessary to be prepared for the different appearance of Sq + L.

3. Solar-flare effects. Another non-K-variation, comparatively rare, is the solar-flare effect, coinciding with intense solar flares. It is described as a temporary augmentation of Sq. If you are not yet familiar with this phenomenon, compare, in your magnetograms, a few of the s.f.e.'s reported in the K + C reports for 1949 or 1950 (see §9).

4. Post-perturbation. This is also considered as a non-K-variation. It is described as the depression of the equatorial H-level after a magnetic storm, and

the slow recovery within the next days and weeks, appearing on quiet days as non-cyclic variation. Secular variation, of course, is likewise non-K.

5. K-variations and definition of K. All other variations are K-variations, including the additional daily variation on disturbed days (SD), bays, sudden commencements, pulsations.

The meaning of K can be described as follows: At an individual station recording D, H, and Z, the magnetic force at a given instant may be conceived as a three-dimensional vector in an orthogonal coordinate-system with a vertical axis and two horizontal axes, parallel and perpendicular to the magnetic meridian. Suppose this vector to be drawn from a fixed origin 0. The actual magnetic time variation at that station would then be given by the curve described by the end-point of that vector; the curve would have time-marks at suitable intervals. For a particular three-hour-interval, the assumed non-K-variation for the day would be given by a smooth curve. Connect simultaneous points on this smooth curve and on the actual curve: the vectors thus obtained would express the K-variation.

Plotted from a fixed origin, the ends of these vectors showing the K-variations would form a continuous, more or less irregular curve which, with time-marks, is a complete representation of the K-variations. Now, enclose this curve in a close-fitting rectangular box with plane surfaces horizontal, vertical in the magnetic meridian, and vertical normal to the magnetic meridian. Measure, in γ, the longest edge of that box. This is the range R which determines K, according to a scale chosen for your observatory once and for all. One of these scales--valid for Cheltenham--assigns

K = 0 1 2 3 4 5 6 7 8 9

if the range exceeds

R = 0 5 10 20 40 70 120 200 330 500γ

Other scales are proportional, and can therefore be described by the lower limit for K = 9, for which the following choice is given: 300γ, 350γ, 500γ, 600γ, 750γ, 1000γ, 1200γ, 1500γ, 2000γ. If your observatory is already working with a certain scale, adhere to it; stations taking up K-scaling for the first time are advised to please communicate with the Committee for advice in the selection of the proper scale.

6. Practical procedure. Use is made of K-gauges prepared corresponding to the scale-values (in γ/mm) for each force component. N. H. Heck recommended to use a piece of clear photographic film, about seven by ten inches in size. A common base-line is ruled across the base of the sheet. The K-scales for each component appear side by side as horizontal lines about one inch long. They are ruled, at the appropriate distances (corresponding to the range-limits R) from the base-line of the gauge, and marked 0, 1, 2, ..., 8. Since K over 7 occurs rarely, it may be convenient to make the gauge in two parts, a smaller one for K = 0 to 6, and a longer strip for K = 7 to 9. The gauges are kept vertical.

In scaling K, the gauge is moved from left to right across the three-hour-interval following the sweep of the non-K-variation assumed for the day in question, and so that the base-line of the gauge just touches the magnetogram curve from below. This is done for each of the three components (unless it is quite apparent which component has the most disturbed curve), to see which is the range-limit into which the magnetogram is fitting, and the greatest index K thus obtained is noted.

The non-K-variation assumed for a particular three-hour-interval may be rather independent of the non-K-variation assumed for other intervals within the same day. For instance, if a short storm of, say, only 10 hours' duration leaves H much depressed, the level of the non-K-variation is shifted accordingly and chosen to correspond to the possible great recovery of H (non-cyclic variation). If there occur, in a three-hour-interval, in an otherwise smooth curve, two (or more) deflections of (say) 10γ in the same direction, the range is 10γ, but if one of the deflections is positive, the other deflection negative, the range is 20γ.

7. Small K-indices. Do not hesitate to scale K = 0 for an interval in which the K-range is smaller than the upper limit set for K = 0. Do not commit the mistake of scaling K = 1 as soon as you notice small fluctuations; such fluctuations must surpass the upper limit for K = 0 in one component at least in order to make K = 1 the correct index. If you wish, give K = o (no K-fluctuation can be discerned) and K = 0 for the other cases.

At equatorial stations, the sensitivity of the D-variometer is sometimes small, with scale-values of the order 10γ/mm. The upper limit for K = 0 for such stations, 3γ, is then of the order of 0.3 mm on the D-trace, rather difficult to judge. If you cannot supplement the ordinary D-variometer by a more sensitive instrument, and if you have difficulties, because of the day-to-day variability of Sq + L, to distinguish between the lower grades of K, please use the alleviation to combine the indices K = 0, 1, and 2 into one lowest index K = Q (= quiet). The upper limit for K = Q is that for K = 2, namely, K = 12γ, or 1.2 mm on the D-trace, if you use the K-scale for ordinary equatorial stations with K = 300γ as lower limit for K = 9.

8. The diagnosis of solar-flare effects needs additional information on solar eruptions and radio fade-outs. If such an effect occurs in otherwise quiet times, and, by erroneous diagnosis, should be conceived as K-variation, this may result in a higher K-index. If, then, through your own observations or reports from other sources, such as the quarterly reports from De Bilt, you recognize that your K-index was raised by a solar flare effect, please notify the De Bilt center as soon as possible and estimate a corrected index K′ for the pure effect of particle radiation.

9. Information on further topics related to K-indices is given in the papers cited in the following selected bibliography:

Bartels, J., N. H. Heck, and H. F. Johnston. The three-hour-range index measuring geomagnetic activity. Terr. Mag., 44, 411-454 (1939).

__________. Geomagnetic three-hour-range indices for the years 1938 and 1939. Terr. Mag., 45, 309-337 (1940).

Circular letter reproduced by H. F. Johnston, Terr. Mag., 46, 301-303 (1941).

IATME Bulletins Nos. 12, 12a, ..., 12e, for years 1940-1950, and 1932-33; they contain two papers by Bartels: The standardized index, Ks, and the planetary index, Kp (Bull. No. 12b, 97-120); An attempt to standardize the daily international magnetic character-figure (Bull. No. 12e, 109-137).

International data on magnetic disturbances. Quarterly reports by Bartels and Veldkamp, in every issue of J. Geophys. Res. since 1949.

Crichton, J. The K-index at Eskdalemuir. J. Geophys. Res., 54, 175-176 (1949).

Report of the Committee No. 9 on Characterization of Magnetic Disturbances. (In press for IATME Bull. No. 14, Trans. Brussels Meeting, 1951.)

TABLE I

Quiet times, with n = 12 or more successive three-hour-intervals
with Kp = 0o, 0+, 1- or 1o,
that occurred in the Polar Year 1932/33 and in Jan. 1940 to July 1951.
R/5 = Zürich sunspot number divided by 5
μ = Mean lunar phase number for the center date,
with μ = 0 for New Moon, μ = 18 for first quarter, μ = 12
for Full Moon, μ = 6 for last quarter.

19			n	R/5	μ
		January			
33	Ja	4d 03h..... 6d 03h	16	4	17
33	Ja	9d 18h.....12d 12h	22	4	13
42	Ja	30d 21h.Fe 1d 12h	13	4	12
43	Ja	14d 00h.....16d 12h	20	1	17
45	Ja	10d 21h.....12d 12h	13	6	2
45	Ja	23d 06h.....26d 09h	25	5	15
46	Ja	20d 06h.....21d 18h	12	11	10
47	Ja	8d 18h.....15d 09h	53	24	8
		February			
33	Fe	16d 00h.....18d 12h	20	0	6
40	Fe	17d 18h.....19d 21h	17	10	16
45	Fe	20d 18h.....22d 06h	12	2	17
		March			
40	Mr	17d 03h.....18d 24h	15	11	16
41	Mr	26d 09h.....27d 21h	12	8	0
44	Mr	16d 18h.....18d 06h	12	3	6
		April			
33	Ap	11d 12h.....13d 09h	15	0	10
40	Ap	8d 18h.....11d 09h	21	10	22
43	Ap	23d 00h.....24d 24h	16	8	8
44	Ap	12d 15h.....14d 09h	14	0	8
44	Ap	21d 18h.....23d 24h	18	0	0
47	Ap	21d 12h.....23d 03h	13	17	23
47	Ap	23d 18h.....25d 09h	13	22	21
		May			
33	My	26d 00h.....27d 15h	13	0	22
42	My	25d 15h.....27d 06h	13	3	15
43	My	8d 00h.....10d 09h	19	3	20
44	My	15d 09h.....16d 24h	13	0	5
44	My	19d 15h.....21d 21h	18	0	2
47	My	7d 15h.....10d 06h	21	32	9
49	My	28d 12h.....30d 12h	16	24	22
		June			
41	Je	3d 12h..... 5d 06h	14	11	16
42	Je	9d 09h.....10d 24h	13	2	3
42	Je	21d 15h.....23d 06h	13	4	17
43	Je	17d 03h.....19d 03h	16	2	12
44	Je	12d 00h.....13d 12h	12	0	7
45	Je	21d 06h.....23d 06h	16	12	14
48	Je	15d 09h.....16d 24h	13	31	16
		July			
33	Jl	14d 09h.....16d 09h	16	0	6
40	Jl	26d 09h.....27d 24h	13	9	6
42	Jl	3d 15h..... 5d 06h	13	5	7
44	Jl	11d 09h.....12d 21h	12	1	7
47	Jl	4d 06h..... 5d 18h	12	28	10
		August			
32	Au	9d 12h.....11d 21h	19	1	17
32	Au	16d 03h.....17d 21h	14	0	11
33	Jl	31d 21h.Au 2d 21h	16	0	16
33	Au	3d 00h..... 4d 21h	15	0	14
33	Au	30d 09h.....31d 21h	12	0	15
40	Au	16d 09h.....17d 21h	12	21	13
40	Au	23d 21h.....25d 18h	15	18	7
45	Au	9d 03h.....10d 24h	15	7	22
45	Au	17d 21h.....21d 09h	28	6	15
46	Au	22d 06h.....23d 18h	12	22	4
46	Au	28d 21h.....30d 18h	15	20	22
49	Au	24d 06h.....26d 06h	16	30	23
		September			
41	Se	3d 09h..... 4d 21h	12	10	13
41	Se	5d 00h..... 6d 18h	14	10	13
45	Se	23d 03h.....25d 03h	16	15	10
48	Se	27d 12h.....28d 24h	12	27	4
49	Se	18d 15h.....21d 21h	26	31	2
		October			
40	Oc	13d 03h.....14d 24h	15	14	14
40	Oc	22d 21h.....25d 09h	20	12	5
41	Oc	3d 09h..... 4d 21h	12	7	13
45	Oc	2d 18h..... 4d 24h	18	16	3
45	Oc	9d 18h.....12d 06h	20	10	20
		November			
32	Nv	23d 15h.....25d 03h	12	0	3
40	Nv	10d 06h.....11d 21h	13	12	15
44	Nv	12d 09h.....14d 18h	19	2	2
44	Nv	21d 03h.....22d 15h	12	3	19
44	Nv	23d 06h.....25d 24h	22	5	17
44	Nv	26d 18h.....28d 18h	16	4	14
45	Nv	5d 18h..... 8d 12h	22	8	22
45	Nv	18d 12h.....20d 03h	13	12	12
45	Nv	20d 06h.....21d 18h	12	9	11
46	Nv	28d 09h.....30d 12h	17	17	20
47	Nv	6d 00h..... 7d 12h	12	16	6
48	Nv	29d 09h.Dc 1d 12h	17	12	1
50	Nv	6d 12h..... 7d 24h	12	16	2
		December			
32	Dc	21d 03h.....22d 18h	13	0	4
40	Dc	7d 03h..... 8d 24h	15	18	17
42	Dc	31d 03h.Ja 1d 15h	12	3	5
45	Dc	3d 03h..... 5d 15h	20	8	0
46	Dc	13d 21h.....15d 09h	12	24	7
47	Dc	20d 21h.....22d 12h	13	20	17

REPORT OF COMMITTEE ON CENTRALIZATION AND STANDARDIZATION OF RECORDS

By Elliott B. Roberts, Secretary

1. Preface

The report of Committee No. 6 on Methods of Observatory Publication at the Oslo Assembly of 1948 contains a recommendation that "a committee be designated whose purpose shall be (a) ... and (b) ... (cf. report cited)".

Accordingly there was appointed this Committee to consider and report upon the stated objectives. It will be noted that they are not completely independent but of related interest and may be considered together.

The Committee has functioned by

(a) Circularizing its own membership and about twelve other internationally known magneticians, including four members of the Executive Committee of the Association, for opinions as to the practicability, and specific proposals toward the realization of the proposal.

(b) Circularizing about fifty observatory directors for (1) reports upon the present and prospective adequacy of publication programs, (2) opinion as to the value of a central station for processing and publication purposes, and (3) suggestions as to what station might so function.

2. Questionnaire Response

From the Committee members and others from whom opinions and suggestions were requested there have been received five responses. These contain one unqualified approval of the suggested procedures without recommendation as to how they could be accomplished, one expression of doubt that central office processing is desirable, one expression of fear that the designation of a chain of key observatories would lose more than it would gain, and several suggestions that the whole matter be thrown into general discussion at Brussels.

The responses from observatory directors account for 34 observatories. Included are information on the status of the publication programs and a number of interesting and constructive general comments, but the replies fail to provide the Committee with any basis for positive proposals. A brief account of these responses follows.

On the first question, all 34 observatories report a program that is planned to achieve virtual conformity with the schedule of items recommended at Oslo. In a good many cases there is a serious backlog, extending back to before the last war. On the second question, 12 of the observatories considered that the establishment of a processing center would expedite their publication program; 17 were indifferent or felt that it would be of no help to them. On the third question, response was almost uniformly negative; it appears that considerable difficulty may be encountered in attempting to set up such centers.

A number of the comments received with the returns are of special interest. Two agencies representing 9 observatories report active punch-card programs already under way. Two comments noted that the scaling of the hourly values, a job that must apparently remain with the individual observatories or institutions, is itself a substantial part of the total job of preparing results for publication. There was one suggestion that a central agency might usefully serve for distributing data to users before their regular publication. Another stressed the need for a center to relieve the observatories of actual publication, suggesting that the observatories do their own processing and supply the central agency with film duplicates of the tabular results. This was one of several replies that brought out the wide variety of factors impeding final publication even where there is a considerable backlog of processed results ready for the printer. At the same time, there seems to be a feeling on the part of agencies which might eventually be in a position to become processing centers that the actual publication would not be a suitable function of such a center.

One institution was definitely against central processing, stating that "it is by working on the records that defects are discovered, and can then be eliminated." The same reply was also skeptical of the efficacy of punch-cards for observatory reductions, suggesting however that it would be interesting to hear of actual experience in this field. A number of replies suggested further informal discussion of the whole topic at the Brussels Assembly.

Data obtained from the replies to the Committee's questionnaire included some detailed information on the extent of present and prospective compliance with the Oslo recommendations of Committee No. 6. All such material has been turned over to Committee No. 6.

3. Recommendation

The Committee has received no constructive suggestions for the working out of the recommendations presented by Committee No. 6 at Oslo. It has, on the contrary, determined that the proposals would be most difficult or impossible to realize and would be of doubtful value, with possibly undesirable consequences. It is therefore recommended that the matter be dropped and the Committee discharged.

REPORT OF COMMITTEE TO PROMOTE OBSERVATIONS OF DAILY VARIATION OF THE HORIZONTAL MAGNETIC FORCE BETWEEN AND NEAR THE GEOGRAPHIC AND MAGNETIC EQUATORS. 1948-1951

By J. Egedal, Chairman

The Committee was appointed at the Oslo Assembly in 1948. Its members are: Banerji, Berlage, Coulomb, Egedal (Chairman), Giesecke, Herrinck, Lützow-Holm, Madwar, Martyn, McNish and Romañá.

The task of the Committee is in the first line to organize observations of the range of the daily variation of the horizontal force for different longitudes at stations about 150 km apart lying in a N-S line crossing the magnetic and geographic equators with at least three stations lying outside the area between the two equators, as well to the north as to the south. A further extension of the task of the Committee might be the establishment of provisional or permanent observatories in places suitable to the purpose where not only magnetic, but also ionospheric measurements, should be made. As to the establishment of permanent observatories, a collaboration with the "Committee on selection of sites of new observatories for terrestrial magnetism and electricity" would be necessary. The Committee has only taken up the arrangement of observations. In most cases members of the Committee have been active (Togoland, South America, Gulf of Guinea and India). The observations have ordinarily been made by means of QHM's belonging to the Association. Through Circular Letters the members have been informed of the work of the Committee. Two of these Circular Letters have, in accordance with the wish of the Editor, been published in the Journal of Terrestrial Magnetism and Atmospheric Electricity, and Journal of Geophysical Research (vol. 53, 470-476 (1948); vol. 55, 98-100 (1950)).

