FOR OFFICIAL USE.

M.O. No. 208.

REPORT OF THE NINTH MEETING

OF THE

INTERNATIONAL METEOROLOGICAL COMMITTEE,

AND OF THE

SIXTH MEETING OF THE COMMISSION FOR TERRESTRIAL MAGNETISM AND ATMOSPHERIC ELECTRICITY.

BERLIN, 1910.

Published by Authority of the Meteorological Committee.

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Report of Proceedings at a Meeting of the Commission for Maritime Weather Signals, London, 1909. (8vo.)

Provisional Summary of the Maritime Weather Signals at present in use in the various countries of the Globe. (M.O. 206.) (8vo.)

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LIST OF INTERNATIONAL METEOROLOGICAL MEETINGS.

1872. LEIPZIG, Conference of Meteorologists.

1873. VIENNA, Congress of Official Delegates.

1874. UTRECHT, First Meeting of the Permanent Meteorological Committee.

1876. LONDON, Second Meeting of the Permanent Meteorological Committee.

1878. UTRECHT, Third Meeting of the Permanent Meteorological Committee.

1879. ROME, Congress of Official Delegates.

1880. BERNE, First Meeting of the International Meteorological Committee.

1882. COPENHAGEN, Second Meeting of the International Meteorological Committee.

1885. PARIS, Third Meeting of the International Meteorological Committee.

1888. ZÜRICH, Fourth Meeting of the International Meteorological Committee.

1891 MUNICH, First Ordinary Conference of Directors of Offices and Observatories.

1894. UPSALA, Fifth Meeting of the International Meteorological Committee.

1896. PARIS, Second Ordinary Conference of Directors of Offices and Observatories.

1899. ST. PETERSBURG, Sixth Meeting of the International Meteorological Committee.

1903. SOUTHPORT, Seventh Meeting of the International Meteorological Committee.

1905. INNSBRUCK, Third Ordinary Conference of Directors of Offices and Observatories.

1907. PARIS, Eighth Meeting of the International Meteorological Committee.

1910. BERLIN, Ninth Meeting of the International Meteorological Committee.

A meeting of the Committee was held in Paris in 1900 for the transaction of formal business, in connexion with an open Congress of Meteorologists.

PREFACE.

THIS REPORT of the proceedings of the Meeting of the International Meteorological Committee, which was held at Berlin, in September, 1910, and of the meeting of the Commission for Terrestrial Magnetism and Atmospheric Electricity which preceded it, embodies a translation of the original edition in German, issued by the Royal Prussian Meteorological Institute, under the direction of Geheimrat Hellmann, Secretary of the Committee.

For the use of readers of the English edition, the Appendices which were not originally in English, have been translated.

The English edition has been amplified by printing *in extenso* the list of stations for the globe, at the rate, as far as possible, of two for each ten degree square, prepared at the Meteorological Office for the consideration of the Solar Commission in 1909, and the data for those stations for the month of January, 1905, which were to be found in publications received at the Meteorological Office by Midsummer, 1910.

The original draft of the list of stations was made with the personal assistance of the late Sir John Eliot, and the list has been revised by various members of the Solar Commission, to which the list of stations was presented in 1909. The data for January, 1905, which occupy the twenty-four pages, 28 to 51, were taken out in 1910 by Mr. R. G. K. Lempfert, who was at that time Superintendent of Statistics at the Meteorological Office. One of the first results of the endeavour was that it became necessary not only to quote the data given in the various publications as daily means for the month, but also to quote the formulæ by which the daily means of pressure or temperature had been computed, and to make some note as to the practice of the various publications in respect of the correction of pressure data for the variation of gravity.

The information thus compiled will be found in the columns headed Barometer and Temperature, on the left-hand pages of the list, so that the whole of the left-hand page is taken up with the names of the stations, their geographical positions and heights, and the references for the data and indications of the mode of computing the means of pressure and temperature. The right-hand pages contain the meteorological data.

The data for the specimen month selected are printed in this Report, because it is understood that the Solar Commission wishes to collect and to publish data for the globe in conjunction with data as to terrestrial magnetism and solar changes.

No more effective evidence of successful international co-operation could be given than the regular publication of such a

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collection of data which has long been desired by students of cosmical physics. The publication of the specimen of meteorological data for 1905, marks a new step in advance. The gaps in the list, and the differences of practice in respect of the method of dealing with the observations, show some of the work that has to be done before this long-cherished project is realised.

W. N. SHAW.

Meteorological Office,
London, S.W.
1st January, 1912.

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INTERNATIONAL METEOROLOGICAL COMMITTEE.

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MINUTES OF THE MEETINGS.

APPENDICES.

REPORT OF THE MEETING

OF THE

INTERNATIONAL METEOROLOGICAL COMMITTEE AT BERLIN,

September 26th to 29th, 1910.

MINUTES OF THE MEETINGS.

First Meeting, Monday, September 26th, 1910.

The meeting commenced at 10h. 10m. a.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, Davis, van Everdingen, Maurer, Mohn, Palazzo, Ryder, Rykatcheff, Stupart, Trabert (Members of the Committee), also the President of the Commission for Scientific Aeronautics, Mr. Hergesell.

Mr. F. H. Bigelow was present as a visitor by invitation.

1. **Changes in the Committee.**—The President opened the meeting with a short appreciation of Sir John Eliot, Messrs. Lancaster, Mascart and Pernter, members who had died since the last Conference. He referred cordially to Messrs. Hepites and Hildebrandsson, the retiring members, and welcomed the new members—Messrs. van Everdingen, Maurer, Ryder and Trabert.

2. The definitive programme was settled as follows, on the basis of the provisional programme contained in Circular N.S. No. 6—:

(1.) Report of the Officers.
(2.) Report on the negotiations regarding Weather Telegrams from the Iberian Peninsula and the extension of the ten day Reports.
(3.) Report of the Commission for Terrestrial Magnetism and Atmospheric Electricity.
(4.) Report of the Commission for Scientific Aeronautics.
(4a.) Proposal of M. Köppen regarding units of measurement for pressure.
(5.) Report of the Solar Commission.
(6.) Report of the Commission for a *Réseau Mondial*.
(7.) Report of the Commission for preparing new Isothermal Charts of the Globe.
(8.) Report of the Commission for Weather Telegraphy.
(9.) Report of the Commission for Maritime Weather Signals.
(10.) Report of the Squalls Commission.

(11.) Proposals of M. Hellmann, regarding—

(*a*) Meteorological organisation in Colonies.
(*b*) The publication of Monthly Weather Reports.
(*c*) International meteorological symbols.

(12.) Proposal of M. Bjerknes (Christiania) regarding facilities for the study of aero-dynamics.

(13.) Proposal of M. Chaves to utilize the wireless telegraph station at the Azores for the transmission of weather telegrams.

(14.) Proposals of M. Palazzo, regarding—

(*a*) Observations on the polarisation of the sky.
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(15.) Proposal of Mr. Davis regarding the introduction of a standard evaporimeter.

(16.) Seven proposals of Professor Moore.

(17.) Proposal of M. Chaves for the publication of an annual atlas illustrating graphically the variations of the meteorological elements.

(18.) M. von Hann's communication on meteorology in Servia.

(19.) Consideration of a question referred by the Magnetic Commission in the year 1905.

(20.) Advance copies of the second edition of the International Cloud Atlas.

The documents referring to the various items were distributed so far as they had not already been sent.

3. **Report of the Officers.**—The Secretary read the "Report of the Officers" (Appendix II., p. 24). M. Angot informed the meeting that the French edition of the Minutes of the Paris Conference of 1907 and of the Codex of Resolutions would soon appear.

4. **Distribution of Minutes.**—In reply to the suggestion of M. Rykatcheff for the more extensive distribution of the printed Minutes of the Committee and its Commissions, Messrs. Angot, Hellmann, Hergesell and Shaw explained that no difficulty need be experienced in obtaining copies of the printed Reports.

In order that the matter should receive attention and that institutions should not be overlooked, the President suggested the compilation of a list of the Meteorological Institutes, Observatories, Societies and kindred Associations interested in the subject.

The Secretary promised to have a list of this kind prepared.