Arrangements of Observations

Professor J. Coulomb has arranged observations in Togoland. By means of the QHM's 5, 7 and 12 belonging to the Association Mr. L. Pontier made observations at five stations in Togoland.

Father Romañá has arranged observations in the Gulf of Guinea. Using QHM 111 belonging to Observatorio del Ebro Captain Sánchez-Martinez and Lieutenant Capuz have made observations at Bata and on Fernando Póo.

A. A. Giesecke, Director of the Geophysical Observatory of Huancayo, has arranged measurements in South America at 14 stations forming a chain 2200 km long. The magnetic observatory in Huancayo has served as reference station. The QHM's 17, 18 and 32 belonging to the Association have been used at the measurements. With the help of the Peruvian Military Geographic Institute and similar institutes in Columbia and Ecuador three expeditions were equipped. The three expeditions observed simultaneously.

Dr. S. K. Banerji has taken care that measurements were made in India. The measurements were made under the supervision of B. L. Gulatee, President, Geodetic and Research Branch, Survey of India, to whom the QHM's 17, 18 and 32 were sent from A. A. Giesecke, Huancayo. Observations were made at five stations in southern India.

Dr. C. del Rosario, Director, Philippine Weather Bureau, has arranged observations at Santa Maria, Mindanao, and the measurements were made with the QHM's 17, 18 and 32, received from Mr. Gulatee in December 1950.

Efforts have been made in order to arrange observations at stations in a chain from Congo Belge to Anglo-Egyptian Sudan, and the question has been discussed with Mr. P. Herrinck; the Directors of the East African Meteorological Department in Nairobi, D. A. Davies and W. A. Grinsted; and the Director of Surveys, R. C. Wakefield, Sudan Government. Dr. M. R. Madwar is now examining the question as regards the northern part of the chain. P. Herrinck communicates that Mr. Van der Elst, Chief of Belgian Congo Meteorological Service, has assured that the measurements at stations lying in the chain in Belgian Congo could be made.

Efforts have also been made in order to obtain observations from places where the magnetic and geographic equators coincide. For all above mentioned places the two equators are widely separated, and, as it is not certain that the augmentation of the daily variation of H at the magnetic equator is the same when the magnetic equator is near to the geographic equator (cfr. McNish: Progress of research in magnetic diurnal variations, IATME, Trans. Edinburgh Meeting, 1936, p. 271-280) it is necessary to obtain observations also from such regions. The two regions where the equators are coinciding are in the Atlantic and the Pacific, but islands where measurements may be made are only to be found in the Pacific (Jarvis a.o.). Dr. Martyn has applied to the Australian Bureau of Mineral Resources (Dr. J. M. Rayner), interested in an expedition to Pacific islands, for measuring magnetic variations. It has not yet been possible to fix a definite date for the departure of the expedition. The QHM's 17, 18 and 32, used in the Philippines, are placed at the disposal of Dr. Rayner.

It has been the intention to arrange observations in a chain of stations in Malacca, and the question has been discussed with Dr. Berlage. In a letter of February 6, 1951, Dr. Berlage regrets that it has not been possible to take part in the observations of the Committee and gives the following information concerning magnetic work in Indonesia: The magnetic station on the island Kuyper, near Batavia (now Djakarta), which was destroyed during the last war, has not yet been reestablished. A new set of variometers, received by the Meteorological and Geophysical Service of Indonesia in 1950, were set up provisionally at the Bosscha Astronomical Observatory at Lembang, near Bandung, where they have been recording since September 1950. Under the present conditions it therefore has been found necessary to give up the observations in Malacca.

The Observations and their Reduction

The observations of the daily variation of H have been made by means of QHM's. A series of determinations have been made in the periods in the morning and in the afternoon where minima occur and just before noon where the maximum occurs. From these observations the range of the daily variation is found. In cases where no reference station has been used the ranges must be corrected for variation with sunspot-numbers, and for annual and lunar variations. If a reference station has been used, the ratio between the observed range and that of the reference station is only slightly influenced by the just mentioned variations and therefore roughly may represent the variation of the range.

In Table 1 the corrected mean ranges of the daily variation of H for different stations in Togoland are given. In Tables 2 and 3 the ratios between the mean observed range at a station and the mean range for the same period at the reference station are given for different stations in South America and India, respectively.

Table 1--Togoland. Magnetic Equator: ϕ = 9°.6N. Geomagnetic Equator: ϕ = 4°.0S.

	1950 Feb. 4-8	1949 May 7-11	1949 Dec. 15-20	1949 Sept. 9-14	1949 13 days	1933 (Moka) July 1-31
Place λ =	0°.5E	0°.9E	1°.0E	1°.2E	1°.3E	8°.7E
Place ϕ =	10 .4N	9 .4N	8 .4N	7 .2N	6 .2N	3 .3N
Corrected mean range:	140γ	106γ	116γ	80γ	79γ	67γ

Table 2--South America. Reference Station: Huancayo (λ = 75°.3W; ϕ = 12°.0S). Magnetic Equator: ϕ = 13°.3S. Geomagnetic Equator: ϕ = 11°.4S.

	1949 Sept. 22-25	1949 Sept. 22-25	1949 Sept. 21-24	1949 Sept. 28-Oct. 1	1949 Sept. 28-Oct. 1	1949 Sept. 29-Oct. 2
Place λ =	73°.6W	74°.9W	76°.1W	77°.8W	78°.3W	79°.0W
Place ϕ =	16 .2S	14 .8S	13 .4S	10 .8S	9 .5S	8 .1S
Mean ratio:	0 .75	0 .91	1 .01	0 .86	0 .71	0 .59

	1949 Oct. 2-5	1949 Oct. 3-5	1949 Oct. 3-5	1949 Nov. 5-7	1949 Oct. 12-15	1949 Oct. 18-21	1949 Oct. 23-26	1949 Oct. 29-31
Place λ =	79°.8W	80°.6W	80°.5W	79°.9W	78°.6W	78°.1W	77°.1W	76°.5W
Place ϕ =	6 .9S	5 .2S	3 .6S	2 .2S	0 .9S	0 .4N	1 .9N	3 .4N
Mean ratio:	0 .47	0 .45	0 .46	0 .50	0 .44	0 .52	0 .41	0 .59

Table 3--India. Reference Station: Kodaikanal (λ = 77°.5E; ϕ = 10°.2N). Magnetic Equator: ϕ = 8°.7N. Geomagnetic Equator: ϕ = 9°.7N.

	1950 July 31-Aug. 2	1950 July 9-12	1950 June 5-8	1950 June 18-20
Place λ =	77°.4E	77°.6E	77°.6E	80°.2E
Place ϕ =	15 .2N	13 .0N	8 .7N	6 .0N
Mean ratio:	0 .74	0 .82	1 .12	0 .86

In Figure 1 a curve produced by A. A. Giesecke representing the ratios for 14 stations in South America is given. The curves for the observations for Togoland and India are of similar form.

The observations made in Bata and at Fernando Póo confirm the results from Moka (see below).

Besides the observations in the field the Committee by the courtesy of Mr. J. R. Navarro, Madrid, has received a complete reduction of all values of H recorded at the Polar Year station at Moka, Fernando Póo (cfr. Table 1).

According to the results given in Tables 1-3, the augmentation of the range of the daily variation of H is greatest at the magnetic equator and disappears at about 800 km (7° latitude) to the north and to the south.

It has been tried to derive the mean range of the daily variation of H at the magnetic equator in South America, Togoland and India. The ranges have been

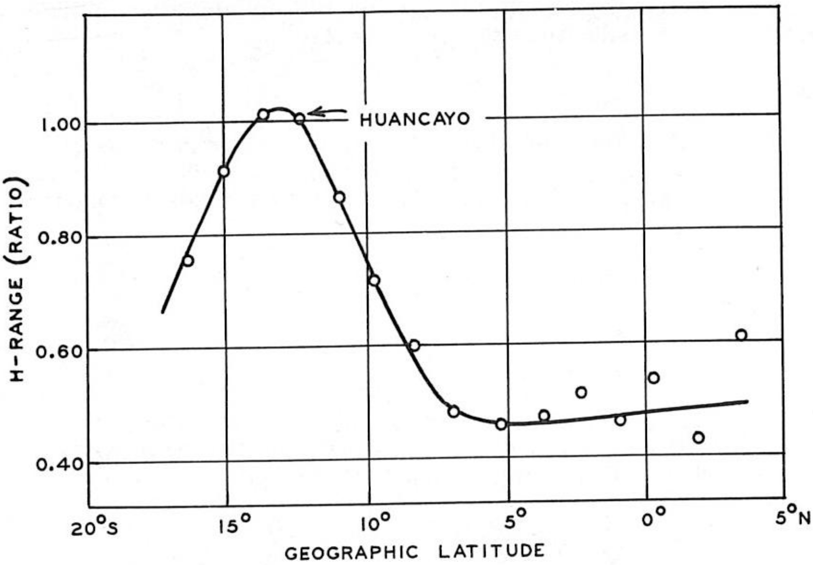


Figure 1--Comparative ranges in H non-corrected except for reduction to reference station. (A. A. Giesecke)

corrected for variation with sunspots and for annual and lunar variations. The result is given in Table 4.

Table 4--Mean ranges of H at the magnetic equator corrected for variations with sunspots and for annual and lunar variations

Latitude		Mean range of H
South America	13°.3S	116γ (mean hourly values)
Togoland	9 .6N	124γ (instantaneous values)
India	8 .7N	106γ (instantaneous values)

Lacking Observations

The Committee desires to obtain observations from a chain of stations in central Africa in order to get observations taken at a region far from the sea. These observations may give further information concerning the daily variation of H near the magnetic equator in the northern hemisphere.

As already mentioned, it is especially desirable to get observations from places where the geographic and magnetic equators coincide, on account of their importance for the understanding of the considered problem.

Remaining Work

Besides the above mentioned desired observations the Committee has to consider the establishment of provisional or permanent observatories in suitable places. The question has been discussed, but the opinions of the members and of different experts are differing very much, and therefore the Committee does not wish to set forth any definite proposal in the matter but suggests that the question be deferred until the present report has been considered at the Brussels Meeting.

The Committee wishes that the question of a collaboration in the matter with URSI also may be considered at the Brussels Meeting.

Finances

The Committee received 1431.98 Danish Crowns from the Secretary February 1949 and 700 Danish Crowns from UNESCO funds July 1950. The last mentioned amount has been used. On December 31, 1950, the cash balance amounted to 981.36 Danish Crowns.

Det Danske Meteorologiske Institut
København, Denmark

COMMITTEE TO PROMOTE OBSERVATIONS OF DAILY VARIATION OF THE HORIZONTAL MAGNETIC FORCE BETWEEN AND NEAR THE GEOGRAPHIC AND MAGNETIC EQUATORS

Supplementary Report

By J. Egedal

Arrangement of observations. It has been examined whether an Argentine magnetician on his way to the Brussels meeting might be able to make observations on the island Fernando da Noronha. This island is situated at the magnetic equator and only 4° latitude from the geographic equator. The Argentine authorities have declared their willingness to support an arrangement, and considerations are still going on.

Father Romañá communicates that Father I. O. Cardús in connection with a visit to Spanish Guinea will make observations on the island Annobon and at other places.

The Committee has informed the Secretary of the Eclipse Committee of the Mixed Commission on the Ionosphere, Dr. A. H. Shapley, that the Committee would be willing to place three QHM's to the disposal of the Eclipse Committee for measurements in Central Africa where the center of the eclipse occurring February 1952 and the magnetic equator are coinciding (ϕ = 10°N; λ = 26°E). The Eclipse Committee is considering the matter.

The observations. The results of the observations arranged by Dr. C. del Rosario, Director, Philippine Weather Bureau, at Mindanao have been received. The observations were carried out at Siocon, Zamboanga (ϕ = 7° 42.'0N; λ = 122° 09.'0E), just at the magnetic equator during the days from January 17 to January 22 inclusive (1951). Excluding the value of the range of the daily variation of H for January 22, which was the most disturbed day in the month of January, and correcting the values of the rest of the days for variation with sunspots and for annual and lunar variations a mean range of 113γ has been found (cf. Table 4 of the report).

B. L. Gulatee, Director, Geodetic and Training Circle, has sent results from one more station in southern India. For this station, Mandapam, (ϕ = 9° 16′45″N; λ = 79° 07′50″E) the ratio of the range of the daily variation of H to that of Kodaikanal was found to be 1.20 (cf. Table 3 of the report).

Publications. In a paper to appear in Dr. Moriköfer's Archiv Prof. Chapman has discussed the results obtained by A. A. Giesecke in South America. From this investigation S. Chapman concludes that "it is highly desirable that the ATME investigation should be extended not only to determine $S_q(H)$ in South America in latitudes below 16°S, to complete Director Giesecke's Figure 4, but also to determine the variation with latitude, along or near the meridian of Huancayo, of the amplitude of $S_q(Z)$".

Director A. A. Giesecke has prepared a manuscript for publication on the result of the observations of the range of the daily variation of H made in South America. The treatment has revealed that the curve given in the report (Fig. 1) should be altered as regards the values for the region near the geographic equator, the new ratios being lower than those of Fig. 1.

REPORT OF THE COMMITTEE ON MAGNETIC AIRBORNE SURVEYS

By J. W. Joyce, Chairman

The Committee has brought together in this report a brief summary of the developments and activities in the field of aeromagnetic surveying since the time of the Oslo Assembly. Instrumental improvements and operational experience are included.

In general, the very limited number of airborne magnetometers that have been available, as well as the relatively high costs of developing and building new systems, has been a deterring factor to the rapid expansion of geomagnetic air surveys. Those groups who have flown magnetometers have usually used modified equipments which were originally intended for other uses, although there have been some exceptions, notably among the commercial users.

Details of developments in the various countries contributing information on which this report is based follow.

Australia

Mr. J. M. Rayner reports that during 1950, following a decision to carry out aeromagnetic surveys over wide areas of Australia, New Guinea, and surrounding regions, steps were taken to acquire two sets of aeromagnetic equipments, aircraft, and necessary auxiliary devices. The nucleus of a staff has been established and trial flights made. Regular surveys were started in mid 1951. Initial surveys will measure total field only, but eventually it is planned to use a three-component magnetometer.

Canada

Messrs. P. Serson and S. Z. Mack submitted the following report on a universal airborne magnetometer of Canadian design.

"During the past three years experiments have been proceeding in Canada aimed at the development of a universal airborne magnetometer which will record directly the elements of declination, vertical force, and horizontal force. This work has been a cooperative project between the Division of Terrestrial Magnetism of the Dominion Observatory, the National Research Council, the Defence Research Board, the Royal Canadian Air Force, and the Physics Department of Toronto University.

"The instrument involves three main elements:

(1) An automatic sun compass with photoelectric guiding for the continuous indication of the true heading of the aircraft.

(2) A gyro-controlled horizontal platform for the accurate determination of the direction of the vertical.

(3) Three elements of a saturable core magnetometer, the detecting coils of which are mounted on the horizontal platform. Two of these coils measure the horizontal and vertical force in gammas while the third serves to indicate the direction of magnetic north and to keep in alignment the coil for the measurement of horizontal force.

"A main feature of the experiments has been the design and development of a device to distinguish the true vertical, as determined by the direction of gravity, from the apparent vertical as determined by the resultant of gravity and the horizontal accelerations to which an aircraft in flight is subject. What is hoped will be a successful solution to this problem is found in the use of a so-called low-pass mechanical filter which attenuates the influence on the erecting gyro of accelerations of the aircraft having periods less than two minutes while giving full value to the acceleration of gravity which acts continuously.

"Successful flight tests have been made of the automatic sun compass and of a preliminary model of the horizontal platform.

"It is hoped that the completed instrument will have an accuracy of a few tens of gammas in force measurements and a few minutes of arc in declination."

France

Mr. Selzer reports that the development of airborne magnetometers has been under consideration in France, although financial and material factors have limited progress. The problem is now under the auspices of "Office National d'Etudes et de Recherches Aéronautiques." Temporarily, further investigations are held up awaiting a decision on availability of funds.

Great Britain

Mr. C. A. Jarman reports as follows on work in aeromagnetic surveying in Great Britain during the period covered by this report.