5. **Dekaden-bericht.**—Item 2 (extension of the area of the "Dekaden-bericht" of the Deutsche Seewarte, Paris Report, 1907, p. 11). The communication from the Deutsche Seewarte of the 20th June, 1908 (Appendix III., p. 25), was read, and it was noted that the contemplated experiment dealing with the synoptic weather charts for tropical regions between 10° N. and 10° S. latitude on one map had not yet been made, or at least they had not been issued. Captain Ryder was requested to discuss the matter further with the Seewarte.

6. **Telegrams from Spain and Portugal.**—The President gave information as to the steps which he had taken to expedite meteorological telegrams from the Iberian Peninsula. A representation through the usual diplomatic channels had been so far successful that the telegrams from Corunna and Lisbon now came to hand more regularly, and this was confirmed also by M. Angot.

The Committee instructed the Bureau to thank the Spanish and Portuguese Governments for their courteous assistance.

7. The consideration of Items 3 and 4—Reports of the Commissions on Terrestrial Magnetism and Atmospheric Electricity, and on Scientific Aeronautics—was deferred.

8. The President gave a detailed statement of questions that arose in connection with Items 5 and 6—Report of the Solar Commission and of the Réseau Mondial—as follows:—

9. **Report of Solar Commission. Meteorology of the Globe.**—After the Report of the President of the Solar Commission had been read (Appendix IV., p. 26), the President submitted a first attempt at a summary, in the form of tables and charts, of the mean meteorological conditions of the globe for one month (January, 1905, *see* pp. 28-51). He pointed out the great gaps in the réseau of observing stations which still exist in uncivilised countries, even where only two stations are required for a 10° square, as well as the different methods of calculating daily means, the absence of extreme values at many stations, &c.

10. **Réseau Mondial.**—After a letter from M. Hildebrandsson, Secretary of the Réseau Mondial Commission, and also one from M. Teisserenc de Bort had been read, the discussion centred on the difficulty caused by both Commissions (namely, the Solar Commission and the Réseau Mondial Commission) overlapping in their wishes and requirements (Appendix V., p. 52). Messrs. Stupart, Bigelow, Rykatcheff and Angot gave their opinions on the matter, while the Secretary objected mainly to entrusting to a Commission the study of a purely scientific problem, such as the relation between solar and terrestrial phenomena, which must in the end be left to the investigation of individual scientists. Messrs. Angot and van Everdingen expressed their willingness to supply regularly in manuscript the mean values from several stations, as desired by the Solar Commission, if they knew that a monthly summary embracing the whole globe, such as the President had shown, would indeed be published. M. Rykatcheff drew attention to the Daily and Monthly Weather Reports from which it would be possible to extract the printed values.

The further discussion of questions 5 and 6 was postponed.

The meeting adjourned at 1h. p.m.

(Signed) W. N. Shaw, G. Hellmann.

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The further discussion of questions 5 and 6 was postponed.

The meeting adjourned at 1h. p.m.

(Signed) W. N. Shaw, G. Hellmann.

Second Meeting, Monday, September 26th, 1910.

The meeting commenced at 3h. 8m. p.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, Davis, van Everdingen, Maurer, Mohn, Rykatcheff, Stupart, Trabert, Hergesell; Visitor: Mr. Bigelow.

Messrs. Palazzo and Ryder arrived later.

1. **Report of the Commission for Scientific Aeronautics.**—Introducing Item 4 on the programme, the President of the Commission for Scientific Aeronautics, Professor Hergesell, read the Report (Appendix VI., p. 57).

2. **Captive Pilot Balloons.**—In this connection M. Maurer described a method successfully used by himself for the determination of wind velocity by means of captive pilot balloons (Appendix VII., p. 61).

3. **New Aeronautical Observatories.**—M. Palazzo made a report on the Aeronautical Observatory of the Military Authorities in Bracciano, near Rome, towards the scientific equipment of which he had supplied instruments. He stated also that it was the intention of M. José Morandi, of Montevideo, to establish an aerological station at that place.

M. van Everdingen called attention to the recent investigations carried out by Lieut. Rambaldo relating to the region between the West Indies and Europe, and to the regular kite ascents now instituted also at De Bilt.

Messrs. Stupart and Davis remarked that they intended arranging for such observations in Canada and Argentina respectively.

4. **Teneriffe.**—Professor Hergesell gave a detailed explanation of the utility of the Observatory at Teneriffe, mentioned in the Report, for which the Aeronautical Commission were responsible.

5. **Publication of Observations.**—After Messrs. Shaw, Hellmann, Hergesell and Ryder had discussed the question of accelerating the publication of the observations obtained from international balloon ascents, the following resolutions were adopted:—

"The Committee congratulates the Aeronautical Commission on the progress they have made with regard to the investigation of the upper air, entrusted to them, and adopts the resolutions contained in Professor Hergesell's Report."

"The Committee desires that steps may be taken, preferably by the adhesion of those Governments which have not yet subscribed, to augment the funds for the publication of the international aerological observations, so that these may be brought as nearly as possible up to date."

"The Committee has learned with pleasure that the observations desired by the Aeronautical Commission at their Meeting in Monaco have been recently begun in several countries, and supports the request that other States, which have not yet organised observations of this character should also co-operate in the continuous meteorological investigation of the upper air."

6. **New Isothermal Charts.**—Item 7. M. Mohn presented a Report (Appendix VIII., p. 62) to which he added some explanations, while Mr. Trabert communicated the opinions and wishes of Professor von Hann. Messrs. Angot, Rykatcheff and Hellmann pointed out the difficulties which stand in the way of the solution of the problem by means of a Commission, while Messrs. Bigelow, Davis and Stupart reported on work undertaken for the purpose of representing the temperature conditions of their countries. After some discussion on the difficulty of reducing averages of temperature to mean sea-level and to means for 24 hours, the following resolution was adopted:—

"The Committee is of opinion that it is most desirable to issue new charts of isotherms on the basis of temperature averages calculated according to a common rule, but the Committee is not in a position to deal further with this matter at present."

The meeting adjourned at 5h. 40m. p.m.

(Signed) W. N. Shaw, G. Hellmann.

Third Meeting, Tuesday, September 27th, 1910.

The meeting commenced at 10h. 10m. a.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, Davis, van Everdingen, Maurer, Mohn, Rykatcheff, Stupart, Trabert, Hergesell. Messrs. Bigelow and Melander were present as visitors by invitation.

1. **Minutes.**—The minutes of the first two meetings were read and confirmed.

2. **Weather Telegraphy.**—The Committee proceeded with the consideration of Item 8 (Weather Telegraphy).

The President gave a general report of the Conference of the Commission for Weather Telegraphy, held in London in 1909, and read the twelve resolutions adopted, as published in "Report of Proceedings at a Meeting of the Commission for Weather Telegraphy, held at London, on June 21-24, 1909," pp. 5 and 6, issued by the London Meteorological Office in 1909.

By the issue of a Circular dated February, 1910 (Circular N.S. No. 5), the officers of the Committee fulfilled the request of the Commission to bring these resolutions under the notice of the institutes concerned and invite their opinion of them. The President of the Commission, Dr. W. N. Shaw, prepared a summary of the answers received, as given in Appendix IX., p. 64.

It remained now for the Committee to express an opinion on the various suggestions and to come to a definite decision.

3. **Barometric Tendency.**—The discussion by the Committee dealt first with the question of the inclusion of "barometric tendency" in the weather telegrams. Although there seemed a general inclination in favour of this, yet on the other hand several members stated that all their telegraphic reporting stations were not as yet provided with the necessary barographs. M. Angot laid stress on the maintenance of the groups of five figures in telegrams in their present order of sequence.

After a debate, in which the majority of the members participated, the following resolutions were adopted with regard to "barometric tendency":—

"The Barometric Tendency, deduced from barograph records, shall be included in the morning international telegrams."

"The specification of the Barometric Tendency shall be substituted for that of the Wet Bulb (T′T′T′ on the Continent, T′T′ in England). If the Barometric Tendency cannot be specified, by reason of a station not being equipped with a barograph, the figures telegraphed shall read 999 or 99."

"The Barometric Tendency shall be given for the three hours preceding the hour of observation."

With regard to the last resolution, seven members voted for the three-hour interval and four for the six-hour interval, while one member did not vote.

The decision of the question of the degree of accuracy to be used in the messages, whether two or three figures should be given, was for the time being, left open. (See seventh meeting, p. 20.)