"Little survey work has been carried out, with the exception of three minor local surveys in Kent, Lancashire, and Yorkshire, to determine the extent of anomalies due to geological causes. The results have been employed by Runcorn and his associates in their work on the radial variation of the geomagnetic field within the surface of the earth.

"The radial variation of the geomagnetic field with height above the surface of the earth has been measured up to 20,000 feet, and the values found to be consistent with classical theory.

"To obtain experimental evidence for or against the Distributed Theory suggested by Blackett, flights have been made, with the courteous assistance of the Norwegian Government, over the Sogne Fiord in Western Norway. The results, on assessment, provide no support for the Distributed Theory of origin of the main geomagnetic field.

"A total force Survey of the United Kingdom, planned for the Department of Scientific and Industrial Research by a private consultant in 1949 has, unfortunately, been abandoned.

"Two competent and well-equipped private operators, Oscar Weiss and Hunting Geophysics Ltd., announced in early 1950 their entry into the commercial field of aeromagnetic surveying in the United Kingdom. So far as is known no work has yet been done in Great Britain by either operator for private firms or governmental agencies.

"A British manufacturer has made the supply, on a commercial basis, of airborne total force variometers a part of his standard range of instruments. Instruments (based on the Ministry of Supply design) have been supplied to and used in Australia, New Zealand, and in South Africa.

"Development of equipment for research into the configuration of the geomagnetic field has proceeded at a steadily decreasing rate, due to the demands of overseas trade and the defence program on the industry of the country. It is hoped that this work, undertaken by the Ministry of Supply, can continue and a contribution thereby, made to the fundamental study of the distribution of the main geomagnetic field close to the surface of the earth."

New Zealand

Mr. H. F. Baird has reported the following aeromagnetic survey activity in New Zealand.

"The branch now operates a total-force magnetic detector which is mounted on the tail of a twin-engined Miles Aerovan. Recording is in the cabin. Flights have given some very useful data around Banks Peninsula and even out to Mernoo Bank, submerged some 140 miles east. A close grid was flown over a thermal region in the North Island. Longer flights have been made from Bulls to White Island, and V. B. Gerard and J. A. Lawrie are now relating Amberley base station and land magnetic survey stations en route with air-flown traverses between here and the thermal area where over an area of 9000 square miles a special geological problem is being studied. Areas of magnetic disturbance towards, as well as in and around, Cook Strait region have been revealed at 5000 feet. The gradient with height has been ascertained, and early work already completed indicates that this speedy tool will be most useful in magnetically mapping both the disturbed and undisturbed areas in and about New Zealand. This activity is very young yet but correlation with land magnetic stations on non-ferrous sedimentaries is good. Already it has thrown some light on the extent of disturbed regions referred to in the penultimate paragraph of my 1948 report."

Subsequent correspondence with Mr. Baird indicates the instrument used was an AN/ASQ-1 total-force magnetometer modified by the British Ministry of Supply. Effective compensation was applied for both the permanent and induced magnetic fields caused by the aircraft. As of March 1951, approximately 3000 traverse miles had been flown, using a Miles Aerovan aircraft. The detector head was carried on a rigid support below the tail of the aircraft.

United States

The past three years have witnessed continued progress in the development of aeromagnetic survey instruments and significant increases in using facilities. In addition to government groups, which include the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, and the U. S. Naval Ordnance Laboratory, a number of commercial geophysical companies, both United States and Canadian, have actively entered the field. Parts of the material contained in this section of the report have been supplied by these organizations, which include Aero Service Corporation, Gulf Research and Development Company, Weiss Geophysical Corporation, Fairchild Aerial Survey, Inc., Frost Geophysical Corporation, Lundberg Explorations, Ltd., and Photographic Surveys, Ltd.

While instrumental stability requirements over periods of time for large-scale mapping operations are usually on a higher order than for local surveys, the latter usually require greater relative accuracy, and hence a more precise knowledge of instrumental drift over shorter time intervals. In both applications, therefore, there is a common need for more stable equipments, with linear and determinable drifts.

The Naval Ordnance Laboratory has continued earlier development work toward a three-component measuring magnetometer, at the same time developing an interim system for determining relative bearing of the total magnetic vector with respect to reference axes. These consist of the three principal axes of the aircraft. Then, knowing aircraft heading and attitude, all components of the geomagnetic field may be computed for all points along the flight path.

Using U. S. Air Force planes and modified Naval Ordnance Laboratory equipment of the interim type described above, over 35,000 miles of traverse lines had been flown by March 1951. Added to the very substantial traverse mileage covered by commercial concerns, a substantial collection of air magnetometer observations have been accumulated, and large parts of the United States and surrounding areas have been surveyed.

Approximate orders of accuracy for the interim instrument mentioned above are:

Element (lat. 40° N)	Est. accuracy
Declination	± 0.5°
Horizontal intensity	± 100 gammas
Vertical intensity	± 100 ”
Total intensity	± 100 ”
Inclination	± 0.2°

These are for absolute values. Where variations only are of interest over relatively short periods of time, relative accuracies of ± 2 gammas are strived for, although, as a practical matter, ± 5 gammas is a more readily realizable accuracy.

Among the practical problems in all aeromagnetic surveys are:

(a) Reduction of the magnetic field due to the aircraft. This is accomplished by removing every magnetic part that can be discarded without compromising flight safety, followed by an effective compensation program.

(b) The exact location of the aircraft in space and an accurate continual indication of true heading and true vertical.

(c) The establishment of check-points where absolute values of the geomagnetic field are known on the ground.

(d) Determination of instrumental drift at any time.

Geophysical surveys for commercially important raw materials, using aeromagnetic equipments, have been carried out in the search for petroleum, iron, lead, zinc, chromium, nickel, manganese, and aluminum. In addition, these magnetometer systems have rendered valuable assistance in studies of major geological structures such as the continental shelf off the east coast of the United States and the Appalachian Mountains.

The economic results of most of this work have not yet been evaluated, or have not been released to the public. It is known, however, that seven new deposits of magnetite of possible economic significance have been discovered by the airborne magnetometer in the northwest Adirondacks, New York. Five of the seven deposits have been drilled and an indicated tonnage of 6,000,000 has been shown. It has also been announced that large deposits of magnetite have been discovered by the airborne magnetometer in southeastern Pennsylvania and near Ottawa, Ontario, Canada.

During the last three years, no major changes have been made in the airborne magnetometer equipment, or methods of survey and compilation, but improvement has been continued. All geophysical organizations are apparently now using the three-element automatic orienting system and most have incorporated some method for measuring or correcting the drift of the instrument. Straight-line computers are now used in surveys with Shoran flight control. The attempt to improve accuracy has continued and most organizations report that an accuracy of $\pm$ 2 gammas can be obtained, but that $\pm$ 5 gammas is more practical.

The cost of the work varies with the particular survey, but most commercial organizations report on an average of about $10 per traverse mile. The field surveys are accomplished at the rate of 7000 to 10,000 traverse miles per month and the office compilation at the rate of about one traverse mile per man hour.

The bibliography of articles and reports dealing with the equipment, its use, and its results now amounts to about 200 items and more than 150 aeromagnetic maps have been released to the public.

Conclusions

The importance of aeromagnetic surveys, both for charting and applied prospecting purposes, appears to have been soundly established during the past three years. It is fully expected that the coming years will witness an equal or accelerated degree of progress.

Accurate measurements of the geomagnetic field at ground stations will still be required to furnish check or control points for aeromagnetic surveys, particularly those used by large-scale mapping operations. As a corollary, for the immediate future, therefore, non-magnetic vessels will continue to be needed for observations at sea.

The cost of continuing the development and improvement of aeromagnetic survey systems is high.

Recommendations

In view of the importance of aeromagnetic surveys to the fields of interest of the Association, it is recommended that a Committee on Airborne Magnetic Surveys be continued at the Brussels meeting. It is recommended that activities engaged in aeromagnetic surveys be encouraged to make the results of their surveys available after any commercial advantages accruing from suppression of data may have expired, and that in making such surveys all practicable efforts be made to tie surveys to absolute values so that the maximum use can eventually be made of the data for world mapping purposes.

It is recommended that an attempt be made to "pool" or combine instrumental development work to avoid duplication in costs and to assure the widest possible distribution and usefulness of aeromagnetic systems. As a corollary, there is great need for locating a source of commercially available airborne magnetometers at reasonable costs.

Acknowledgment

In addition to the contributions of the Committee members to this report, acknowledgment is made of the assistance rendered by Mr. J. R. Balsley of the U. S. Geological Survey in collecting and collating information from United States and Canadian sources.

Washington, D. C.
July 1951

JOINT COMMITTEE OF THE ASSOCIATIONS OF METEOROLOGY AND TERRESTRIAL MAGNETISM AND ELECTRICITY ON THE STUDY OF LUNAR VARIATIONS IN METEOROLOGICAL, MAGNETIC AND ELECTRICAL ELEMENTS

S. Chapman, Chairman

Editor's note: The Secretary of the Committee, Mr. M. V. Wilkes, presented an oral report of the Committee's activities at the Brussels meeting. No manuscript of this report has been received.

REPORT OF THE TEMPORARY COMMISSION ON THE LIQUIDATION OF THE POLAR YEAR, INTERNATIONAL METEOROLOGICAL ORGANIZATION

The Liquidation of the International Polar Year 1932-33

By V. Laursen, Executive Officer, TCLPY

In the Transactions of the Oslo Meeting, p. 346, Dr. J. A. Fleming, President of the Liquidation Commission, has given an outline of the work to be carried out under the auspices of the Commission. Now when the liquidation program has been completed and the Commission formally dissolved, Dr. Fleming has suggested that a brief report should be prepared and presented at the Brussels Assembly, thereby giving a statement of those aspects of the work which are of particular interest to the Association.

From the very beginning the Association of Terrestrial Magnetism and Electricity took a leading part in the implementation of the International Polar Year 1932-33. Through its Polar Year Commission, established at the Stockholm Meeting 1930, the Association was very active in planning and supporting investigations to be carried out within its domain; and especially the auroral observations of the Polar Year were to a large extent organized under the auspices of the Association. The Photographic Atlas of Auroral Forms, prepared by the Association and issued in 1930, with its Supplement, issued in 1932, served as a general basis for these observations. Furthermore, the Association provided a large number of special aurora-cameras and aurora-spectroscopes to be used at the Polar Year stations.

The Association later contributed largely towards the costs of the establishment of comprehensive archives of photo copies of magnetic registrations and other magnetic data from the large number of magnetic stations operated during the Polar Year. The Association has also defrayed the expenses of the publications of the magnetic character figures for that period.

Also the work of the Liquidation Commission has been actively supported by the Association. The publication of the Bulletin 12d of the Association: Geomagnetic K-indices for the Polar Year, prepared by Prof. J. Bartels, was the result of a joint action of the Committee on Characterization of Magnetic Disturbances in the IATME and the Liquidation Commission.

The following brief summary may be given of further investigations, initiated or supported by the Liquidation Commission and bearing upon geomagnetism:

a) The magnetic records and observations from the South American Polar Year stations Tatuoca (Brazil) and Magallanes (Chile) have been worked up under the supervision of Dr. J. Olsen, Danish Meteorological Institute and published by the Commission. Also published are the results of a special investigation by Dr. J. Egedal of the lunar daily variation at Tatuoca.

b) The magnet records and observations from Cape Town for the period Aug.-Dec. 1932 have been prepared for publication by Dr. van Wijk, Hermanus, and published by the Trigonometrical Survey Office, South Africa.

c) A thorough investigation of the numerous quick-run records obtained during the Polar Year has been made by Dr. E. Sucksdorff, Helsingfors, the results being printed in the series of publications from the Meteorological Service of Finland.

d) Dr. K. F. Wasserfall, Bergen, is making a comprehensive investigation of magnetic variations on quiet days, based on data from 45 observatories and magnetic stations operated during the Polar Year.

e) A general Polar Year bibliography has been prepared, listing as far as possible all publications relating to the observations of the Polar Year. This bibliography is being printed and will be given a very wide distribution.

One of the main tasks of the Liquidation Commission was the preparation of an inventory of the great number of magnetic instruments which the International Polar Year Commission, thanks to a grant from the Rockefeller Foundation, had been able to lend to countries taking part in the magnetic program of the Polar Year. Some of these instruments have been returned to the Commission, some have been lost during the war, but the greatest part are now in use at permanent observatories all over the world. Having considered the result of a general inquiry among the institutions holding Polar Year instruments, the Commission decided, with the approval of the Rockefeller Foundation, that instruments actually in use at observatories in Algiers, Australia, Azores, Canada, Denmark, Great Britain, New Zealand, Norway, Peru, South Africa, Spain, Sweden and U.S.A. should be left definitely to these observatories. The Commission further decided that all instruments not in use should be returned to the Bureau of the Commission and that such instruments after a general overhaul, which in many cases was badly needed, should be placed at the disposal of the IATME. The Association has accepted the responsibility for this equipment, which is provisionally stored at the Danish Meteorological Institute, and which comprises the following parts:

5 sets of variometers, D, H, Z
5 quick-run recorders, 180 mm/h
1 normal-speed recorder, 15 mm/h
4 spare clocks for 180 mm/h recorder
3 Helmholtz coils

In addition one quick-run recorder and one spare clock are stored at the Department of Terrestrial Magnetism, Carnegie Institution of Washington, while one set of variometers and one normal-speed recorder, now operated at College, Alaska, will be made available later. All the instruments are of the la Cour type.

Finally the Commission is glad to report that it has been possible to make a contribution towards the printing of a new edition of the above-mentioned Photographic Atlas of Auroral Forms, which proved of such fundamental importance for the auroral observations of the Polar Year, and which will be of equal importance also for future observations of auroral displays. The new edition is being printed by the Association under the direct supervision of Prof. Störmer, Chairman of the Auroral Committee.

Danish Meteorological Institute
Charlottenlund, Denmark
24 May 1951

PART V

COMMUNICATIONS

In accordance with a policy adopted at the Brussels Meeting, the presentation of technical communications is limited to references to periodicals where complete texts may be found and where such information has become available to the Editor; to brief author's abstracts in those cases where they have been supplied and citations are not available; or to titles only where citations or abstracts are lacking. Discussion has also been omitted.

A. Physics of the high atmosphere and the ionosphere (Joint meetings with the International Association of Meteorology)

RESULTS OF ROCKET AND METEOR RESEARCH

By Fred L. Whipple

The complete text is published in the Bulletin of the American Meteorological Society, Vol. 33, pp. 13-25 (1952).

RECENT STUDIES OF THE DIURNAL VARIATIONS OF THE UPPER ATMOSPHERE EMISSIONS 5577 AND 6300 (OXYGEN) AND 5893 (SODIUM)

By F. E. Roach and Helen B. Pettit

Material bearing on this subject is contained in the paper by the same authors entitled "Excitation patterns in the nightglow", Mémoires de la Société Royale des Sciences de Liège, Tome XII, Fas. I-II, pp. 13-49 (1952). See also "On the diurnal variation of [OI] 5577 in the nightglow", Journal of Geophysical Research, Vol. 56, No. 3, pp. 325-353 (1951).

EVIDENCE FOR IONOSPHERE CURRENTS FROM ROCKET EXPERIMENTS NEAR THE GEOMAGNETIC EQUATOR

By S. Fred Singer, E. Maple, and W. A. Bowen, Jr.

The complete text is published in the Journal of Geophysical Research, Vol. 56, No. 2, pp. 265-281 (1951).

EXPERIMENTAL RESULTS OF AURORAL RESEARCH

By L. Vegard

The complete text is published under the title "Recent advances in auroral spectroscopy and in our knowledge of the upper atmosphere", in Annales de Géophysique, Vol. 8, No. 1, pp. 91-99 (1952).

THE AURORA

By S. Chapman

The complete text is published under the title "Theories of aurora polaris", in Annales de Géophysique, Vol. 8, No. 2, pp. 205-225 (1952).

BASIC REACTIONS IN THE UPPER ATMOSPHERE

By D. R. Bates

The complete text is published under the title "Some reactions occurring in the earth's upper atmosphere", in Annales de Géophysique, Vol. 8, No. 2, pp. 194-204 (1952).

ÜBER ECHOLOTUNGEN DER IONOSPHÄRE BEI SCHRÄGEM EINFALL

By W. Dieminger

The complete text is published in Zeitschrift für angewandte Physik, Band 3, Heft 3./4., pp. 90-96 (1951).