4. **Telegrams from Iceland.**—On the question of weather telegrams from Iceland (No. 3 on page 7 of the above-mentioned Report), the letter from Captain Ryder, printed in Appendix X., p. 65, was read, and the following resolution adopted:—

"As soon as the Westmann Islands (South of Iceland) shall have been connected with the Icelandic telegraphic system, reports including sea disturbance from this station should be incorporated in the messages in place of the reports from Blonduos which should be omitted altogether."

5. **Wireless Reports.**—The President gave an account of the experiments made by Britain and Germany for receiving weather reports by means of wireless telegraphy from ships on the high seas, as represented on pp. 7-9 of the Report mentioned, and stated, giving examples, that the telegrams received by the Meteorological Office in London from British ships since April, 1910, has been used and published in the weekly issue of the "Monthly Meteorological Charts of the North Atlantic and Mediterranean."

6. **Prof. Bjerknes' Proposals.**—The Committee then proceeded to the consideration of Item 12, and on the reading of M. Bjerknes' communication (Appendix XI., p. 65) an animated discussion took place as to whether local or zonal time is used when taking observations at stations in different countries. In most réseaux the former seems to be used, but one could not be sure that the prescribed local time is always observed, as after the introduction of zonal time the public gradually conform to the latter.

"The committee recommends, therefore, that it should be stated in the introduction of the annual registers containing meteorological observations whether local or zonal time is used."

After Messrs. Hellman, Shaw, van Everdingen, Hergesell, Mohn and Davis had discussed M. Bjerknes' request, the following conclusion was arrived at:—

"The Committee acknowledges the great scientific value of studies in dynamical meteorology and recommends the Central Meteorological Institutes to collect data, as copious as possible, of hourly observations at G.M.T. for days on which international meteorological ascents take place, and to arrange for the issue of a number of cheap copies of these observations. On special application, copies should be placed at the disposal of individual investigators. It would even be desirable to supply copies of the recorded curves as well."

M. Rykatcheff explained that he could accede to this wish only to a limited extent.

The meeting adjourned at 1h. 5m. p.m.

(Signed) W. N. Shaw, G. Hellmann.

Fourth Meeting, Tuesday, September 27th, 1910.

The meeting commenced at 3h. 10m. p.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, Davis, van Everdingen, Maurer, Mohn, Palazzo, Ryder, Rykatcheff, Stupart, Trabert; *Visitor:* Mr. Bigelow.

1. **Storm Signals.**—With regard to Item 9 (*a*) **Report of Commission on Storm Signals,** the President read a report of the proceedings of the Commission appointed for that purpose, which met in London on June 22-25, 1909. They are given in the printed "Report of Proceedings at a Meeting of the Commission for Maritime Weather Signals, held in London on June 22-25, 1909," published by the Meteorological Office, while in Appendix II. belonging to it, but published separately, the systems of storm signals at present in use in different countries are set forth.

(*b.*) **Night Signals.**—Since the meeting of the Commission the Deutsche Seewarte and M. Angot (Appendix XII., p. 68) have made fresh suggestions for night signals, in regard to which the British Board of Trade has already expressed a favourable opinion. Both suggestions were discussed.

In the discussion Messrs. Ryder, van Everdingen and Mohn pointed out that they could not dispense with the simple storm warning having no reference to the direction of the wind (No. 2 on page 6 of the above Report), while Mr. Stupart laid great stress on the importance of discriminating between ordinary and heavy gales in forecasting.

(*c.*) **Uniformity in Signals.**—Mesrs. Ryder, Hellmann and Davis expressed the opinion that storm signals need not necessarily be the same for the whole world, as they primarily serve the more local purposes of the fishing industry and coastal navigation, while big ships pay little or no heed to them. Let it therefore suffice if, for the present, uniformity of storm signals be obtained for Europe.

The President pointed out the great advantage of general uniformity in contrast with the present great variety of storm signals of sea-faring nations (Appendix II. of the above-mentioned Report), and urged that a signal should everywhere have the same meaning.

After an animated discussion it was clear that members were unable to agree on the question of night signals, which should be shown by means of two lamps according to the original proposal of the Commission, and by means of three lamps according to M. Angot, while until now it has been the practice in some countries to use only one lamp. This part of the resolution, regarding night signals, was therefore referred back to the Commission for further consideration by a wider circle of experts.

(*d.*) **Day Signals.**—In voting on the adoption of the day signals proposed by the Commission, three members did not vote, six members were for the adoption, while three were against it in order that it might be referred back to the Commission for further consideration. As, however, one member who had voted for it afterwards changed his mind and voted against it, the preponderance of votes in favour of the adoption of the proposed day signals was so small that this first part of the Commission's resolution also fell through.

(*e.*) **Permanent Commission.**—Consequently the entire resolution with regard to the introduction of an international system of storm signals was referred back to the Commission. (But see below, fifth meeting.) By the following resolution it was agreed that this Commission is to become permanent.

"**The Committee approves resolution 5 of the Commission (Report of the Commission for Maritime Weather Signals, held in London, June 22–25, 1909, p. 7) to establish a permanent Commission on Maritime Meteorology and Storm Warnings, and requests its Officers to nominate the Members of this Commission from among those gentlemen who are specially interested in the service.**"

(*f.*) **Scale for Marine Charts.**—In conclusion, the President informed the Committee of the resolutions adopted by the same Commission in London in 1909, as regards a uniform scale in the projection of Maritime Charts for Meteorological purposes.

The meeting adjourned at 5h. 10m. p.m.

(Signed) W. N. Shaw, G. Hellmann.

Fifth Meeting, Wednesday, September 28th, 1910.

The Meeting commenced at 10h. 5m. a.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, van Everdingen, Maurer, Mohn, Palazzo, Ryder, Rykatcheff, Stupart, Trabert; *Visitor*: Mr. Melander.

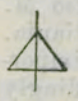
1. **Minutes.**—The Minutes of the third and fourth Meetings were read and confirmed.

2. **Storm Signals.**—Captain Ryder stated that at the previous discussion of the resolutions as regards storm signals by day, he had voted under a misunderstanding. He agreed entirely with their adoption on the understanding that the addition at discretion of other storm signals for individual countries is permissible. M. Mohn also agreed with this statement.

3. **International Day Signals adopted.**—The question of the adoption of the proposed day storm signals was therefore again put to the vote, when 8 members voted for and 1 against its adoption, 2 members not voting.

The day signals thus adopted by the Committee are described as follows in the above-mentioned Report:—

International Storm Signals.

Day.	Description of Gale.	Day Signals.
	For a gale commencing with wind in the N.W. quadrant.	Single cone, point upward.
	For a gale commencing with wind in the S.W. quadrant.	Single cone, point downward.
	For a gale commencing with wind in the N.E. quadrant.	Two cones, one above the other, both point upward.
	For a gale commencing with wind in the S.E. quadrant.	Two cones, one above the other, both point downward.
	For a hurricane	Two cones, with their bases together.

4. **Commission for Terrestrial Magnetism and Atmospheric Electricity.**—M. Rykatcheff then read the Report of the Commission for Terrestrial Magnetism and Atmospheric Electricity. This is contained in the Report of Proceedings at the session of the above-named Commission in Berlin, September 23rd and 24th, which follows later (p. 89); it need, therefore, be only briefly referred to here.

All the resolutions of the Magnetic Commission with a small alteration in one of them, were adopted by the Committee.

5. **Magnetic Survey of Denmark.**—In this connexion, the Secretary requested M. Ryder, if possible, to undertake the responsibility of arranging for the publication of the magnetic survey of Denmark made by the late Professor Paulsen.

6. **Magnetic Observatory at Santiago de Chile.**—The Secretary also read an extract from a letter from Dr. Knoches, stating that a Magnetic Observatory is to be established in Santiago de Chile.

7. **Commission for Atmospheric Electricity.**—The Secretary drew attention to the fact that the Commission for Terrestrial Magnetism and Atmospheric Electricity, established in Paris in 1896, had, up to the present time, given practically its whole attention to Terrestrial Magnetism, and that, in consequence of the great strides recently made in the investigation of Atmospheric Electricity, due consideration should also be given to this subject. As the Magnetic Commission itself desires to be allowed to confine its attention to Terrestrial Magnetism, he proposed that the formation of a separate Commission for Atmospheric Electricity might be considered.

Messrs. Angot, Rykatcheff and Shaw agreed to this, also M. Mohn, who gave an account of observations made in Christiania.

The Committee unanimously acknowledged the great importance of observations in Atmospheric Electricity, and accordingly the following resolutions were adopted:—

"The Commission for Terrestrial Magnetism and Atmospheric Electricity will henceforth become the Commission for Terrestrial Magnetism."

"The Committee has in view the formation of a special Commission for Atmospheric Electricity."

8. **Commission for the study of Squalls.**—On the discussion of Item 10 (Squalls), M. Angot, the President of the Squalls Commission originally formed in Innsbruck, 1905, expressed the opinion that the work of scientific investigation of squalls does not come within the scope of a Commission, and proposed the dissolution of the special Commission.

The Committee agreed, but the wish was expressed, that the necessary data should be made as easily accessible as possible to those engaged in such investigations. (Innsbruck 1905 Report, pp. 42-45.)

M. van Everdingen drew attention to the curves for days of squall which he publishes in the Monthly Weather Summary of the Netherlands Institute.

In this connexion a suggestion of Mr. Lempfert's was discussed (Appendix XIII., p. 70), which could not, however, be recommended for general acceptance on account of the rules laid down by the Governments of the different Institutes with regard to the supply of information.

9. **Professor Hellmann's Proposals.**—The Secretary then brought forward, in succession, his three proposals (Appendix XIV., p. 71).

10. **Distribution of Colonial Observations.**—In connexion with the first one (Item 11*a*), which refers particularly to English conditions, the President's announcement (Appendix XV., p. 73) that the Meteorological Office has arranged for the regular issue in future of unpublished observations from the Colonies was received with general satisfaction.

After a few remarks made by Messrs. Stupart and Angot, the following motions were carried:—

"Every civilized country which already has a meteorological service of its own, and which owns Colonies, should also arrange for the establishment of regular meteorological observations in its Colonies and Protectorates, and for their publication in accordance with international forms."

"All Meteorological Institutes should make a point of publishing regularly meteorological observations made at isolated places in those countries which as yet have no meteorological organisation."

11. **Monthly Weather Reports.**—On the second proposal (Item 11*b*) regarding the regular publication of Monthly Weather Reports, the Secretary specially pointed out a few European gaps in this connexion. Mr. Trabert stated that he would shortly undertake a publication on these lines for Austria.

The following proposal was accepted:—

"The committee considers it desirable that all Central Meteorological Institutes shall publish, as fully as possible, Monthly Weather Reports for their areas."

12. **Gale Symbol.**—The Secretary's third proposal (Item 11*c*) regarding the symbol for gale and the abbreviations for denoting the height of instruments gave rise to a lengthy discussion between Messrs. Shaw, Mohn, Rykatcheff, and Hellmann, and was finally accepted in the following form:—

"For the sake of uniformity it is desirable to amend the resolution of the congress of Vienna and to use the symbol ⚑ only for winds of gale force" (Beaufort Forces 8—12).

13. **Height of Station and of Instruments.**—

"It is desirable to use a special symbol (H) for the height of the station, *i.e.*, of the raingauge site above mean sea level, and to give next to it the height of the barometer above mean sea level by means of the abbreviation H_b."

In amplification of the previously arranged international abbreviations, the following symbols would mean:—

H	Height of the	Station	above M.S.L.
H_b	„	Barometer	
h_a	„	Anemometer	above the ground.
h_r	„	Rainguage	
h_s	„	Sunshine Recorder	
h_t	„	Thermometer	

The Meeting adjourned at 1h. p.m.

(Signed) W. N. Shaw, G. Hellmann.

Sixth Meeting, Wednesday, September 28th, 1910.

The Meeting commenced at 3h. 10m. p.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, Davis, van Everdingen, Maurer, Mohn, Palazzo, Ryder, Rykatcheff, Stupart, Trabert; *Visitor:* Mr. Bigelow.

1. **Absolute Units for Pressure.**—(4*a*.)—The President opened the Meeting with a discussion of Köppen's "Proposal to give all

pressure measurements in absolute units" (Meteorologische Zeitschrift, 1909, Part 4), which had been submitted at the last Conference of the Commission for Scientific Aeronautics held in Monaco, but which was referred by that body to the International Meteorological Committee for further discussion and decision.

Meanwhile, Prof. W. L. Moore, Director of the United States Weather Bureau, had submitted to the Committee a more general memorandum with reference to meteorological units of measurement, which is published in Appendix XVI. (p. 75) of this Report.

It appeared from the discussion, in which Messrs. Angot, Bigelow, Mohn and Shaw took part, that the suggested absolute measurement for pressure data was appropriate for theoretical investigations, but that it would be premature as yet to express all pressure data in these units. M. Mohn again reminded the Meeting of the necessity of reducing to standard gravity, as decided upon at the Conferences in Munich and Southport. The President exhibited barograph forms for an instrument of the Richard type, and pointed out how it was possible thereby to express pressure in percentages of an atmosphere. The line 1·00 occurs in the middle of the barogram, 1·05 is found on the upper edge, and 0·95 on the lower; thousandths of an atmosphere can easily be read. The following resolution was adopted:—

"With reference to all suggestions concerning any alteration of the meteorological units of measurement, the Committee has come to the conclusion that the time has not yet arrived for a final opinion to be given on the matter."

2. **Polarisation.**—M. Palazzo's proposals (Appendix XVII., p. 79) contained in Item 14 were then examined.

With regard to observations of polarisation, Messrs. Bigelow and Angot were of opinion that these could be made only at the larger observatories. The Secretary stated that similar observations are carried on at the Meteorological Observatory near Potsdam.

It was decided to adopt the following resolution proposed by the President:—

"The Committee notes with pleasure the investigations undertaken by M. Palazzo, and hopes that similar observations of polarisation will be carried out at other Observatories."

3. **Measurement of Snowfall.**—On the discussion of M. Palazzo's second proposal with regard to the measurement of snowfall, Messrs. Rykatcheff, Stupart, Bigelow, Hellmann and Maurer stated the methods of measurement adopted in their countries, and the difficulty in specifying a rule which will hold good generally for converting depth of snow into depth of rain. At the same time attention was drawn to the resolutions already adopted in this connexion (Codex, English Edition, pp. 20, 21, 22), which for the present settle the matter.

4. **Evaporation.**—In the discussion of Mr. Davis' proposal (item 15 of the programme) to introduce a standard evaporimeter, stress was laid by everyone on the importance of determining evaporation particularly in tropical countries, such as South America, Africa, Australia and India; on the other hand the difficulty of obtaining the absolute values, necessary for practical use, from the relative amount of evaporation measured at meteorological stations was confirmed.

Mr. Bigelow gave a short summary of the investigations of evaporation recently carried out under his supervision in California, and the President remarked that the time had come for an expert to collect and work up the extensive data on evaporation obtained since the resolutions of the last Conference (*see* Codex, p. 22).

After Messrs. Maurer, Stupart and Rykatcheff had given their experiences with regard to the measurement of evaporation, the following resolution was passed:—

"The Committee notes with satisfaction the investigations of evaporation carried out in the Argentine and in California; it is not, however, of the opinion that it is yet possible to recommend an evaporimeter for general use."

The Meeting adjourned at 5h. p.m.

(Signed) W. N. Shaw, G. Hellmann.

Seventh Meeting, Thursday, September 29th, 1910.

The Meeting commenced at 10h. 10m. a.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, Davis, van Everdingen, Maurer, Mohn, Palazzo, Ryder, Rykatcheff, Stupart, Trabert; *Visitor:* Mr. Bigelow.

1. **Monthly Publication for the Globe.**—The President returned to items 5 and 6, which had been discussed during the first meeting, but on which no decision had as yet been reached.

The President gave a satisfactory reply to the Secretary's inquiry as to whether the Solar Commission were in a position to publish, in tabular form (with departures), a monthly review of the meteorological conditions of the globe, in which case all Institutes would doubtless gladly supply the necessary data. Thereupon the following resolutions were adopted:—

"The Committee approves the list of stations chosen by the Solar Commission to represent the meteorological conditions throughout the globe, subject to alterations suggested by the Directors of individual réseaux for their districts. It also approves the efforts of the Commission in regard to the publication of data from a few selected stations within a year following that to which the observations refer."