ION BALANCE IN THE ATMOSPHERE

By J. Clay

In the course of a research about the balance of the ions executed on Helgoland, V. F. Hess (V. F. Hess, Gerlands Beitr. z. Geophys., Vol. 22, 256-314, 1929) measured the ionization caused by the radiation of the soil and by cosmic radiation, also the disappearance of ions by recombination and the total number of ions present above the sea.

For many years in our laboratory in Amsterdam investigations have been carried on about the various factors affecting the balance of ions. This balance was first struck, however, for the situation above the ocean. During a voyage some of us made daily simultaneous recordings of the conductivity of the air and of its decrease through recombination in a closed vessel. From these data the number of produced ions could be determined. During the whole voyage ionization by cosmic radiation was measured as well. From an extensive experimental material collected by way of conductivity measurements a value of 2.0 $I/cm^3/sec$ was derived for the number of produced ions, of which 1.66 $I/cm^3/sec$ was due to cosmic radiation.

Afterwards, at the occasion of striking the balance in Amsterdam where cosmic radiation is being measured continuously, observations were made of the influence of the radiation of the soil, which was found to be 1.70 $I/cm^3/sec$ (J. Clay and M. Rutgers van der Loeff, Physica, Vol. 3, 781-796, 1936) and of that of the radioactive emanation in the air, which was recorded every 10 minutes for eight months in two arrangements with vessels of 60 L. The amount of the emanation was found to lie between 0 and $485 \cdot 10^{-18}$ Curie with an accuracy of $20 \cdot 10^{-18}$ Curie. The ionization value hereof lies between 0, 0.20, and 11.9, 0.52 $I/cm^3/sec$. If the mean values are put for the ionization by emanation at 2.30 - 6.7 I, for that by γ radiation of the soil at 1.70 I and for that by cosmic radiation at 1.66 I, their total will vary from 5.66 to 10.06 $I/cm^3/sec$.

Simultaneous measurements made in Amsterdam by Rutgers van der Loeff on the conductivity of the air gave values of 8.43 ± 0.77, 9.0, and 11.8.

Later, the total value of ionization has again been determined by an improved method. A large ionization vessel of wire netting, inside which a uniform field is maintained, has been placed in a second cage of wire netting, so that the first one can be surrounded on all sides by an electric field. The influence of a variation of the fields was tested. If the inside and the outside fields were equally strong, the ionization current in the inside cage was approximately constant. In a series of measurements with increasing fields in the inner cage, the current could be observed caused by the ions produced on the spot and at the moment by the various agents collectively. In this way a series of values was obtained in fairly good agreement with previous results: Total ionization 9.1 I/cm^3/sec with a mean deviation of 1.2 I/cm^3/sec.

ACTIONS DU RAYONNEMENT SOLAIRE DANS LA HAUTE ATMOSPHÈRE

By M. Nicolet

The complete text is published in Annales de Géophysique, Vol. 8, No. 2, pp. 141-193 (1952).

B. Terrestrial Magnetism

A PHYSICAL ANALYSIS OF THE GEOMAGNETIC SECULAR CHANGE

By F. J. Lowes and S. K. Runcorn

The complete text is published under the title "The analysis of the geomagnetic secular variation", in the Philosophical Transactions of the Royal Society, A, Vol. 243 (No. 871), pp. 525-546 (1951).

INVESTIGATION OF MAGNETIC SECULAR CHANGE IN CANADA

By R. D. Hutchison

Au cours de la préparation des cartes magnétiques du Canada on a démontré que la variation séculaire de chaque composante (X, Y ou Z) du champ magnétique s'exprime par une serie de Fourier très simple surimposée à une variation de vitesse constante. On a trouvé une période de 50 ans pour le Z et une combinaison des périodes de 400/3 et 400/6 ans pour les X et Y. Les coéfficients de Fourier et la valeur de la variation constante sont des fonctions simples de position, et on les a portées sur une carte pour la composants Z; les recherches d'X et Y ne sont pas complètes.

SECULAR VARIATION OF THE MAGNETIC FIELD AT COLABA AND ALIBAG

By S. K. Pramanik

The complete text is published in the Journal of Geophysical Research, Vol. 57, No. 3, pp. 339-355 (1952).

L'ÉTUDE DE LA VARIATION SÉCULAIRE EN BELGIQUE. CHOIX DES STATIONS ET PREMIÈRE CAMPAGNE DE MESURES

Par E. Hoge et E. Lahaye

Material bearing on this subject is contained in "Les stations de variation séculaire du réseau magnétique belge", by E. Hoge and Edm. Lahaye, Institut Royal Météorologique be Belgique Mémoires, Vol. XLIV (1951).

LES DÉPLACEMENTS ISOPORIQUES ET LEURS RAPPORTS AVEC LES PRINCIPAUX ACCIDENTS GÉOTECTONIQUES

Par C. Gaibar-Puertas

Le seul foyer isoporique positif de F est situé depuis 1880 sur le continent euroasiatique, où se trouvent les trois quarts des observatoires permanents du globe.

Après avoir choisi sept époques à des intervalles appropriés, l'auteur utilise les donneés de tous ces observatoires pour établir six cartes isoporiques se rapportant aux six décades comprises entre 1883 et 1943.

Elles prouvent que le dit foyer a éprouvé une grande expansion géographique en même temps que la valeur du gradient à son aire centrale devenait double et que celle-ci se deplasait lentement et sans interruption vers le NW.

Ces changements présentent des petites oscillations, grâce à une sorte de pulsations parties du centre isoporique, à propagation géographique très lente.

Leur vitesse de propagation diminue vers la périphérie, se trouvant conditionnée par les principaux accidents géotectoniques: elle est favorisée le long des chaînes et obstaculisée dans le sens perpendiculaire à celles-ci. Ou trouve aussi une forte adhérence des isopores aux bords des continents.

Les variations les plus intenses semblent donc en quelque rapport avec le Sial et par cette raisson l'auteur suggère la possibilité de ce qu'elles soient partiellement provoquées par un déplacement vertical des isogéothermes.

Le travail complet constituira le Mémoire n° 11 de l'Observatoire de l'Ebre.

SOME RESULTS FROM THE STATISTICAL INVESTIGATIONS OF DIURNAL VARIATIONS OF TERRESTRIAL MAGNETISM ON DATA OF THE II POLAR YEAR

By M. Hasegawa, M. Ota, and H. Maeda

The first part of this note summarizes a communication entitled "A suggestion for the electric conductivity of the upper atmosphere from an analysis of diurnal variations of geomagnetism", by M. Hasegawa and H. Maeda, published in "Report of Ionospheric Research in Japan", Vol. V, No. 4, pp. 167-178 (1951). The second part of the note concerns the communication which immediately follows.

THE DAILY MAGNETIC VARIATION IN EQUATORIAL REGIONS

By M. Hasegawa

By title

DAILY VARIATION IN DECLINATION AT RESOLUTE BAY MAGNETIC OBSERVATORY

By J. F. Clark

Les rapports d'une année, enrégistrés au variomètre la Cour, ont été mesurés et réduits. La courbe de la variation diurne a été tracée et analysée.

Trois faits significatifs en ressortent: d'abord les courbes sont des vagues cosinus commencant a 0^h L.M.T.; ensuite l'allure de la courbe a été conservée malgré une différence d'amplitude saisonnière considérable; enfin, si l'on considère la valeur de l'intensité horizontale à Resolute Bay (981 gammas) les courbes se comparent favorablement à celles des stations à plus basse latitude. L'écart moyen quotidien de la déclinaison varie de 3° 21!5 en Décembre à 11° 19!2 en Juin. La principale conclusion tirée de ces observations est que les courbes sont d'une forme périodique plus régulière qu'il avait été anticipé pour cette région.

NOTE ON A PRELIMINARY DIRECT DETERMINATION OF THE LUNAR PHASE EFFECT IN THE MAGNETIC DECLINATION AT TORTOSA

B. A. Romañá and J. O. Cardús

By title

TRACES OF RESIDUAL LUNAR EFFECTS IN GEOMAGNETIC K-INDICES

By Otto Schneider

The complete text is published in Meteoros (Buenos Aires) Ano III, No. 2/3 (April - September 1953), pp. 135-139, under the title "Rastros de un efecto lunar no eliminado en los índices k de actividad geomagnética". Also available as Publicación No. 8, Serie Geofísica, del Servicio Meteorológico Nacional, Buenos Aires, República Argentina.

MAGNETOGRAPHE ENREGISTREUR À RÉPÉTITION PHOTO-ÉLECTRIQUE

Par A. Dauvillier

By title

AIRBORNE MAGNETOMETER FOR DETERMINING ALL MAGNETIC COMPONENTS

By E. O. Schonstedt and H. R. Irons

The complete text is published in the Transactions of the American Geophysical Union, Vol. 34, No. 3, pp. 363-378 (1953).

AEROMAGNETIC SURVEYS

By George Shaw

The Geological Survey of Canada has been making aeromagnetic surveys since 1947, the chief purpose being to assist the geologists of the Survey in the mapping and interpretation of the geology of Canada. The instrument used is the modified submarine detector AN/ASQ/3A, a flux gate magnetometer which measures the total field to an accuracy of 2γ.

Since 1947 some 85,000 square miles of Canada have been surveyed entailing the flying of over 150,000 line miles of magnetic profile taking over 2000 hours of flying time.

Aeromagnetic maps on a scale of one inch to one mile are published showing by contours the variations in the earth's field.

The present paper describes in some detail the various phases of this type of surveying as presently being done in Canada by the Geological Survey. Instruments and their installation and operation are discussed together with methods of survey procedure. Compilation and plotting techniques are described and followed through to the final contour map.

Maps of certain typical areas are compared with the known geology of those areas in an attempt to show the value of this type of survey to the geologist and prospector.

AEROMAGNETIC SURVEY OF VERTICAL INTENSITY OVER THE SOUND WITH APPARATUS OF THE BMZ TYPE

By Asger Lundbak

The complete text is published in Tellus, Vol. 3, No. 2, pp. 69-74 (1951).

PRELIMINARY REPORT ON SWEDISH-FINNISH GEOMAGNETIC MEASUREMENTS IN THE BOTHNIAN GULF FROM THE SURVEYING VESSEL "KOMPASS"

By N. Ambolt and E. Sucksdorff

In 1939 there was started a cooperative work between the Finnish Meteorological Office and the Swedish Hydrographic Office to carry out a geomagnetic survey of the Gulf of Bothnia, using the nonmagnetic Swedish surveying vessel "Kompass". This work was interrupted by the second world-war but has been taken up and completed in 1950. In all 126 points have been measured. The instruments used were: for D an ordinary compass with shadow pin, for H a Bidlingmaier double-compass and for Z a special instrument devised by Professor Ising, Stockholm, and earlier used at the measurements further to the south carried out by Dr. Ljungdahl. Acting observers have been from Finland, Dr. Sucksdorff, and from Sweden, Dr. Ljungdahl, Mag. Åslund, Dr. Ambolt, and Ass. Borg. In the year 1950 also continuous readings under way of magnetic declination were obtained, when the weather conditions allowed. The observations clearly show that the Gulf is a rather disturbed area and therefore, in order to get a satisfactory picture of the geomagnetic conditions prevailing there, a far denser net of observation points is required. The results of the survey will soon be published in the Finnish Erdmagn. Untersuchungen and in the Swedish Jordmagn. Publikationer.

UNE ANNÉE D'ENREGISTREMENT DES VARIATIONS RAPIDES DU CHAMP MAGNÉTIQUE TERRESTRE À TAMANRASSET

Par G. Grenet

Pour effectuer de tels enregistrements les procédés qui viennent d'abord à l'esprit sont: l'utilisation d'une boucle, l'utilisation d'une cellule photo-électrique recevant un flux lumineux réfléchi par le miroir d'un magnétomètre et enfin le concentrateur de champ, parce qu'il a déjà été préconisé par certains expérimentateurs. La boucle n'a pas été retenue parce qu'elle se prête difficilement à la mesure de la composante horizontale prépondérante à Tamanrasset. Les deux autres précédés ont été expérimentés, mais leur mise au point présentait des difficultés, surtout à Tamanrasset. C'est alors que j'ai recherché s'il était possible d'obtenir une sensibilité suffisante au moyen d'un appareil ainsi construit: Un aimant de magnétomètre est entouré d'un bobinage; les courants induits dans le bobinage par les mouvements de l'aimant sont envoyés dans un galvanomètre. Les calculs ayant montré que la sensibilité était suffisante, J. CASTET a d'abord construit en 1949 un appareil d'essai avec des moyens de fortune. Maintenant nous en construisons d'autres d'un emploi plus aisé pour l'enregistrement de la composante horizontale et de la déclinaison. Un modele est à l'étude pour la composante verticale.

On se reportera aux articles déjà publiés pour plus de détails sur ces appareils. Je dirai ici que leur sensibilité varie comme la racine carrée des dimensions linéaires de l'aimant et comme l'inverse de la racine carrée du moment d'inertie de l'équipage mobile du galvanomètre.

L'appareil enregistre la dérivée des variations du champ magnétique terrestre dH/dt pour les périodes supérieures aux périodes propres de l'appareil. Dans le cas de l'enregistreur utilisé à Tamanrasset cette sensibilité était de 10^{-6} gauss/seconde pour 1^{m},7, lorsque la période des variations est supérieure à 6 secondes, la vitesse d'enregistrement utilisée est 8 mm par minute.

Les variations rapides du champ magnétique terrestre ont été observées depuis longtemps mais je n'ai pas connaissance de beaucoup d'enregistrements effectués pendant plus de quelques mois, je pense donc utile de donner ici les caractéristiques principales des enregistrements de Tamanrasset.

(A) Les variations qui paraissent brusques sur nos enregistreurs lents (11' mm par heure) correspondent en général à des oscillations plus ou moins régulières ayant une période de l'ordre de 5 minutes. A l'échelle de notre enregistrement il s'agit donc de variations très lentes auquelles peuvent ou non être superposées des oscillations plus ou moins régulières de période de quelques dizaines de secondes. Cette remarque s'applique à Tamanrasset, ausi bien aux observations de nuit qu'aux observations de jour. Ceci n'est pas en accord avec les résultats obtenus au Japon par Y. KATO et S. UTASHIRO. D'après ces auteurs les oscillations associées aux variations brusques existeraient seulement le jour.

(B) Des oscillations régulières d'une période de vinge à trente secondes paraissent en relation certaine avec celles observées pour les courants telluriques par SCHLUMBERGER et KUNETZ et présentent le même caractère que ces courants: maximum le matin, minimum la nuit.

(C) Un phénomène oscillatoire amorti est apparu dès les premiers enregistrements. La période des oscillations étant aussi de l'ordre de 30 secondes.

(D) Enfin on observe aussi des oscillations de période plus courte, 10 secondes environ, qui apparaissent aussi bien de jour que de nuit, elle sont probablement de même nature que celles signalées pour les courants telluriques par SCHLUMBERGER et KUNETZ.

Conclusions--Les phénomènes B et C présentent une variation diurne extrêmement nette qui permet de penser à une influence des couches ionisées de la haute atmosphère. Les phénomènes A et D au contraire sont peu sensibles à l'heure.

Il serait essentiel de disposer d'enregistrements des variations rapides du champ magnétique terrestre du des régions variées du Globe parce qu'il est fort probable qu'elles ne se présentent pas de la même façon dans les divers lieux.

GRENET, G., Variomètre électromagnétique pour l'enregisment des variations rapides du champ magnétique terrestre. Ann. de Géophysique, t. 5 - 1949, p. 188.

CASTET, J., Variomètre électromagnetique type A. Ann. de Géophysique, t. 5, 1949, p. 214.

SCHLUMBERGER et KUNETZ, Observations sur les variations rapides des courants telluriques. Union Géodésique et Géophysique internationale. Association of Terrestrial Magnetism and Electricity. Transactions of Oslo Meeting, p. 518.

KATO, Y., et UTASHIRO, S., Sciences reports. Tôhoku University, first serie Geophysics, Vol. 2, no. 1, Mars 1950, p. 51.

Il m'est agréable de remercier ici tous mes collègues de l'Institut de Météorologie et de Physique du Globe de l'Algérie qui ont contribue à ce travail et plus particulièrement ceux qui à Tamanrasset assurent la bonne marche de l'Observatoire, dans des conditions souvent difficiles.

RECENT ANNUAL MAGNETIC VALUES AT WORLD WIDE OBSERVATORIES

By H. F. Johnston

The complete text is published in the Journal of Geophysical Research, Vol. 56, No. 3, pp. 431-438 (1951) under the title, "List of geomagnetic observatories and thesaurus of values".