"The President is requested to continue in the future to assist the Solar Commission in the choice of stations and in procuring meteorological data; at the same time he is empowered to request the Directors of the various réseaux, in the name of the Committee, to supply the necessary data for selected stations, provided that a published report (monthly or otherwise) containing the necessary data will be accepted in lieu of a separate copy of the data for selected stations."

"Of the data collected with this object the President is requested to place at the disposal of Professor Hildebrandsson those necessary for continuing the study of the relations between atmospheric centres of action, as desired by the Commission for a Réseau Mondial."

2. Daily Observations for the Globe by Telegraph.—Most Members agreed to the original suggestion of M. Teisserenc de Bort that meteorological observations by telegraph should be received daily from a limited number of stations distributed over the globe; they pointed out, however, that the realisation of a scheme of this nature would, at present, meet with great difficulties, technical as well as financial. At the suggestion of M. Angot the following resolution was adopted:—

"In recognition of the great interest of the proposal of M. Teisserenc de Bort with regard to the rapid exchange of daily weather telegrams from distant regions, the Committee earnestly recommends it to the notice of the Directors of Meteorological Institutes, who are requested to do their utmost to secure the realisation of the project."

3. Barometric Tendency.—The question of the manner in which barometric tendency should be given in the morning telegram, upon which no decision had been arrived at at the third meeting, was then settled.

As individual Members of the Committee had given the question further consideration during the time that had elapsed since the third meeting, agreement was reached on the following three resolutions, which were adopted:—

"In consideration of the differences of opinion expressed in the answers of Meteorological Institutes to the circular of February, 1910, regarding the use to be made of figures set free, the three figures set free in the Continental telegram shall in future be used to express barometric tendency in tenths of a millimetre, and the two figures in the British telegram to express this value in hundredths of an inch. Positive and negative variations shall be shown in the same way as with temperature."

"The Commission for Weather Telegraphy shall be continued, and is requested to consider the matter further in order that barometric tendency may be expressed by only two figures in the Continental telegram, leaving the third figure free for other purposes."

"May 1st, 1911, is agreed upon as the date for the above change in the morning telegram to come into force."

3. Code for Barometric Tendency.—The code for the barometric tendency in Continental telegrams would thus read as follows:—

000	No change.
001 to 500	Positive change from 1 to 500, tenths of a millimetre.
501 to 998	Negative change from 1 to 498, tenths of a millimetre.
999	Cannot be specified (owing to the absence of a barograph or from other causes).

Similarly in British telegrams, 21 would denote a rise in the barometer of 0·21 inch and 71 a fall of 0·21 inch.

Even at stations in Iceland the range of pressure within three hours would never be so great but that it could be telegraphed in this way.

4. Cloud Observations.—M. van Everdingen urged for future Meetings of the Commission for Weather Telegraphy, that the question should again be considered as to whether it would not be possible for readings of the dry bulb thermometer (air temperature) to be confined to two places (whole numbers) in the Continental telegram. He hopes thereby to gain room for cloud observations.

"The resolution of the Commission (10) concerning the proposal by the Deutsche Seewarte for the specification in telegrams of precipitation (*see* Report of the Commission, p. 4) is confirmed."

5. Telegrams from the Azores.—The Secretary then read a report by M. Chaves (Appendix XVIII., p. 83) on the improvement and extension of the telegraphic weather service of the Azores.

Messrs. Stupart and Bigelow referred to the importance of these telegrams for America as well as for Europe. As the messages from Horta always reach their destinations before those from Ponta Delgada and Angra do Heroismo, a request was put forward for all telegrams from the Azores to be sent by way of Horta. The suggestion was also made that the newly established Western station at Flores take the place of Angra do Heroismo, as being of greater importance.

The following resolution on the subject was adopted:—

"The Committee desire to express to the Portuguese Government and to M. Chaves their thanks for their efforts to extend the Weather Telegraphic service of the Azores, and they take the opportunity to request that in future the telegrams from Flores, Horta and Ponta Delgada may be transmitted by way of Horta."

The Committee did not think itself in a position to settle the second question submitted by M. Chaves, namely, how weather telegrams could be used to benefit ships sailing past the Azores, as the rights and privileges of Wireless Telegraphy Companies come into consideration.

6. Solar Radiation and Ozone.—The Committee then proceeded to discuss Mr. Moore's seven proposals, which are contained in Appendix XIX., p. 85.

The importance of question 1 was unanimously acknowledged; nevertheless, according to the evidence of Messrs. Angot, Bigelow and van Everdingen, it would seem that these investigations are more suited for astrophysical than for meteorological observatories.

7. Standard Pyrheliometric Observations.—At the suggestion of the President, the second and third questions were referred to the Solar Radiation Commission.

8. **Solar Radiation Commission.**—At the same time the Secretary suggested that this Commission, which up to the present time had never had a Meeting, should be constituted anew, based on certain principles explained by him.

The Committee agreed and elected the following as Members of this Commission:—M. Maurer, as President, and Messrs. Åkerblom (Upsala), Bigelow (Buenos Aires), Chistoni (Naples), Gorczynski (Warsaw), Hale (Pasadena), Kimball (Washington), Schmidt (Vienna), and Walker (Eskdalemuir). Just as with every other Commission nominated by the Committee, these have the right to elect additional Members.

9. **Gradient of Temperature.**—Question 4 gave rise to a lengthy discussion, especially as at their last Conference in Monaco the Commission for Scientific Aeronautics had already taken their position in regard to this. (*See* Rapport . . . . Monaco, 1909, pp. 17 and 47.)

Conformity with the mathematical conception, required on the part of the United States Bureau, is not possible, for, as pointed out by the President, gradient is not a mathematical conception. It was, as the Secretary continued, transferred from engineering science to meteorology and denotes slope of pressure, while aerologists have recently used the word gradient as signifying fall of temperature.

"The Committee decided that in order to prevent misunderstanding it is best to leave the word gradient with its original meaning (slope) and for the heading of tables which contain the decrease of temperature to give 'Fall of Temperature per 100 m.' instead of 'Gradient $\Delta t/100$.'"

The signs for the fall of temperature remain the same as those adopted by the Commission for Scientific Aeronautics in agreement with the general practice, namely, positive when temperature falls with height, negative when it rises.

10. **Observations of Unusual Phenomena in the Upper Atmosphere.**—Question 5 was noted.

11. **Publication of Results for the Upper Air.**—Question 6 was referred to the Commission for Scientific Aeronautics, and at the same time it was suggested to the Commission that Dr. Blair of the Mount Weather Observatory should be elected a Member.

12. **Meteorological Dictionary.**—Question 7, regarding the preparation of a meteorological dictionary, had already received the attention of the Meteorological Congress in Rome (Codex, p. 48). Nothing generally useful, however, had been achieved in this direction.

"The Committee fully recognises the great usefulness of a publication of this nature and requests the U.S. Weather Bureau to work out a suitable scheme for the consideration of the Committee. The latter will then have pleasure in choosing experts in various languages who might be of assistance in completing the dictionary."

The Meeting adjourned at 1h. 5m. p.m.

(Signed) W. N. Shaw, G. Hellmann.

Eighth Meeting, Thursday, September 29th, 1910.

The Meeting commenced at 3h. 5m. p.m.

Present: Messrs. Shaw (*President*), Hellmann (*Secretary*), Angot, Davis, van Everdingen, Maurer, Mohn, Palazzo, Ryder, Rykatcheff, Stupart, Trabert.

1. **Annual Meteorological Atlas.**—The President submitted for consideration a proposal of M. Chaves (Appendix XX., p. 88) regarding the issue of an annual meteorological atlas for the globe, similar to the one for France published for the last few years by M. G. Eiffel. Messrs. Angot, Shaw, Mohn, Hellmann, and Rykatcheff took part in the discussion and agreed on the following resolution suggested by Messrs. Angot and Maurer.

"The Committee recognises the interest which an atlas, published annually, can, in certain cases, possess if it contains graphic representations of the variations of the principal meteorological elements for the globe.

"After the Committee had been informed by Messrs. Chaves and Eiffel of the observations suitable for such a publication, Messrs. Shaw and Angot were requested to discuss the matter with M. Eiffel."

2. **Observations in Servia.**—The Committee noted the receipt of a letter from M. von Hann in which he expressed his regret that M. Nedelkowitch, of Belgrade, had no means to publish regularly the extensive meteorological observations available in Servia.

3. **Magnetic Hourly Mean Values.**—A resolution of the Magnetic Commission at their Meeting in Innsbruck in 1905 regarding the tabulation of hourly mean values in place of the instantaneous values at the hour was referred to the decision of the Committee (*see* Report of Directors' Conference in Innsbruck 1905, p. 35), and should really have been settled at the Meeting of the Committee at Paris in 1907.

4. **Publication of Magnetic Observations.**—As the Magnetic Commission on their last day of meeting in Berlin had not arrived at a decision regarding the most suitable form of publishing magnetic observations, but had referred the matter to the further consideration of their executive Officers, the Committee decided likewise to postpone the decision of the question, above referred to, on the tabulation of mean values.

5. **International Cloud Atlas.**—Finally the Secretary submitted two copies of the Second Edition of the International Cloud Atlas (Quarto, 24 pp., XIV coloured plates) sent by M. Teisserenc de Bort. This new edition, compiled by Messrs. Hildebrandsson and Teisserenc de Bort, contains a few new cloud pictures, and the corrected definitions, &c., adopted by the Conference of Directors at Innsbruck.

6. This concluded the programme of the Session. The President thanked the Members for their active interest in the work. M. Rykatcheff thanked the President for the able way in which he had conducted the business. Messrs. Angot and Shaw, in the name of the other foreign Members, thanked Professor Hellmann for the kind hospitality offered them.

The Meeting adjourned at 4h. 40m. p.m., and the Session was closed.

APPENDICES.

APPENDIX I.

PROGRAMME OF THE MEETING.

(Already printed on pp. 7, 8.)

APPENDIX II.

REPORT OF THE OFFICERS.

Since the Paris Conference in 1907, we have had the misfortune to lose by death three members of the International Committee, Sir John Eliot, Messrs. Lancaster and Pernter, while M. Hepites has retired from the Committee in consequence of his resigning the Directorship of the Roumanian Service.

The places thus become vacant have been filled by co-opting Messrs. van Everdingen, Ryder, Trabert, and G. T. Walker. The Committee is thus once more complete and is at present composed of the following members:—Messrs. Angot (Paris), Chaves (Ponta Delgada), Davis (Buenos Aires), van Everdingen (de Bilt), Hamberg (Stockholm), Hellmann (Berlin), Maurer (Zürich), Mohn (Christiania), Moore (Washington), Nakamura (Tokio), Palazzo (Rome), Ryder (Copenhagen), Rykatcheff (St. Petersburg), Shaw (London), Stupart (Toronto), Trabert (Vienna), and Walker (Simla).

The English and French editions of the minutes of the Directors' Conference held at Innsbruck were published and distributed by the institutes of London and Paris very soon after the meeting of the Committee in 1907. The minutes of the latter were published in German at the beginning of 1908 by the Berlin Institute, and in the course of the same year the English edition, containing also some additional information in Appendix XIII, was distributed by the London Office, which in 1909 had also issued an English translation of the "Internationaler Meteorologischer Kodex," prepared by Messrs. Hellmann and Hildebrandsson.

The Commission for Scientific Aeronautics held a Conference at Monaco from 31st March to 6th April, 1909, the proceedings of which have been published. At the same time a meeting of the Réseau Mondial Commission, formed at the last Session of the Committee in Paris, was also held in Monaco.

The Commissions for Weather Telegraphy and Maritime Signals, also appointed at the Paris Conference in 1907, met in London from June 21st to 24th, 1909; the minutes have been published in English by the Meteorological Office.

The Solar Commission held two meetings in London, June 28th and 29th, 1909, of which the discussions have been printed in English as an Appendix to the report of the Solar Physics Committee.

Finally we may mention that the Commission for Terrestrial Magnetism has just held a Conference at Berlin.

W. N. SHAW, President. G. HELLMANN, Secretary.

APPENDIX III.

LETTER FROM THE DEUTSCHE SEEWARTE REGARDING TEN-DAY REPORTS.

Hamburg,
20th June, 1908.

To the President of the International Meteorological Committee,

Dr. W. N. Shaw,
London, S.W.

The Deutsche Seewarte begs leave to reply as follows to your kind letter of the 19th May last regarding the Committee's resolutions Nos. 6, 10.

The object of the Seewarte's Ten-Day Reports is to give, as quickly as possible, a provisional, but at the same time an adequate, review of the main features of the weather of the Northern Hemisphere, which, at present, is fairly well covered with observing stations. It appears regularly within a month of the end of the period represented. After one or more years the data contained in these reports will also be published in larger, definite publications of the various institutes.

This characteristic of the Ten-Day Report, as well as the following circumstances, render the successful accomplishment of the desire expressed by the International Meteorological Committee impossible, even if the Deutsche Seewarte were able to provide the clerical assistance necessary to cope with the work, which is, at present, not feasible:—

(1.) The small variations of the barometer in the tropics—tropical hurricanes are hardly ever shown in our daily synoptic charts—require for their investigation far more accurate and comprehensive observation than is necessary for higher latitudes. Data from the Atlantic Ocean in the neighbourhood of the tropics are, however, far more scanty than from the region between Europe and the United States. Added to this the support of well organised observation réseaux on the adjacent mainland, which give the charts such a firm basis in the north, is wanting there. The uncertainty of the single barometer reading, which amounts to nearly 1 mm. on the sea, does not conceal the general features of pressure distribution in higher latitudes; in the tropical zone they are often entirely distorted by it.

(2.) As regards wind, matters are far more satisfactory than for pressure. In lower latitudes pressure differences for the same wind force are much smaller than in higher latitudes. The determination, therefore, of the moving boundaries of the trades, or horse latitudes and the African monsoon, is a more easily solved problem than the construction of efficient isobaric charts for these regions. These boundaries are, however, published annually by the Deutsche Seewarte in "Tabellarischen Reiseberichten." They can be extracted and compiled with very little trouble by those interested, usually about one year after the observation.

(3.) As regards data from the tropics, it would be impossible to carry out a publication so nearly up to date as is done at present for the small charts of the Ten-Day Report; one could not get on without sailing ships there. Delay of a few weeks would interfere with the purpose of the Ten-Day Report very considerably, and the new undertaking would not gain much thereby.

(4.) If cartographic representation is needed, then, according to the above, the matter is far more suitable for the Synoptic Charts of the Deutsche Seewarte and the Danish Meteorological Institute than for the provisional ones of the Ten-Day Report. There might be introduced, in the form of a small inset chart which can take the place of the Sahara, a representation of the conditions (principally wind) in the region between 10° N. and 10° S. latitude and 10° to 40° W. longitude, on Mercator's projection, as the conical projection is unsuitable for these latitudes. At the same time it would be necessary to obtain good observations from Sierra Leone and the east of Brazil for this purpose.

As there will be some relaxation in the work on the Synoptic Charts in about nine months time, the Deutsche Seewarte is prepared then to make an attempt in this direction, and further work in the matter will depend on the results obtained. At that time it will probably be also possible to expedite the issue of the charts. Entries will be made in the manuscript charts immediately on receipt of the logs concerned, so that, except for special investigations, it will be possible, on certain conditions, for the charts to be available earlier than now.

HERZ.

APPENDIX IV.

REPORT OF THE PROCEEDINGS OF THE SOLAR COMMISSION.

Presented by the President, Sir Norman Lockyer.

I beg to submit the following report of the actions of the Solar Commission since the last communication of the proceedings of this Commission was made to the International Meteorological Committee at the Paris Meeting in 1907.

A meeting of the Commission, the third that has occurred, took place in London in June, 1909, in the rooms of the Royal Society.

Unfortunately the Commission has lost the very valuable services of Sir John Eliot, K.C.I.E., their Secretary. They would take this opportunity of placing on record their appreciation of the important part he took in the work of this Commission.

At the London Meeting Dr. W. J. S. Lockyer was elected Secretary.

The discussions at the meeting centred mainly on three subjects, namely, the form in which temperature data should be sent to the Commission, the preparation of a réseau of stations to represent the meteorology of the earth, and, lastly, the form of publication. In the case of the first named, a small committee was formed. This sub-committee reported the changes suggested

by their discussion, but the Commission decided that their conclusions before being adopted should be communicated in a circular to the members of the Commission not present. This circular has not yet been distributed.