LA DISTRIBUTION DU MAGNÉTISME TERRESTRE DANS L'EST DE LA BELGIQUE. SES RAPPORTS AVEC LA GÉOLOGIE, LA GRAVIMÉTRIE ET LA SÉISMOLOGIE

Par E. Hoge

Lors de l'Assemblée d'Oslo en 1948, nous avons présenté une note intitulée: "Essai d'interprétation géologique des anomalies magnétiques décelées dans l'Est de la Belgique". Ce travail a été poursuivi et nous espérons pouvoir le mener bientôt à bonne fin.

Notre brève communication a uniquement pour but de signaler le sens dans lequel nous orientons notre étude. Lorsque le calcul des anomalies de la composante verticale du champ magnétique terrestre sera terminé, nous dresserons la carte des isanomales pour toute la partie Est du territoire belge. Nous nous proposons alors de comparer cette carte avec les données de la géologie et de la géophysique (notamment la gravimétrie et la séismologie).

En 1950, au cours du Congrès National des Sciences qui s'est tenu à Bruxelles, MM. Charlier, Fourmarier, Jones et nous-même avons présenté une note intitulée: "Les mouvements récents du sol de la Belgique et les enseignements qu'ils apportent dans le domaine de la géophysique."

Cette étude nous avait permis d'établir quelques comparaisons intéressantes entre les diverses cartes géologiques et géophysiques de la Belgique. Rappelons notamment les constatations suivantes:

1.- La coincidence des aires pléistoséistes avec les aires d'anomalies magnétiques positives maxima.
2.- La plupart des zones en surrection affectées par des anomalies magnétiques positives.
3.- En général, présence d'anomalies magnétiques positives là où les anomalies de Bouguer sont négatives et vice versa.
4.- Les axes des anticlinaux jalonnés par des anomalies magnétiques positives et les axes des synclinaux soulignés par des anomalies magnétiques négatives etc.

Il semble donc y avoir une liaison étroite entre ces divers phénomènes. L'étude détaillée de ces relations présente certainement un très vif intérêt en vue d'obtenir des renseignements sur la structure du profond sous-sol. Disposant pour l'Est de la Belgique d'un réseau de stations environ 10 fois plus dense que pour la carte magnétique de l'ensemble du pays, nous espérons pouvoir serrer le problème de plus près et tirer des conclusions qui seront susceptibles d'intéresser à la fois les géologues et les géophysiciens.

MAGNETIC SURVEY IN JAPAN

The complete text,prepared by the Geographic Survey Institute, is published in the Journal of Geomagnetism and Geoelectricity (Kyoto), Vol. II, No. 3, pp. 89-93 (1950).

SUR LE CARACTÈRE GÉNÉRAL DE LA LOI DE CLASSIFICATION DES BAIES GÉOMAGNÉTIQUES POUR LES LATITUDES MOYENNES

Par A. Romañá

La loi de classification et distribution le long du jour des baies géomagnétiques à Tortosa a été publiée dans la collection de Mémoires de l'Observatoire de l'Ebre, No. 10 (1949). Ce Mémoire contient aussi le catalogue des baies à partir de 1913.

L'extension de la loi aux observatoires Mexicains de Cuajimalpa et Teoloyucan a paru dans la revue "Geofisica Pura e Applicata", Vol. XVIII (1950). Le tirage à part constitue le No. 7 de la collection de Mélanges de l'Observatoire de l'Ebre.

Finalement l'étude des modifications saisonnières de la distribution diurne des baies, de leur distribution annuelle et des baies simultanément enregistrées au Mexique et à Tortosa, se trouve dans la revue "Las Ciencias", de Madrid, Vol. XVI (1951). Elle paraîtra aussi dans les Comptes-Rendus du Congrès de Lisbonne (1950) de l'Association Portugaise pour l'Avancement des Sciences.

L'auteur fait remarquer l'utilité de la connaissance des types des baies pour la détermination des systèmes de courants ionosphériques responsables de leur apparition, et la convenance, pour cela, d'étendre l'étude à un nombre plus grand de stations et tout particulièrement à quelques-uns où les baies de Z soient plus nettes et nombreuses qu'aux endroits étudiés jusqu'à présent.

GEOMAGNETIC ACTIVITY CHARACTERIZED BY THE K-INDICES

By M. Ota

The complete text is published in the Journal of Geomagnetism and Geoelectricity (Kyoto), Vol. II, No. 3, pp. 86-88 (1950).

CORRÉLATION ET RECURRENCE DE L'ACTIVITÉ DES COURANTS TELLURIQUES ET DU CHAMP MAGNÉTIQUE

Par G. Kunetz

The period investigated goes from August to December 1950. A good correlation has been found (1) between the daily mean intensities of the rapid variations (period ~ one minute) of the telluric currents in France, North Africa, Gabon and Madagascar, and (2) between the overall averages of these intensities and the daily magnetic character figures at Chambon-la-Forêt. In both cases the coefficients of correlation range from 0.50 to 0.90 for series of 50 to 175 observations.

The recurrency of the earth-current intensities has been investigated by calculating the correlation r between the intensity of day J and that of day J + N, with the following results:

N	25	26	27	28	29	30
r	0.10	0.31	0.48	0.50	0.35	0.04

Based on this recurrency an attempt to predict the earth-current activity has been made with fairly good results.

During the whole period the percentages of calm, medium, and disturbed days were respectively 55%, 29%, and 17%, while the percentage of calm days among those predicted as calm was 83%, the corresponding percentages for medium and disturbed days being 55% and 72%.

SUR LES PERTURBATIONS MAGNÉTIQUES À MOGADISCIO

Par M. Bossolasco

The complete text is published in Geofisica Pura e Applicata (Milano), Vol. XX, pp. 46-49 (1951).

INVESTIGATION OF THE MAGNETIC STORM BY THE INDUCTION MAGNETOGRAPH

By Y. Kato and S. Utashiro

The complete text is published in the Journal of Geomagnetism and Geoelectricity (Kyoto), Vol. II, No. 3, pp. 71-73 (1950).

THE ELECTRICAL STATE OF THE EARTH'S INTERIOR AS INFERRED FROM VARIATIONS OF THE GEOMAGNETIC FIELD

By T. Rikitake

The author has published an article on this subject in four parts. The complete text is found in the Bulletin of the Earthquake Research Institute (Tokyo); Part I, Vol. 28, pp. 45-100 (1950); Part II, Vol. 28, pp. 219-283 (1950); Part III, Vol. 29, pp. 61-69 (1951); Part IV, Vol. 29, pp. 539-547 (1951).

RÉSULTATS NOUVEAUX DANS LA RECHERCHE DU CHAMP MAGNÉTIQUE FOSSILE; ÉPOQUE ROMAINE ET MOYEN-ÂGE

Par O. Thellier
By title

RESIDUAL MAGNETIC MOMENT IN CLAYS AND SEDIMENTARY ROCKS

By J. W. Graham and H. E. Tatel

Johnson and Murphy constructed a sensitive rotating magnetometer for the measurement of the remanent moment in varved clays. Their apparatus was most successful for the clays and some sedimentary rocks, but the limit of sensitivity of 10^{-6} cgs unit per cc was not high enough to measure many hard rock samples. Hence a new instrument was devised and built in early 1950 in which sensitivity was gained by increasing the speed of rotation of the sample from 10 cps to 270 cps. The rotating system, in the form of a Beams' air turbine, was constructed of methyl-methacrylate (lucite), thereby eliminating all metal in the rotating system. The limit of sensitivity was increased twenty-fold and all residuals eliminated. Thus Graham and Torreson were enabled to measure the remanent magnetic moments in flat-lying sedimentary rocks in regions to the west and north of the Appalachians.

The results are that rocks so far sampled in the flat-lying regions have residual magnetic vectors spreading over a considerable portion of the northern magnetic hemisphere, but with the general direction along the earth's present magnetic field. These samples of Ordovician, Silurian, and Devonian rock have moment directions considerably different than those of the Silurian rocks in the folded Appalachians. The latter contain magnetic vectors (after graphical unfolding back to the flat condition) which point in many directions, some of which persist in similar strata over more than 300 km. However, on different sides of the folds the aggregate picture of all moments is different. This large divergence of the moments is in itself proof of the stability of the remanent moment, while stability of the flat-lying rocks is yet to be firmly established.

The measurement of the tensor of magnetic susceptibility, or the direction of easiest magnetization, of these samples was undertaken. The hope was that the original magnetic particles would have a greater dimension associated with greatest ease in magnetization. A 400-cycle bridge and amplifier were connected to a coil in such a manner that as the sample rotated slowly within the coil, changes in the east of magnetization could be observed. The apparatus could detect 10^{-7} cgs unit/cc of susceptibility. Many samples were found to be anisotropic up to several per cent of their total susceptibility. The most interesting samples measured by Bhattacharya were in a set taken by Graham from a Silurian fold. In these samples Graham has shown that, although the present remanent magnetizations of the rocks diverge considerably, after rotating the samples back to the position before folding all the magnetic vectors fall within a circle of about 25° diameter. Bhattacharya found the same results for the susceptibility, thereby showing that this rock was not fortuitously magnetized and that the magnetic properties were most probably a property of the original rock grains.

RECENT PROGRESS IN PALAEOMAGNETISM IN JAPAN

By N. Kumagai, N. Kawai, and T. Nagata

The complete text is published in the Journal of Geomagnetism and Geoelectricity, Vol. II, No. 3, pp. 61-65 (1950).

MAGNETIC DECLINATION COMPUTED FROM VERTICAL INTENSITY

By Asger Lundbak

The complete text is published under the title "Calculation of magnetic declination and horizontal intensity on the basis of the vertical intensity", in Geofisica Pura e Applicata (Milano), Vol. XX, pp. 31-45 (1951).

QUICK-RUN MAGNETIC RECORDS AT ALIBAG DURING SEPTEMBER 12, 1950, DAY OF SOLAR ECLIPSE OVER NORTH PACIFIC

By S. L. Malurkar and A. S. Chaubal

With the usual rate of run of magnetic recording instruments it is difficult to detect the small effects due to phenomena like the solar eclipse, particularly when the path of the eclipse is far away. When a quick run instrumental arrangement is set up (180 mm per hour) the linear extension of the magnetometers makes the curves appear almost straight lines and sharp changes stand out.

The time of central eclipse was from $02^h\ 50.1^m$ to $04^h\ 27.0^m$ GMT. In the horizontal magnetic record there is a fall of about 6γ between $12^h\ 16^m$ and $12^h\ 34^m$ GMT, which appears to be connected with the day's eclipse.

QUICK-RUN MAGNETIC RECORDS DURING STORMS JANUARY 1949, MAY 1949, AND DECEMBER 1950

By S. L. Malurkar and A. S. Chaubal

It would be interesting to study in slightly greater detail than usual the onset of magnetic storms which are described as "sudden commencement ones". In the usual 15 mm/hr records, hardly any details can be observed in the commencement stage. Due to economic considerations it will not be possible to have quick run records all the time to be able to study how sudden these commencements are. Some attempts were made to have quick run records in 1949-50 on some particular days. Among them some interesting records were obtained in connection with the magnetic storms of January 1949, May 1949, and December 1950. A description of the records is given in the paper.

EARTH'S MAGNETIC FIELD DAMPED RAPID VARIATIONS AT TAMANRASSET

By J. L. Bureau

By title

C. Upper atmosphere and ionosphere

LABORATORY STUDIES RELATED TO THE PHYSICS OF THE UPPER ATMOSPHERE

By J. Kaplan

The complete text is published in Mémoires de la Société Royale des Sciences de Liege, Tome XII, Fasc. I-II, pp. 295-302 (1952).

A RELATION BETWEEN DIFFUSION AND ELECTRICAL CURRENTS

By M. H. Johnson

The complete text is published under the title of "The relation between electrical and diffusion currents", in the Journal of Geophysical Research, Vol. 57, No. 3, pp. 405-412 (1952).

A SUGGESTION FOR THE ELECTRIC CONDUCTIVITY OF THE UPPER ATMOSPHERE FROM AN ANALYSIS OF DIURNAL VARIATIONS OF TERRESTRIAL MAGNETISM

By M. Hasegawa and H. Maeda

The complete text is published in Report of Ionosphere Research in Japan (Tokyo), Vol. V, No. 4, pp. 167-178 (1951).

CIRCULATORY MOTIONS IN THE IONOSPHERIC ATMOSPHERE AND THEIR RELATION TO THE S FIELD OF TERRESTRIAL MAGNETISM, III

By S. Matsushita

The complete text is published in the Journal of Geomagnetism and Geoelectricity (Kyoto), Vol. II, No. 1, pp. 9-19 (1950).

ELECTRO-DYNAMICAL BEHAVIOR OF THE IONOSPHERE REGION VIEWED FROM GEOMAGNETIC VARIATIONS

By T. Nagata, N. Fukushima, and M. Sugiura

The complete text is published in the Journal of Geomagnetism and Geoelectricity (Kyoto), Vol. II, No. 2, pp. 35-44 (1950).

RELATIONS ENTRE L'AGITATION MAGNETIQUE ET L'IONISATION DES HAUTES COUCHES DE L'ATMOSPHÈRE

Par G. Billaud

By title

D. Atmospheric and terrestrial electricity, cosmic rays, and solar and terrestrial relationships

DETERMINATION OF THE MOON'S INFLUENCE ON THE EARTH CURRENTS BY THE CHAPMAN-MILLER METHOD

By A. Romañá and J. O. Cardús

At the Oslo Meeting of the IUGG the Ebro Observatory (Tortosa) presented a paper on the influence of the moon on the earth currents. A direct method was used, directly measuring our records divided into lunar time. A striking feature of the results was the non-appearance of the phase-law.

Now we have worked out the same years by the Chapman-Miller method. The compared results are as follows:

n	c_n		λ_n	
	d	C-M	C-M	d
	mv/km	mv/km	°	°
1	0.14	0.32 ± 0.11	95	346
2	3.06	3.18 ± 0.16	219	0
3	0.05	0.40 ± 0.13	84	256
4	0.11	0.08 ± 0.09	1	206

In both methods appears the outstanding importance of the second harmonic and the perfect coincidence of its amplitude. The amplitudes of the other harmonics do not show any particular relationship. In particular, it is worthwhile remarking the importance of the third harmonic in the C-M method against the small value in the direct method. The discrepancies in the phases have not yet been accounted for, but further investigations in these lines are under way.

Neither the direct nor the C-M method shows for the particular days of the lunation the increase of amplitude during the daylight hours as stated by the phase-law. The cause may be the small amplitude of all harmonics but the second one.

CHAMP ÉLÉCTRIQUE DE LA TERRE

Par E. Medi

By title

THE DIURNAL VARIATION OF ATMOSPHERIC ELECTRICITY AS A METEOROLOGICAL-AEROLOGICAL PHENOMENON

By H. Israel

The complete text is published in the Journal of Meteorology, Vol. 9, No. 5, pp. 328-332 (1952).

THUNDERSTORMS - THE ELECTRIC-FIELD VARIATIONS AS RADIATED FROM LIGHTNING DISCHARGES

By H. Norinder

Material bearing on this subject is contained in the paper by the same author entitled "Variations of the electric field in the vicinity of lightning discharges", in Arkiv for geofysik (Stockholm), Band 1, Nr. 20, pp. 543-570 (1952).

SOME RECENT RESULTS OF INVESTIGATIONS OF THE ATMOSPHERIC ELECTRICITY AT THE INSTITUTE OF HIGH-TENSION RESEARCH OF THE UNIVERSITY OF UPPSALA

By H. Norinder

By title

DISTRIBUTION OF ELECTRICITY IN THUNDERCLOUDS

By Y. Tamura

By title

ON THE ELECTRICAL CONDUCTIVITY OF THE UPPER ATMOSPHERE

By K. Maeda

The complete text is published in the Journal of Geomagnetism and Geoelectricity (Kyoto), Vol. II, No. 2, pp. 45-53 (1950).

A METHOD OF MEASURING THE ION SPECTRUM

By M. Misaki

The complete text is published in Papers in Meteorology and Geophysics (Tokyo), Vol. I, No. 2-4, pp. 313-318 (1950).

ON THE DISTURBANCE OF THE ATMOSPHERIC POTENTIAL GRADIENT CAUSED BY THE ERUPTION SMOKE OF THE VOLCANO ASO

By H. Hatakeyama and K. Uchikawa

The complete text is published in Papers in Meteorology and Geophysics (Tokyo), Vol. II, No. 1, pp. 85-89 (1951).

ON THE DIURNAL VARIATION OF COSMIC RAYS: PART II, ANNUAL CHANGE OF COSMIC-RAY DIURNAL VARIATION

By Y. Sekido and S. Yoshida

The complete text is published in the Journal of Geomagnetism and Geoelectricity (Kyoto), Vol. II, No. 3, pp. 66-70 (1950).

THE ELECTRICAL CONDUCTIVITY OF THE EARTH'S MANTLE

By H. Hughes

Chapman and Price have shown that the electrical conductivity of the mantle increases rapidly at a depth of about 600 km. It is shown that the explanation of this as ionic conductivity is unsatisfactory but that at these depths olivine is likely to be an intrinsic semi-conductor. From the data the excitation energy of the conducting process must be in the neighborhood of 4 ev, which agrees well with the value of 3.7 ev obtained from the ultra-violet absorption spectrum. This appears to be much too low a value for Ramsey's theory of the constitution of the earth's core. The work enables the approximate conductivities down to the core boundary to be given and puts limits on the temperature gradients possible in the mantle. Methods of determining the conductivity of olivine and similar rocks experimentally will be described.

UN NOUVEL ÉLECTROMÈTRE PORTATIF ET SON APPLICATION À LA RADIOSONDE

Par L. Koenigsfeld et Ph. Piraux

The complete text is published by the same authors under the title "Un nouvel électromètre portatif pour la mesure des charges électrostatiques par système électronique. Son application à la mesure du potentiel atmosphérique et à la radiosonde", in Institut Royal Météorologique de Belgique Mémoires, Vol. XLV (1951).

CONTRÔLE DE L'ACTIVITÉ GÉOMAGNÉTIQUE PAR LES CENTRES D'ACTIVITÉ SOLAIRE DISTINGUÉS PAR LEURS PROPRIÉTÉS RADIO-ÉLECTRIQUES

Par J. F. Denisse, J. L. Steinberg et S. Zisler

The complete text is published in Academie des Sciences, Paris, Comptes Rendus, Vol. 232 (25), pp. 2290-2292 (1951).

QUELQUES RÉSULTATS D'OBSERVATIONS FAITES AVEC LE CERAUNOGRAPHE DANS L'ITALIE DU NORD

Par M. Bossolasco

The complete text is published under the title "Quelque résultats d'observation des décharges atmosphériques dam l'Italie du Nord", in Geofisica Pura e Applicata (Milano), Vol. XX, pp. 181-182 (1951).

A PROPOS DE L'EFFICACITÉ DU PARATONNERRE

Par J. Bricard et C. Ledoux

The complete text is published in Annales de Géophysique, Vol. 7, No. 4, p. 275 (1951).

A NOTE ON A COMPARISON BETWEEN WULF'S NUMBERS AND THE NUMBER OF SOLAR FLARES OVER TWO SUNSPOT CYCLES, BASED ON DATA OBSERVED NEAR PARIS

By R. Bureau

By title

A NOTE ON THE USE OF LIGHT IMPULSES TO MEASURE CLOUD HEIGHTS IN FULL DAYLIGHT

By R. Bureau

By title

CENTRES RADIOACTIFS DANS DES COMPOSÉS DU FER

Par A. Hee

Nous avons été conduits à mesurer la susceptibilité magnétique de deux roches dont nous avions localise les centres radioactifs pour deux raisons.

(1) Parce que l'une de ces roches a un assez grand pouvoir d'émanation (PE) à la température ordinaire, c'est à dire que le rapport de la quantité d'émanation qu'elle dégage à une température donnée à la quantité totale d'émanation formée est assez grand. Or, il y a une relation entre le (PE) et les propriétés magnétiques d'une substance en ce sens qu'ils dependent de la structure de cette substance. Ainsi, la comparison pour certains oxydes de fer des courbes de variation du (PE) et de l'aimantation en fonction de la témperature établit une coincidence entre leur point de Curie et le maximum de (PE).

(2) Parce que la localisation des centres radioactifs de ces roches montre que ceux-ci se trouvent en trés grand nombre dans des composés du fer.

La mesure de la susceptibilité magnétique nous a permis de conclure pour la rhyolite du Rosskopf (Vosges), de susceptibilité $4.3 \cdot 10^{-3}$, que les centres se trouvent non seulement dans le fer oligiste et la limonite, mais encore dans des titanomagnétites plus ou moins ferromagnétiques. Tandis que les centres du granite de Raon-l'Etape, de susceptibilité $0.07 \cdot 10^{-3}$, sont associes fréquemment non à de la magnétite mais à de l'ilménite qui est paramagnétique.

PART VI

RESOLUTIONS AND COMMITTEES

A--RESOLUTIONS OF THE ASSOCIATION

(1) Guide for Magnetic Work: The Association of Terrestrial Magnetism and Electricity recommends the proposal by the Fifth General Assembly of the Pan-American Institute of Geography and History as a guide for magnetic work, especially in lower and medium magnetic latitudes. Details of the proposal may have to be altered to suit the different geophysical and financial conditions prevailing in the respective countries. These changes must be left to the judgment of those who are in actual charge of the work.

(1) Guide pour les Travaux Magnétiques: L'Association de Magnétisme et Electricité Terrestres recommande que la proposition de la Cinquième Assemblée Générale de l'Institut Panaméricain de Géographie et d'Histoire serve de guide pour les travaux magnétiques, spécialement aux latitudes magnétiques basses et moyennes, les détails de la proposition pouvant être modifiés d'après les conditions géophysiques et économiques de chaque pays. Ces modifications doivent être laissées au jugement des organismes s'occupant actuellement de ces travaux.

(2) Observational and Instrumental Standards: The Association of Terrestrial Magnetism and Electricity recommends that, in submitting their reports to the Association, National Committees be urged to include a statement indicating the degree to which the various recommendations of the Association concerning observational standards, control of variometer-magnet orientation, and related subjects have been followed.

(2) Normes en Matière d'Observation et d'Instruments: L'Association de Magnétisme et Electricité Terrestres recommande que, dans la présentation de leurs rapports à l'Association, les Comités Nationaux soient invités à inclure une déclaration indiquant jusqu'à quel degré ils ont suivi les différentes recommandations de l'Association en ce qui concerne les normes en matière d'observation, le contrôle de l'orientation des aimants de variomètres et sujets connexes.

(3) Observatory Instrumentation at High Latitudes: The Association of Terrestrial Magnetism and Electricity recommends that observatories in geomagnetic latitudes of 50° or more should be equipped with QHM and BMZ instruments for determination of H and Z base-line values and for frequent comparisons with a base observatory, and urges that this be done in all cases before the next Assembly of the Association in 1954.

(3) Equipement des Observatoires situés à une Latitude Elevée: L'Association de Magnétisme et Electricité Terrestres recommande que les observatoires situés à des latitudes géomagnetiques égales ou supérieures à 50° soient équipés avec des appareils QHM et BMZ pour déterminer les valeurs des lignes de base de H et de Z et pour effectuer de fréquentes comparaisons avec un observatoire de base; elle insiste pour que cette recommandation soit suivie dans tous les cas avant la prochaine Assemblée de l'Association en 1954.

(4) Expressions of Thanks for Special Magnetic Observations: The Association of Terrestrial Magnetism and Electricity expresses its thanks

(a) to the Office de la Recherche Scientifique Outre-Mer for valuable magnetic observations taken in Togoland in 1949 and 1950, hoping for a continuation of the work;

(b) to the Geophysical Institute of Huancayo for magnetic measurements in South America along a line 2000 kilometers long, thereby giving important scientific information;

(c) to Observatorio del Ebro for magnetic measurements made in Spanish Guinea;

(d) to the Geodetic and Research Branch, Survey of India, for important magnetic observations obtained in southern India; and

(e) to the Philippine Weather Bureau for magnetic observations made at the magnetic equator.

(4) Expressions de Gratitude pour la Réalisation d'Observations Magnétiques Spéciales: L'Association de Magnétisme et Electricité Terrestres exprime sa reconnaissance:

(a) à l'Office de la Recherche Scientifique Outre-Mer pour les importantes observations magnétiques réalisées au Togo en 1949 et 1950 et elle souhaite que les travaux y soient continués;

(b) à l'Institut Géophysique de Huancayo pour les mesures magnétiques exécutées en Amérique du Sud sur une ligne de 2000 Km de longueur, ces mesures ayant fourni des renseignements scientifiques de grande valeur;

(c) à l'Observatorio del Ebro pour les mesures magnétiques faites en Guinée Espagnole;

(d) au Survey of India, Geodetic and Research Branch, pour les importantes observations magnétiques réalisées dans l'Inde méridionale; et

(e) au Philippine Weather Bureau pour les observations magnétiques réalisées sur l'équateur magnétique.

(5) Magnetic Observatories along the Magnetic Equator: The Association of Terrestrial Magnetism and Electricity recommends that a magnetic observatory be established at the magnetic equator in the northern hemisphere, for instance, at Tinnevelly, India, and that the desirability of establishing a magnetic observatory where the geographic and magnetic equators coincide (Jarvis Island) be examined.

(5) Observatoires Magnétiques sur l'Equateur Magnétique: L'Association de Magnétisme et Electricité Terrestres recommande l'établissement d'un observatoire magnétique sur l'équateur magnétique dans l'hémisphère nord, par exemple à Tinnevelly, Inde, et elle souhaite que soit pris en considération l'établissement d'un observatoire magnétique à l'endroit où les équateurs géographique et magnétique coïncident (Ile Jarvis).

(6) Measures for the Intensity of Magnetic Disturbances: The Association of Terrestrial Magnetism and Electricity adopts, as measures for the intensity of magnetic disturbances in three-hour intervals, the K-index to describe the local conditions, and the principle of the planetary index Kp to describe the level of magnetic activity for the earth as a whole.

(6) Mesures de l'Intensité des Perturbations Magnétiques: L'Association de Magnétisme et Electricité Terrestres adopte comme mesure de l'intensité des perturbations magnétiques, pendant les intervalles trihoraires, l'indice K pour décrire les conditions locales; elle adopte le principe de l'indice planétaire Kp pour décrire le niveau d'activité magnétique de la Terre dans son ensemble.

(7) Meteorological Service of Portugal: The Association of Terrestrial Magnetism and Electricity encourages the efforts of the Meteorological Service of Portugal for the establishment of two new magnetic observatories near Luanda and Lourenço Marques. It believes that well-operated magnetic, electric, and ionospheric stations at these two locations would be most desirable.

(7) Service Météorologique du Portugal: L'Association de Magnétisme et Electricité Terrestres voit avec satisfaction les efforts du Service Météorologique du Portugal pour établir deux nouveaux observatoires magnétiques près de Luanda et Lourenço Marques. Elle estime que des stations magnétiques, électriques et ionosphériques situées en ces deux endroits et fonctionnant efficacement pourraient être de très grande utilité.

(8) "World Days": Having considered the propositions of the Joint Commission on High-Altitude Research Stations regarding the adoption of "World Days",

(a) The Association of Terrestrial Magnetism and Electricity approves the ideas expressed in this proposal concerning the making of non-routine observations and the analysis of routine data at (1) new moon: two days, and (2) full moon: one day. These days might be called "regular World Days".
(b) The Association of Terrestrial Magnetism and Electricity suggests that rocket firings should be scheduled for optimum geophysical conditions in the light of the principal scientific purposes of the experiment. For example, in some cases a magnetically quiet day is required, in which case the astronomical criteria of paragraph (a) may not be pertinent. Days of launching of rockets, solar eclipses, or other sporadic events may be termed "special World Days".
(c) The Association of Terrestrial Magnetism and Electricity recommends that the scheduled date for the firing of a rocket should be communicated to interested parties in advance, in order to facilitate the execution of simultaneous observations. In case of a delay, the new date should be communicated.
(d) The Association of Terrestrial Magnetism and Electricity feels that there is no mechanism for the execution of the full program by the International Union of Geodesy and Geophysics alone. It recommends that the proposition on "World Days" by the Joint Commission on High Altitude Research Stations be transmitted to the World Meteorological Organization, requesting their assistance, particularly in the acquisition of increased radiosonde data; and to the International Scientific Radio Union for cooperation in ionospheric studies during regular or Special World Days.

(8) "Jours mondiaux": Ayant pris connaissance des propositions de la Commission Mixte des Stations de Recherches en Hautes Altitudes relatives à l'adoption des "jours mondiaux",

(a) L'Association de Magnétisme et Electricité Terrestres approuve les idées exprimées dans cette proposition relativement à l'exécution d'observations non habituelles et à l'analyse des données régulières pendant (1) deux jours à la nouvelle lune, (2) un jour à la pleine lune. Ces jours pourraient prendre le nom de "jours mondiaux ordinaires".
(b) L'Association de Magnétisme et Electricité Terrestres suggère que les tirs de fusées soient prévus dans les meilleures conditions géophysiques possibles, compte tenu des buts scientifiques principaux

de l'expérience. Par exemple, dans certains cas un jour de calme magnétique est nécessaire et dans ce cas les critères astronomiques du paragraphe (a) peuvent ne pas convenir. Les jours de tir de fusées, d'éclipse solaire et d'autres événements sporadiques, peuvent être dénommés "jours mondiaux spéciaux".

(c) L'Association de Magnétisme et Electricité Terrestres recommande que la date choisie pour le tir d'une fusée soit communiquée à l'avance à tous les services intéressés, de façon à faciliter l'exécution d'observations simultanées. En cas de retard la nouvelle date devrait être communiquée.

(d) L'Association de Magnétisme et Electricité Terrestres pense qu'il n'existe pas d'organisme approprié pour l'exécution du programme complet par l'U.G.G.I. seule. Elle recommande que l'on transmette la résolution relative aux "jours mondiaux" de la Commission Mixte des Stations de Recherches en Hautes Altitudes à l'O.M.M. en demandant sa collaboration, particulièrement pour augmenter le nombre de radiosondages, et à l'U.R.S.I. pour sa coopération aux études ionosphériques, pendant les jours mondiaux ordinaires et spéciaux.

(9) <u>27-Day Numeration:</u> The Association of Terrestrial Magnetism and Electricity recommends the use in time patterns of geophysical data of the 27-day numeration (already much used) whose sequence No. 1601 began with 20 May 1950, and further recommends that the same 27-day numeration be also used in time patterns of solar data constructed for comparison with geophysical time patterns.

(9) <u>Numération par 27 Jours:</u> L'Association de Magnétisme et Electricité Terrestres recommande dans la chronologie des données géophysique l'emploi de la numération par 27 jours (actuellement très en usage), dont la séquence No. 1601 a commencé le 20 mai 1950; elle recommande en outre que la même numération par 27 jours soit aussi employée dans la chronologie des données solaires établie pour comparaison avec la chronologie géophysique.

(10) <u>Magnetic Observations in Regions of Isoporic Foci:</u> In view of the importance of following the movements of isoporic foci, the Association of Terrestrial Magnetism and Electricity recommends the establishment of additional magnetic repeat stations in regions of rapid changes, and further recommends more frequent observations of the magnetic elements at all repeat stations in such areas.

(10) <u>Observations Magnétiques dans les Régions à Foyers Isoporiques:</u> Considérant l'importance de l'étude du déplacement des foyers isoporiques, l'Association de Magnétisme et Electricité Terrestres recommande l'établissement de stations magnétiques de répétition supplémentaires dans les régions à changements rapides, et recommande en outre l'exécution d'observations plus fréquentes des éléments magnétiques dans toutes les stations de répétition situées dans ces régions.

(11) <u>Provisions for Research Funds:</u> The Association of Terrestrial Magnetism and Electricity urges those organizations which operate magnetic observatories to set aside a suitable proportion of their annual budgets for research in terrestrial magnetism and related subjects.

(11) <u>Affectation de Fonds à des Recherches:</u> L'Association de Magnétisme et Electricité Terrestres recommande instamment aux organisations qui possèdent des observatoires magnétiques de réserver une certaine partie de leur budget annuel à des recherches dans le domaine du magnétisme terrestre et des sujets qui s'y rattachent.

(12) Hong Kong Observatory: The Association of Terrestrial Magnetism and Electricity views with regret the continuance of the break, caused by the war, in the important geomagnetic work so long carried on by the Hong Kong Observatory, and expresses the hope that arrangements may be made for the renewal of this work.

(12) Observatoire de Hong-Kong: L'Association de Magnétisme et Electricité Terrestres considère avec regret l'interruption prolongée causée par la guerre des importants travaux géomagnétiques poursuivis pendant si longtemps à l'observatoire de Hong-Kong et souhaite que l'on prenne des dispositions pour permettre la reprise de ces travaux.