With regard to the réseau, a scheme initiated by Sir John Eliot and Dr. W. N. Shaw for a selection of stations to represent the meteorology of the globe, it was resolved that with the exception of Europe, the maximum number of stations per ten-degree square should be two—independent of latitude. The preparation of a provisional list of stations representing the whole réseau for subsequent circulation was placed in the hands of Dr. Shaw. It has now been received and is published as an appendix to the Report of the Solar Physics Observatory for the year 1909-1910, which it is hoped soon to distribute.*

The question of the form in which all the data received should be published was discussed and the Commission decided to issue them in annual volumes, the data being tabulated on monthly forms, *i.e.*, all stations together each month.

It was decided to publish with the meteorological data both the solar and magnetic data, and Dr. van Everdingen agreed that the Commission might make use of the publications of the Commission Internationale de Magnetisme Terrestre for the last-mentioned.

APPENDIX IVA.

The list of stations compiled for the Solar Commission and the meteorological data for January, 1905, as presented to the meeting of the Committee at Berlin, with charts representing the distribution of mean pressure and temperature of the month, are included in the following table of meteorological data representing the meteorology of the globe for January, 1905, by means of stations selected, with certain exceptions, at the rate of two for each ten-degree square.

In the table the meteorological data for the month and, where possible, the differences from average are given in the columns on the right-hand page. Information as to the position of the stations is given in the left-hand page. A column on the same page is assigned for references to the publications from which the data have been extracted, and two columns headed " Barometer " and " Temperature " give information as to the manner in which the mean values entered in the corresponding columns on the opposite page have been computed from the original instrumental readings.

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* The Report of the Solar Physics Observatory for the year 1909–10 includes the following Appendices :

APPENDIX A.—The programme for the meeting of the Solar Commission on June 28, 1909.

APPENDIX B.—The acta of the meeting.

APPENDIX C.—List of stations to represent the meteorology of the globe comprising (with certain exceptions) not more than two (low level) stations for each ten-degree square. (*See* pp. 28–51.)

TABLE REPRESENTING THE METEOROLOGY OF THE GLOBE FOR JANUARY 1905, BY MEANS OF DATA FROM STATIONS SELECTED, WITH CERTAIN EXCEPTIONS, AT THE RATE OF TWO FOR EACH TEN-DEGREE SQUARE OF LATITUDE AND LONGITUDE, PREPARED IN THE METEOROLOGICAL OFFICE, LONDON.

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.	Pressure. Mean at Level of Station.	Pressure. Mean at M.S.L.	Diff. from Av.	Temperature. Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean,	Diff. from Normal.	Rainfall. Total.	Rainfall. Diff. from Av.
1	Gjesvaer	71° 6′ N.	25° 22′E.	6·5m.	Jahrbuch Norwegian Met. Inst., p. 114.	8, 14, 20 corrected.	Mx. not obs. M = n − k (n − Mn.) n = (8 + 14 + 20)/3 k varies for month & station	746·0	—	—	—	6·4C.	15th	−6·5C.	—	—	−3·7C.	—	48·5mm.	— 1
2	Malye Karmakouly	72° 23′	52° 43′	14·8m.	Ann, Obs. Phys. Cent. St. Pet., p. 283.	(7 + 13 + 21)/3	(7 + 13 + 21)/3	742·7	—	—	—	−0·2C.	16th	−21·8C.	—	—	−17·1C.	—	7·1mm.	— 2
3	Kazatchie	70° 55′	136° 27′E.	17m.?	Ann. Obs. Phys. Cent., p. 149.	Do.	*See* below, Archangel, &c.	755·0	—	—	—	−24·1C.	26th	−44·7C.	—	—	−41·5C.	—	1·7mm.	— 3
4	Dejnevskii Post ..	66° 8′	169° 33′W.	7·6m.	Ann. St. Pet., p. 235. August and September only available for 1905.	Do.	(7 + 13 + 21)/3 *See* below, Archangel, &c.	—	—	—	—	—	—	—	—	—	—	—	—	— 4
5	Fort McPherson ..	67° 27′	134° 57′	—	Not published, 1905..	A column headed "pressure" reduced to M.S.L.	Mean Mx. and Mean Mn. not given. Method of computing "mean" not stated.	—	—	—	—	—	—	—	—	—	—	—	—	— 5
6	Dawson	64° 4′	139° 20′	1,200 ft.	Canadian Weather Review, p. 5.			—	—	—	—	—	—	—	—	—	—	—	—	— 6
7	Fort Simpson ..	61° 52′	121° 43′	—				—	—	—	—	—	—	—	—	—	—	—	—	— 7
8	Fort Good Hope ..	? 66°	? 129°	—	Not published for 1905.			—	—	—	—	—	—	—	—	—	—	—	—	— 8
9	Hay River	60° 51′	115° 20′	—				—	—	—	—	—	—	—	—	—	—	—	—	— 9
10	Ash Inlet	—	—	—				—	—	—	—	—	—	—	—	—	—	—	—	— 10
11	Godthaab	64° 11′	50° 55′	9m.	Met. Aarbog Denmark, part II, p. 4.	—	—	747·2	—	—	−9·5C.	+0·1C.	4th	−14·9C.	—	—	−12·3C.	—	45·0mm.	— 11
12	Jacobshavn	69° 13′	51° 2′	12·6m.	Do., p. 4.	—	—	751·1	—	—	−16·6C.	−1·8C.	22nd	−22·8C.	—	—	−20·4C.	—	9·8mm.	— 12
13	Augmagsalik ..	65° 36½′	37° 33½′	31·7m.	Do., p, 6.	(8 + 14 + 21)/3 corrected ?	—	743·9	—	—	−8·0C.	+1·2C.	17th	−15·6C.	—	—	−12·3C.	—	33·9mm.	— 13
14	Stykkisholm ..	65° 5′	22° 46′	11·3m.	Do., p. 3.	—	—	746·5	—	—	0·8C.	+6·6C.	21st	−5·3C.	—	—	−2·8C.	—	141·7mm.	— 14
15	Vestmannö	63° 26′	20° 15′	7m.	Do., p. 5.	—	—	747·5	—	—	+4·0C.	+8·1C.	1st	−2·1C.	—	—	+1·0C.	—	225·6mm.	— 15
16	Seydisfjord	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	— 16
17	Bernfjord	64° 40′	14° 19′	1·8m.	Do., p. 3.	—	—	746·6	—	—	+2·4C.	+2·4C.	28th	−4·6C.	—	—	−1·8C.	—	258·7mm.	— 17
18	Grimsey	66° 33′	18° 0′	6·8m.	Do., p. 3	(8 + 14 + 21)/3 corrected ?	—	747·9	—	—	−0·1C.	6·3C.	26th	−5·9C.	—	—	−3·2C.	—	11·9mm.	— 18
19	Thorshavn	62° 2½′	6° 45′W.	11·0m.	Do., p. 3			752·8	—	—	+6·6C.	10·2C.	29th	0·9C.	—	—	+4·0C.	—	211·0mm.	— 19
20	Bergen	60° 23′	5° 21′E.	21·8m.	Jahrbuch Nor. Met. Inst.. p. 104.	8, 14, 20, corrected. *See* Gjesvaer.	*See* Gjesvaer	759·0	—	—	—	8·0C.	28th	−0·6C.	—	—	1·9C.	—	371·9mm.	— 20
21	Christiansund ..	63° 7′	7° 45′	22·8m.	Do., p. 108			754·5	—	—	—	8·6C.	2nd	−0·9C.	—	—	1·5C.	—	203·9mm.	— 21
22	Trondhjem	63° 26′	10° 25′	39·5m.	Do., p. 108			753·3	—	—	—	8·8C.	2nd	−6·7C.	—	—	−3·1C.	—	173·3mm.	— 22
23	Hernösand* ..	62° 38′	17° 57′	15·3m.	Obs. Mét. Sued., p. 139	(8 + 14 + 21)/3	(8 + 14 + 5 × 21)/8	755·2 (754·9 at 8 a.m.)	—	—	−4·8C.	+8·5C.	28th	−14·7C.	—	—	−9·5C.	—	37·4mm.	— 23
24	Haparanda*	65° 50′	24° 9′	9·2m.	Met. Iakttagelser in Sverige, p. 145.			751·8 (752·0 at 8 a.m.)	—	—	−6·9C.	±0.0C.	28, 29	−18·5C.	—	—	−11·6C.	—	19·8mm.	— 24
25	Helsingfors	60° 14′	24° 57′	—	Not yet received ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	— 25
26	Kuopio	62° 53′	27° 36′	—	1901 last return received.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	— 26
27	Kola	68° 53′	33° 1′	6·7m.	Ann. Obs. Phys. Cent. St. Pet., p. 4.	—	—	749·0	—	—	—	+4·4C.	21st	−15·5C.	−34·4C.	13th	−10·8C.	—	10·4mm.	— 27
28	Petrozavodsk ..	61° 47′	34° 23′	62·7m.	Stopped	—	—	—	—	—	—	—	—	—	—	—	—	—	—	— 28
29	Arkhangelsk ..	64° 33′	40° 32′	6·7m.	Ann. Obs. Phys. Cent. St. Pet., p. 10.	(7 + 13 + 21)/3 7, 13, and 21 are given separately also.	Minimum read at 9 p.m. Maximum temperatures are absolute maxima of the dry bulb readings. (7 + 13 + 21)/3 uncorrected.	753·4	—	—	—	−1·0C.	26th	−16·0C.	−30·8C.	13, 14	−11·0C.	—	37·9mm.	— 29
30	Solvytchegodsk ..	61° 20′	46° 55′	62m.?	Do., p. 16			751·9	—	—	—	−0·8C.	22nd	−18·5C.	−39·6C.	1st	−14·1C.	—	13·6mm.	— 30
31	Oust Sysolsk ..	61° 40′	50° 51′	101m.?	Do., p. 16			747·0	—	—	—	−0·1C.	22, 23	−20·1C.	−39·5C.	1st	−15·3C.	—	11·0mm.	— 31
32	Troitsko-Petchers-koe.	62° 42′	56° 13′	112m.?	Do., p. 242			No Bar.	—	—	—	+0·4C.	—	−23·7C.	−41·9C.	—	−17·7C.	—	11·7mm.	— 32
33	Oust-Tsylma ..	65° 27′N.	52° 10′E.	27m.?	Do., p. 8			748·9	—	—	—	1·0C.	22nd	−17·9C.	−41·1C.	19th	−13·4C.	—	26·6mm.	— 33