(13) Zi-Ka-Wei Observatory: The Association of Terrestrial Magnetism and Electricity views with regret the continuance of the break, caused by the war, in the important geomagnetic work so long carried on by the Zi-Ka-Wei Observatory, and expresses the hope that arrangements may be made for the renewal of this work.

(13) Observatoire de Zi-Ka-Wei: L'Association de Magnétisme et Electricité Terrestres considère avec regret l'interruption prolongée causée par la guerre des importants travaux géomagnétiques poursuivis pendant si longtemps à l'observatoire de Zi-Ka-Wei et souhaite que l'on prenne des dispositions pour permettre la reprise de ces travaux.

(14) Magnetic Observations in Spanish Guinea: The Association of Terrestrial Magnetism and Electricity recommends that magnetic observations be made in Spanish Guinea during the solar eclipse in February 1952, and especially that a provisional magnetic observatory be established in that place.

(14) Observations Magnétiques en Guinée Espagnole: L'Association de Magnétisme et Electricité Terrestres recommande que l'on effectue des observations magnétiques dans la Guinée espagnole pendant l'éclipse solaire de février 1952 et tout spécialement que l'on y établisse un observatoire magnétique provisoire.

(15) Aid in Correcting Instrumental Difficulties: The Association of Terrestrial Magnetism and Electricity invites geomagnetic observatories to communicate with Mr. J. Olsen, Secretary of the Committee on Observational Technique (c/o Danish Meteorological Institute, Charlottenlund, Denmark), regarding any instrumental difficulties they may experience. The Committee is prepared to give advice in response to such communications.

(15) Assistance en Vue de Remédier aux Difficultés Instrumentales: L'Association de Magnétisme et Electricité Terrestres invite les observatoires géomagnétiques à entrer en rapport avec Mr. J. Olsen, secrétaire du Comité pour les Techniques d'Observation (aux bons soins de l'Institut Météorologique Danois, Charlottenlund, Danemark), au sujet de toutes les difficultés instrumentales qu'ils pourront rencontrer. Le comité est prêt à fournir ses conseils en réponse à ces communications.

[RESOLUTIONS SUBMITTED TO AND ADOPTED BY THE UNION]

(16) Geophysical Center at Dourbes: The International Union of Geodesy and Geophysics expresses its great appreciation of the accomplishments of Belgium in the field of geophysics and looks forward to the completion of the center for the Physics of the Earth at Dourbes in order that it may begin to function as soon as possible.

(16) Centre de Physique du Globe à Dourbes: L'Union Géodésique et Géophysique Internationale apprécie particulièrement les travaux accomplis par la Belgique dans le domaine de la géophysique et envisagerait avec plaisir l'achèvement du Centre de Physique du Globe à Dourbes afin qu'il puisse être mis en service aussitôt que possible.

(17) R.R.S. RESEARCH: Considering

(1) that magnetic observations over the oceans are urgently needed to improve knowledge of the earth's magnetic field and of its secular changes, in the interest of navigation, both by sea and air, and to advance the scientific study of the earth's magnetism;

(2) that this information could be provided in part by air magnetic surveys, but that it is unlikely that it can be provided solely by air surveys, so that ocean magnetic surveys will continue to be required;

(3) that before the second world war, the British Admiralty undertook to construct and operate a non-magnetic ship; that this ship, the RESEARCH, has been constructed but not fitted out, and that the Admiralty, in view of changed conditions arising from the war, is not now able to undertake the responsibility of fitting out and operating the ship;

the International Union of Geodesy and Geophysics, as the body responsible for an enhanced effort to increase geomagnetic knowledge at an early date, urges that efforts should be made to obtain funds for these purposes througn the United Nations Organization, UNESCO, or other appropriate agency of the United Nations, or through the proposed new Polar Year organization; and the Union proposes that if the desired funds are obtained, suitable methods for operating the RESEARCH and for publishing the results should be investigated with the help of the Association.

(17) R.R.S. RESEARCH: Considerant

(1) qu'il est urgent de poursuivre des observations magnétiques sur les océans pour améliorer la connaissance du champ magnétique terrestre et de ses variations séculaires, dans l'intérêt de la navigation maritime et aérienne et pour faire progresser l'étude scientifique du magnétisme terrestre;

(2) que ces renseignements pourraient être obtenus partiellement par des observations magnétiques aériennes, mais qu'il est improbable que ces renseignements puissent être fournis uniquement par des observations aériennes, et qu'il reste donc nécessaire de poursuivre des observations magnétiques maritimes;

(3) qu'avant la seconde guerre mondiale l'Amirauté Britannique avait entrepris la construction et la mise en service d'un navire non-magnétique; que ce bateau, le RESEARCH, a été construit, mais non équipé, et que l'Amirauté, par suite des circonstances résultant de la guerre, n'est plus en mesure, maintenant, d'assumer la charge de l'équipement et de la mise en service du navire;

l'Union Géodésique et Géophysique Internationale en tant qu'organisme chargé d'étendre, par des efforts redoublés, nos connaissances en géomagnétisme à une date rapprochée estime urgent que l'on s'efforce d'obtenir des fonds, dans ce but, par l'entremise de l'Organisation des Nations Unies, de l'UNESCO ou de tout autre institution compétente des Nations Unies, ou par l'entremise de la nouvelle organisation projetée pour une Année Polaire; et elle propose que, les fonds étant obtenus, les méthodes convenables pour la mise en service du RESEARCH et pour la publication des résultats soient étudiées en coopération avec l'Association.

(18) Geophysical Institute of Huancayo: The International Union of Geodesy and Geophysics views with the greatest pleasure the following activities of the Government of Peru during the last three years: (1) in increasing its financial aid to the Geophysical Institute of Huancayo; (2) in planning for the establishment of new observatories; and (3) in promoting research and international scientific cooperation. It hopes that the aid given to the Geophysical Institute of Huancayo will be continued and increased, so that the Institute may maintain its position as one of the most important for the study of magnetic, electrical, and ionospheric phenomena.

(18) Institut Géophysique de Huancayo: L'Union Géodésique et Géophysique Internationale considère avec la plus grande satisfaction l'effort réalisé pendant ces trois dernières années par le Gouvernement du Pérou: (1) en augmentant son aide financière à l'Institut Géophysique de Huancayo; (2) en élaborant des plans pour la création de nouveaux observatoires; et (3) en intensifiant le travail de recherche et la collaboration scientifique internationale. Elle souhaite que l'aide apportée à l'Institut Géophysique de Huancayo soit maintenue et accrue, pour permettre à cet Institut de conserver la position de premier plan qu'il occupe en tant que centre d'étude de phénomènes magnétiques, électriques et ionosphériques.

(19) U.S.S.R. Cooperation: The International Union of Geodesy and Geophysics expresses its satisfaction that the Union of Soviet Socialist Republics in the past has contributed to the international scheme of magnetic characterization by supplying K-indices during the period from January 1940 to February 1947; the Union would welcome the renewal of this cooperation by the supply of current K-indices, and would also invite the general cooperation of the U.S.S.R. in the work of the Union.

(19) Coopération de l'U.R.S.S.: L'Union Géodesique et Géophysique Internationale exprime sa satisfaction au sujet de la contribution apportée dans le passé par l'Union des Républiques Socialistes Soviétiques à la détermination internationale des caractères magnétiques en communiquant des indices K de janvier 1940 à février 1947. L'Union verrait avec plaisir se renouer cette coopération par la communication des indices K actuels et invite en même temps l'U.R.S.S. à coopérer de façon générale aux travaux de l'Union.

Editor's Note:

Resolutions adopted by the International Union of Geodesy and Geophysics at the Brussels Meeting are listed in Bulletin d'Information de l'U.G.G.I., 2e Annee, No. 1, Jan. 1953, pp. 100-129. Under the heading, "(b) Various recommendations approved by the General Assembly", items of interest to the Association of Terrestrial Magnetism and Electricity include:

No. 2 - International Polar Year 1957-58
No. 3 - World Days in Upper Air Observations (See IATME Resolution No. 8)
No. 5 - Means of Dealing with the Physics of the High Atmosphere
No. 6 - Publications of the Union and its Associations
No. 8 - Upper Air Nomenclature

B--EXECUTIVE COMMITTEE

President: Prof. J. Coulomb, Institut de Physique du Globe, 191 Rue Saint-Jacques, Paris 5e, France.

Vice-Presidents: Prof. J. Bartels, Herzberger Landstr. 180, (20 B), Göttingen, Germany.

Prof. S. Chapman, 2 Queen's Lane, Oxford, England.

Secretary and Director of the Central Bureau: Mr. V. Laursen, Det Danske Meteorologiske Institut, Charlottenlund, Denmark.

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C--COMMITTEES

1. Committee on selection of sites of new observatories for terrestrial magnetism and electricity:

Prof. E. Lahaye, Chairman
3, Avenue Circulaire, Uccle III, Brussels, Belgium

Prof. J. Coulomb	(France)
Dr. J. A. Fleming	(U.S.A.)
Mr. V. Laursen	(Denmark)

2. Committee on aurora:

Prof. C. Störmer, Chairman
Institute of Theoretical Astrophysics, Blindern, V. Aker, Oslo, Norway

Dr. B. W. Currie	(Canada)
Prof. J. Dufay	(France)
Dr. C. W. Gartlein	(U.S.A.)
Prof. F. W. P. Götz	(Switzerland)
Dr. J. Paton	(Great Britain)
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Dr. I. L. Thomsen	(New Zealand)
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3. Committee on magnetic secular-variation stations:

Dr. E. H. Vestine, Chairman
5241 Broad Branch Road, N. W., Washington 15, D.C., U.S.A.

Mr. J. Egedal	(Denmark)
Dr. F. Errulat	(Germany)
Dr. J. A. Fleming	(U.S.A.)
Mlle. Z. Kalinowska	(Poland)
Dr. T. Nagata	(Japan)
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Dr. L. Slaucitajs	(Argentina)

4. Committee on magnetic charts:

Dr. N. Ambolt, Chairman
Avdelningen för jordmagnetism, Kungl. Sjökarteverket, Stockholm 100, Sweden

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Sir Harold Spencer Jones	(Great Britain)
Dr. J. Keränen	(Finland)
Mr. R. Kjaer	(Norway)
Dr. R. G. Madill	(Canada)
Capt. E. B. Roberts	(U.S.A.)

5. Committee on giant pulsations:

Mr. J. Olsen, Chairman
Det Danske Meteorologiske Institut, Charlottenlund, Denmark

Mr. F. T. Davies	(Canada)
Dr. L. Harang	(Norway)
Dr. E. Sucksdorff	(Finland)

6. Committee on observatory publications:

Capt. E. B. Roberts, Chairman
U. S. Coast and Geodetic Survey, Washington 25, D.C., U.S.A.

Prof. J. Bartels	(Germany)
Dr. J. A. Fleming	(U.S.A.)
Dr. R. G. Madill	(Canada)
Mr. E. Selzer	(France)
Dr. B. Trumpy	(Norway)
Dr. J. Veldkamp	(Holland)

7. Committee to promote international comparisons of magnetic standards:

Mr. V. Laursen, Chairman
Det Danske Meteorologiske Institut, Charlottenlund, Denmark

Dr. N. Ambolt	(Sweden)
Mr. R. E. Gebhardt	(U.S.A.)
Dr. J. Keränen	(Finland)
Dr. L. Koenigsfeld	(Belgium)
Mr. O. Lützow-Holm	(Argentina)
Dr. R. G. Madill	(Canada)
Dr. M. R. Madwar	(Egypt)
Prof. E. Thellier	(France)

8. Committee on observational technique:

Prof. E. Thellier, Chairman
Observatoire du Parc Saint-Maur, Saint-Maur-des-Fossé, Seine, France

Mr. E. A. Chamberlain	(Great Britain)
Mr. O. Lützow-Holm	(Argentina)
Mr. H. E. McComb	(U.S.A.)
Dr. E. Medi	(Italy)
Mr. J. Olsen	(Denmark)

9. Committee on characterization of magnetic disturbances:

Prof. J. Bartels, Chairman
Herzberger Landstr. 180, (20 B), Göttingen, Germany

Mr. J. Egedal	(Denmark)
Mr. H. F. Johnston	(U.S.A.)
Sir Harold Spencer Jones	(Great Britain)
Prof. E. Lahaye	(Belgium)
Dr. E. Sucksdorff	(Finland)
Dr. J Veldkamp	(Holland)

10. Joint committee on atmospheric electricity (with Association of Meteorology):

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Institutet för högspänningsforskning, Uppsala, Sweden

Members appointed by the Association of Terrestrial Magnetism and Electricity:

Prof. J. Clay	(Holland)
Dr. L. Koenigsfeld	(Belgium)

Members appointed by the Association of Meteorology:

Prof. J. Bricard	(France)
Dr. H. R. Byers	(U.S.A.)
Dr. Ross Gunn	(U.S.A.)
Dr. T. W. Wormell	(Great Britain)

11. Committee to promote observations of daily magnetic variations in low latitudes:

Mr. J. Egedal, Chairman
Det Danske Meteorologiske Institut, Copenhagen K, Denmark

Dr. P. H. Berlage	(Indonesia)
Prof. J. Coulomb	(France)
Mr. A. A. Giesecke, Jr.	(Peru)
Mr. B. L. Gulatee	(India)
Mr. P. Herrinck	(Belgian Congo)
Mr. O. Lützow-Holm	(Argentina)
Dr. M. R. Madwar	(Egypt)
Dr. D. F. Martyn	(Australia)
Mr. J. M. Rayner	(Australia)
Capt. E. B. Roberts	(U.S.A.)
Rev. A. Romañá	(Spain)

12. Committee on magnetic airborne surveys:

Dr. J. W. Joyce, Chairman
6641 - 32nd Street, N. W., Washington 15, D.C., U.S.A.

Mr. C. A. Jarman	(Great Britain)
Mr. A. Lundbak	(Denmark)
Mr. J. M. Rayner	(Australia)
Mr. E. Selzer	(France)
Mr. P. H. Serson	(Canada)

13. Committee on the study of lunar variations in meteorological, magnetic and electrical elements:

Prof. S. Chapman, Chairman 2 Queen's Lane, Oxford, England	
Prof. J. Bartels	(Germany)
Prof. M. Bossolasco	(Italy)
Rev. J. O. Cardús	(Spain)
Mr. J. Egedal	(Denmark)
Mr. R. Gallet	(France)
Dr. M. Hasegawa	(Japan)
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Dr. P. Rougerie	(France)
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Mr. A. Thomson	(Canada)
Dr. K. K. Tschu	(China)
Mr. M. V. Wilkes	(Great Britain)
Dr. K. Weekes	(Great Britain)

14. Joint committee on upper atmosphere (with Association of Meteorology):

Prof. J. Kaplan, Chairman
Institute of Geophysics, University of California, Los Angeles 24, California, U.S.A.

Members appointed by the Association of Terrestrial Magnetism and Electricity:

Prof. D. R. Bates	(Great Britain)
Prof. S. Chapman	(Great Britain)
Dr. E. O. Hulburt	(U.S.A.)
Dr. D. F. Martyn	(Australia)
Prof. O. Rydbeck	(Sweden)

Members appointed by the Association of Meteorology:

Prof. W. F. P. Götz	(Switzerland)
Dr. M. Nicolet	(Belgium)
Prof. E. Palmén	(Finland)
Prof. E. Vassy	(France)

15. Committee on a thesaurus of annual observatory values:

Mr. H. F. Johnston, Chairman Department of Terrestrial Magnetism, 5241 Broad Branch Road, N.W., Washington 15, D.C., U.S.A.	
Mr. J. W. Beagley	(New Zealand)
Mr. O. Lützow-Holm	(Argentina)
Mr. E. Selzer	(France)

PART VII

ADDRESSES

The General Secretary of the International Union of Geodesy and Geophysics has prepared and will publish in an issue of the I.U.G.G. News-Letter (Bulletin d'Information de l'U.G.G.I.) which will appear during the summer of 1954, a "World Directory of Geodesists and Geophysicists". Approximately six months after this list appears, a companion list of institutions and organizations concerned with geodesy and geophysics will be issued in the same journal.

In view of these plans, only the names and addresses of the National Committees and their principal officers for the various countries who are now members of the I.U.G.G. are listed below. In addition, where National Committees are divided into sections corresponding to the Associations of the I.U.G.G., the principal officers of the section concerned with terrestrial magnetism are also given.

ARGENTINA

Comite Nacional de la Union Geodesica
y Geofisica Internacional
Instituto Geografico Militar
Cabildo 381
Buenos Aires

President: General de Brigade D. Carlos Alberto Levene (Same address)

Secretary: Ingeniero Civil D. Celso C. Papadopoulos (Same address)

AUSTRALIA

Australian National Committee on Geodesy and Geophysics
Australian National Research Council
Chancery House
485 Bourke Street
Melbourne, C. 1, Victoria

Secretary: Mr. J. M. Rayner, Bureau of Mineral Resources, Geology, and Geophysics, 485 Bourke Street, Melbourne, C. 1, Victoria

Terrestrial Magnetism and Electricity:

Secretary: Dr. D. F. Martyn, Commonwealth Observatory, Mount Stromlo, Canberra, A.C.T.

AUSTRIA

Österreichische Kommission für die Internationale Erdmessung
Friederich Schmidtplatz 3
Wien VIII

President: Dipl. Ing. Karl Lego, Hohenstanfengasse 38, Wien I

Secretary: Hofrat Dr. phil. Karl Mader, Friederich Schmidtplatz 3, Wien VIII

Seismology and Magnetism:

Representative: Dr. phil. Max Toperzer, Hohe Warte 38, Wien XIX

BELGIUM

Comité National Belge de Géodésie et de Géophysique

President: Prof. L. Tison, 61 rue des Ronces, Gentbrugge

Secretary: M. R. Marchant, 8 rue Général Thys, Brussels

BRAZIL

The Secretary General of the Union has been advised by the Conselho Nacional de Geografia that it decided on July 4, 1953 to apply for membership in the I.U.G.G. Pending the completion of the formalities, the adhering organization is designated as:

Instituto Brasileiro de Geografia e Estatistica
Conselho Nacional de Geografia
436 Avenida Beira Mar
Rio de Janeiro, D. F.

General Secretary: Ten. Cel. Déoclécio De Paranhos Antunes, Secretario Geral do Conselho Nacional de Geografia, 436 Avenida Beira Mar, Rio de Janeiro, D. F.

CANADA

Associate Committee on Geodesy and Geophysics
National Research Council
Ottawa, Ontario

Secretary: Mr. D. A. Webster (Same address)

CHILE

Correspondence should be addressed to:

Sr. Coronel Daniel Urra Fuentes
Director Interino
Instituto Geografico Militar
Santiago de Chile

COLOMBIA

Correspondence should be addressed to:

Sr. José Ignacio Ruiz
Instituto Geografico de Colombia "Agustin Codazzi"
Bogota

CZECHOSLOVAKIA

Comité National de Géodésie and de Géophysique
près l'Académie des Sciences Tchécoslovaque
Narodni 5
Prague

President: Dr. Josef Böhm (Same address)

Secretary: Dr. Karel Kucera (Same address)

DENMARK

National-komitéen for Geodesi og Geofysik
Det Kongelige Danske Videnskabernes Selskab
Dantesplads 35
Copenhagen

President: Prof. Director N. E. Nörland, Institut Géodésique, Proviantgaarden, Copenhagen

Secretary: Director H. Petersen, Meteorologiske Institut, Gammelhaveallé 8, Charlottenlund

EGYPT

National Committee for Geodesy and Geophysics
c/o Meteorological Department
Koubri El Quobba
Cairo

President: Dr. M. R. Madwar, Hariri Building, Sharia el-Geizira, crossing Wisa Wasef, Giza

Secretary: Mr. M. F. Taha, c/o Meteorological Department, Koubri El Quobba, Cairo

FINLAND

Finnish National Committee for Geodesy and Geophysics
c/o Meteorological Central Office
Helsinki

President: Prof. W. A. Heiskanen, Hamerenkatu 51, Helsinki
or
Prof. W. A. Heiskanen, Ohio State University, Office of the Graduate School, 309 Administration Building, Columbus 10, Ohio, U.S.A.

Secretary: Dr. E. Sucksdorff, Meteorological Central Office, Helsinki

FRANCE

Comité National Français de Géodésie et Géophysique
19 rue Auber
Paris, 9e

President: M. le R. P. Pierre Lejay, Membre de l'Academie des Sciences, 35 rue de Sèvres, Paris 6e

General Secretary: M. A. Gougenheim, Service Central Hydrographique de la Marine, 13 rue de l'Université, Paris 7e

Terrestrial Magnetism and Electricity:

President: Prof. J. Coulomb, Institut de Physique du Globe, 191 rue Saint-Jacques, Paris 5e

Secretary: Prof. E. Thellier, Observatoire du Parc Saint Maur, 4 avenue de Neptune, Saint Maur des Fossés, Seine

GERMANY (FEDERAL REPUBLIC)

Deutsche Vereinigung für Geodäsie und Geophysik
Bunsenstrasse 10
(20b) Göttingen

President: Prof. Dr. J. Bartels, Herzberger Landstrasse 180, (20b) Gottingen

Secretary: Prof. Dr. M. Kneissl, Walter von Dyck Platz 1, München

GREAT BRITAIN

British National Committee for Geodesy and Geophysics
c/o The Royal Society
Burlington House
Piccadilly
London, W. 1

President: Dr. R. Stoneley, F.R.S., Pembroke College, Cambridge

Correspondence should be addressed to:

Dr. D. C. Martin
Assistant Secretary of the Royal Society
Burlington House
Piccadilly
London, W. 1

GREECE

Commission Géodésique et Géophysique Hellénique
Service Géographique de l'Armée Hellénique
Athens

President: Dr. Demètre Hondros, Professeur de Physique à l'Université d'Athènes, 104 rue Solonos, Athens

Secretary: Général Georges Spiliotopoulos, Directeur du Service Géographique de l'Armée Hellénique, Athens

HOLLAND

Nederlandse Raad der Internationale Geodetische en Geophysische Unie
Koninklijk Nederlands Meteorologisch Instituut
De Bilt

President: Prof. Dr. Ir. F. A. Vening Meinesz, Potgieterlaan 5, Amersfoort

Secretary: Dr. C. Braak, Bilderdijklaan 14, Bilthoven

INDIA

National Committee for the International Union of Geodesy and Geophysics
Central Board of Geophysics
27 Chowringhee Road
Calcutta

Copies of all correspondence are to be addressed to:

Shri D. D. Gupta
Under Secretary to the Government of India
Ministry of Natural Resources and Scientific Research
Central Secretariat
New Delhi

INDO-CHINA

Correspondence should be addressed to the General Secretary of the International Union of Geodesy and Geophysics, 30 avenue Rapp, Paris 7^{e}, for forwarding.

INDONESIA

National Committee for Geodesy and Geophysics
c/o Meteorological and Geophysical Service
Djalan Geredja Inggris 3
Djakarta

IRELAND

National Committee for Geodesy and Geophysics
44 Upper O'Connell Street
Dublin

President: Mr. J. C. B. MacCarthy (Same address)

Secretary: Mr. J. Byrne (Same address)

ISRAEL

Israel Society for Geodesy and Geophysics
P. O. Box 36
Hakirya-Tel-Aviv

President: Dr. M. Goldschmidt, P. O. Box 667, Jerusalem

Secretary: Mr. N. Rosenan, P. O. Box 36, Hakirya-Tel-Aviv

ITALY

Commissione Nazionale di Geodesia e Geofisica
del Consiglio Nazionale delle Ricerche
7 Piazzale delle Scienze
Rome

President: Prof. G. Cassinis, 32 Piazza Leonardo da Vinci, Rome

Terrestrial Magnetism and Electricity:

Address correspondence to:

Prof. Dr. E. Medi
Istituto Nazionale di Geofisica
Citta Universitaria
Rome

and

Prof. M. Tenani
Istituto Idrografico della Marina Militare
Genoa

JAPAN

National Committee for Geodesy and Geophysics
Science Council of Japan
Ueno Park
Taito-Ku
Tokyo

President: Prof. C. Tsuboi, Geophysical Institute, Faculty of Science, Tokyo University, Tokyo

General Secretary: Prof. T. Rikitake, Earthquake Research Institute, Tokyo University, Tokyo

Terrestrial Magnetism and Electricity:

President: Prof. M. Hasegawa, Geophysical Institute, Faculty of Science, Kyoto University, Kyoto

Secretary: Prof. T. Nagata, Geophysical Institute, Faculty of Science, Tokyo University, Tokyo

MEXICO

Direccion de Geografia y Meteorologia
Oficina de Geografia
Avenida Observatorio 192
Tacubaya, D. F.

President: Ing. Manuel Medina, Director "B", Oficina de Geografia, Direccion de Geografia y Meteorologia, Avenida Observatorio 192, Tacubaya, D. F.

For Geodesy (Gravimetry), Seismology, and Magnetism, address correspondence to:

Ing. Ricardo Monges Lopez
Director del Instituto de Geofisico
de la Universidad Nacional Autonoma
Puente Alvarado 71
Mexico, D. F.

(with copies of correspondence to Ing. Medina)

MOROCCO

Comité National Marocain de Géodésie et de Géophysique
Institut Scientifique Chérifien
Avenue Biarnay
Rabat

M. Jean Debrach
Service de Physique du Globe
2 rue de Foucauld
Casablanca

NEW ZEALAND

Department of Scientific and Industrial Research
Box 18, Government Buildings
Wellington

Address all correspondence to:

The Director
Department of Scientific and Industrial Research
Box 18, Government Buildings
Wellington

NORWAY

Den nasjonale Komite for Geodesi og Geofysikk
Norges Geografiske Oppmåling
St. Olavsgt. 32
Oslo

President: Prof. Dr. H. Solberg, Astrofysisk Institutt, Universitetet, Blindern, Oslo

Secretaries: Dir. Kr. Gleditsch, Norges Geografiske Oppmåling, St. Olavsgt. 32, Oslo

Mr. H. Jelstrup (Same address)

PAKISTAN

National Committee for Geodesy and Geophysics in Pakistan
Post Box 2005
Karachi

Secretary: Mr. S. Q. Hasan, Block No. 40, C.M.H. Lines, Karachi

PERU

Instituto Geografico Militar del Peru
Apartado 2038
Lima

For geophysics, address:

Dr. A. A. Giesecke, Jr.
Observatorio de Huancayo
Huancayo

PHILIPPINE REPUBLIC

Philippine Geodetic and Geophysical Institute
O'Racca Building
Manila

President: Captain A. O. Hizon, Director, Bureau of Coast and Geodetic Survey, Barraca Street No. 77, San Nicolas, Manila

POLAND

Comité National de Géophysique
Polska Akademia Nauk
rue Nowy Swiat 72
Warszawa

PORTUGAL

Secças Portuguesa des Unioes Astronomica, Geodesica e Geofisica
Instituto Geografico e Cadastral
Praca da Estrela
Lisboa

President: Mr. A. Paes Clemente, Instituto Geografico e Cadastral, Praça da Estrela, Lisboa

SPAIN

Comision Nacional de Geodesia y Geofisica
Instituto Geografico y Cadastral
Calle del General Ibanez de Ibero No. 3
Madrid

President: Iltmo. Sr. D. Vicente Puyal Gil (Same address)

General Secretary: Iltmo. Sr. D. Guillermo Sans Huelin (Same address)

SWEDEN

Svenska Nationalkomittèn för Geodesi och Geofysik
Sveriges Meteorologiska och Hydrologiska Institut
Stockholm 12

Secretary: Director A. Angström, Sveriges Meteorologiska och Hydrologiska Institut, Stockholm 12

SWITZERLAND

Comité Suisse de l'Union Géodésique et Géophysique Internationale
Eidgen. Technische Hochschule
Hauptgebäude, Zimmer 15c
Zürich 1

President: Prof. C. F. Baeschlin, Dammstrasse 25, Zollikon bei Zürich

Secretary: Dr. E. Hunziker, Eidgen. Technische Hochschule, Hauptgebäude, Zimmer 15c, Zürich 1

SYRIA

Ministère des Travaux Publics
Damas

Address all correspondence to:

M. S. Mazloum
Directeur des Irrigations et des Forces hydrauliques
Ministère des Travaux Publics
Damas

THAILAND

The Royal Survey Department
Bangkok

Address all correspondence to:

The Director
The Royal Survey Department
Bangkok

TUNISIA

Direction des Travaux Publics
Tunis

Address all correspondence to:

Mr. J. Tixeront
Ingénieur en Chef du Service de l'Hydraulique
Direction des Travaux Publics
Tunis

TURKEY

Harta Genel Müdürlügü
Ankara

Address all correspondence to:

General I. Dura
Harta Genel Müdürlügü
Ankara

UNION OF SOUTH AFRICA

South African National Committee for Geodesy and Geophysics
c/o South African Council for Scientific and Industrial Research
P. O. Box 395
Pretoria

Correspondence on general I.U.G.G. matters should be addressed to:

Dr. Eric Boden
Professional Assistant to the President C.S.I.R.
P. O. Box 395
Pretoria

Terrestrial Magnetism and Electricity:

Dr. B. F. J. Schonland
Director, Bernard Price Institute for Geophysical Research
University of the Witwatersrand
Johannesburg

UNITED STATES OF AMERICA

American Geophysical Union
1530 P Street, N.W.
Washington 5, D. C.

Address all correspondence to:

Mr. Waldo E. Smith, Executive Secretary
American Geophysical Union
1530 P Street, N.W.
Washington 5, D. C.

President: Dr. James B. Macelwane, Dean, Institute of Technology, St. Louis University, St. Louis, Missouri

General Secretary: Dr. John Putnam Marble, c/o National Museum, Washington, D. C.

Terrestrial Magnetism and Electricity:

President: Mr. Victor Vacquier, Geophysics Department, New Mexico Institute of Mining and Technology, Socorro, New Mexico

Secretary: Mr. Leroy R. Alldredge, Naval Ordnance Laboratory, Silver Spring, Maryland

YUGOSLAVIA

Conseil des Académies de la République Fédérative
Populaire de Yougoslavie
Comité National de Géodésie et Géophysique
Boite Postale 794
Belgrade

General Secretary: General S. Boskovic (Same address)

INTERNATIONAL ASSOCIATION OF
TERRESTRIAL MAGNETISM AND ELECTRICITY

EXECUTIVE COMMITTEE

President

Prof. J. Coulomb, Institut de Physique du Globe, 191, rue Saint-Jacques, Paris 5e, France

Vice-Presidents

Prof. J. Bartels, Herzberger Landstrasse 180 (20B), Göttingen, Germany

Prof. S. Chapman, The Geophysical Institute, College, Alaska

Secretary and Director of the Central Bureau

Mr. V. Laursen, Det Danske Meteorologiske Institut, Charlottenlund, Denmark

Members

Mr. A. A. Giesecke, Jr., Instituto Geofísico de Huancayo, Apartado 46, Huancayo, Peru

Dr. M. Hasegawa, Geophysical Institute, Kyoto University, Yoshida, Sakyo-ku, Kyoto, Japan

Prof. J. Kaplan, Institute of Geophysics, University of California, Los Angeles 24, California, U. S. A.

Dr. S. L. Malurkar, Director, Colaba and Alibag Observatories, Colaba, Bombay, India

Mr. J. M. Rayner, Bureau of Mineral Resources, 485 Bourke Street, Melbourne, C. 1, Victoria, Australia

PUBLICATIONS

BY THE

INTERNATIONAL ASSOCIATION OF TERRESTRIAL MAGNETISM & ELECTRICITY

Bulletins

No. 1	Organization, Minutes, and Proceedings of the Brussels Meeting, 1919	Out of print
No. 2	General Report of the Rome Meeting, 1922	Out of print
No. 3	Transactions of the Rome Meeting, 1922.	$2.00
No. 4	General Report of the Madrid Meeting, 1924	Out of print
No. 5	Transactions of the Madrid Meeting, 1924.	2.00
No. 6	Preliminary Reports on Subjects of Investigation, 1926 . .	Out of print
No. 7	Comptes Rendus de l'Assemblée de Prague, 1927.	Out of print
No. 8	Comptes Rendus de l'Assemblée de Stockholm, 1930 . . .	3.65
No. 9	Comptes Rendus de l'Assemblée de Lisbonne, 1933	2.80
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No. 11	Transactions of the Washington Meeting, 1939	3.50
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No. 12g	Geomagnetic Indices, K and C, 1952.	1.75
No. 13	Transactions of the Oslo Meeting, 1948	3.50
No. 14	Transactions of the Brussels Meeting, 1951	3.50

Photographic Atlas of Auroral Forms and Scheme for Visual Observations, 1930; second edition, 1951 . . . . 5.00

Supplements to the Photographic Atlas of Auroral Forms, I, 1932. 2.00

Caractère Magnétique Numérique des Jours (from 1 January 1930 to 31 December 1939) and Caractère Magnétique Numérique des Jours pendant l'Année Polaire 1932-1933 (in complete sets only). 5.60