* Gravity correction not applied to the readings of pressure.

	Name of Station.	Latitude.	Longitude,	Height.	References.	Barometer.	Temperature.
1	Obdorsk	66° 31′N.	66° 35′E.	26·2m.	Ann. Obs. Phys. Cent. St. Pet., p. 141.	(7 + 13 + 21)/3 7, 13 and 21 are given separately also.	Minimum read at 9 p.m. Maximum temperatures are the absolute maxima of the dry bulb readings. (7 + 13 + 21)/3 uncorrected.
2	Berezov	63° 56′	65° 4′	39·5m.	Do., p. 232		
3	Sourgout	61° 15′	73° 24′	42m.	Do., p. 141		
4	Touroukhansk ..	65° 55′	87° 38′	40m.?	Do., p. 283		
5	Olekminsk	60° 22′	120° 26′	202m.?	Do., p. 272		
6	Iakoutsk	60° 10′	129° 43′	108m.?	Do., p. 150		
7	Verkhoyansk ..	67° 33′	133° 24′	100m.?	Do., p. 149		
8	Sredne—Kolymsk..	67° 10′	157° 10′	30m.?	Do., p. 148		
9	Nijne—Kolymsk ..	68° 32′	160° 59′	5m.?	Do., p. 233		
10	Gijiginsk	62° 2′	160° 40′	12m.?	Do., p. 187		
11	Markovo sur Anadyr.	64° 45′	170° 50′E.	20m.?	Do., p. 187		
12	Sitka*	56° 50′	135° 0′W.	—	—	—	—
13	Port Simpson* ..	54° 34′	130° 26′	26 ft.	—	—	—
14	Fort Macleod* ..	49° 44′	113° 24′	—	Can. M.W.R., p. 5 ..	*See* above, Canada.	*See* above, Canada.
15	Kamloops*	50° 41′	120° 29′	1,193 ft.	—	—	—
16	Barkerville* ..	53° 2′	121° 35′	4,180 ft.	—	—	—
17	Fort Chipewyan* ..	58° 42′	111° 10′	—	—	—	—
18	Calgary*	51° 2′	114° 2′	3,389 ft.	Can. M.W.R., p. 5 ..		
19	Prince Albert* ..	53° 10′	106° 0′	1,432 ft.	Do.		
20	Qu'appelle*	50° 30′	103° 47′	2,115 ft.	Do.		
21	Fort Churchill* ..	58° 51′	94° 11′	—	—	*See* above, Canada.	*See* above, Canada.
22	Norway House* ..	53° 58′	97° 52′	720 ft.	—		
23	Fort Hope*	51° 32′	87° 48′	—	Not given for 1905.		
24	Moose Factory* ..	51° 16′	80° 56′	—	—		
25	Davis Inlet*	55° 50′	60° 50′	—	—		
26	Nain†	56° 33′	61° 41′	4·2m.	Deutsche Seewarte Ueberseeische Beob., pp. 1, 2, 3.	(7 + 14 + 21)/3 Hours given separately.	7, 14, 21, prob. (7 + 14 + 2 × 21)/4
27	Hebron†	58° 12′	62° 21′	15·0m.			
28	Belle Isle	51° 55′	55° 20′	—	—	—	—
29	Valencia†	51° 56′	10° 15′	45 ft.	British Meteorological Year Book.	(9 + 21)/2 (Hourly available.)	Hourly values available.
30	Aberdeen†	57° 10′	2° 6′W.	88 ft.	Do.		
31	Greenwich† ..	51° 28′	0° 0′	159 ft.	Reg. Gen.		
32	Hamburg†	53° 33′	10° 0′E.	26m.	Deutsche Seewarte Met. Beob. in Deutschland, p. 63.	(8 + 2 + 8)/3 (Hourly available.)	(8 + 20 + Mx. + Mn.)/4 May to August. ½ [(8 + 20)/2 + (8 + 14 + 20)/3] Sept. to April.
33	De Bilt†	52° 6′	5° 11′	3·0m.	Ned. Met. I., pp. 46 and 191.	24 hours ..	Hourly available (8 + 14 + 19)/3 or 24 hours available.
34	Uccle	50° 48′	4° 22′	100m.	1904 last received ..	—	—
35	Upsala†	59° 51′	17° 37′	24·0m.	Met. Iak. in Sverige, p. 134.	*See* above, Haparanda.	*See* above, Haparanda.
36	Potsdam	52° 24′	13° 3′	84·9m.	Potsdam an. volumes	24 hours ...	24 hours.
37	Copenhagen* ..	55° 41′N.	12° 36′E.	13·3m.	Met. Aarbog., pp. 4, 5	—	—

* No information regarding gravity correction.

Pressure.		Diff. from Av.	Temperature.								Rainfall.	
Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.
748·5	—	—	—	—7·5C.	25th	—28·9C.	—38·5C.	4th	—24·1C.	—	2·0mm.	— 1
—	—	—	March-July only.								—	— 2
751·5	—	—	—	—6·3C.	5th	—28·5C.	—41·0C.	1st	—22·8C.	—	7·5mm.	— 3
No Bar.	—	Jan.-Sept.	—	—8·0C.	—	—31·0C.	—46·5C.	—	—25·3C.	—	2·7mm.	— 4
No Bar.	—	—	—	—4·9C.	—	—29·9C.	—51·7C.	—	—24·2C.	—	12·3mm.	— 5
749·8	—	—	—	—17·3C.	27th	—40·9C.	—52·8C.	21st	—35·6C.	—	15·1mm.	— 6
747·8	—	—	—	—24·6C.	1st	—53·8C.	—63·4C.	20th	—49·9C.	—	6·7mm.	— 7
754·9	—	—	—	—23·8C.	2nd	—45·5C.	—55·4C.	21st	—41·5C.	—	11·8mm.	— 8
758·5	—	—	—	—15·2C.	24th	—39·2C.	—47·6C.	16th	—35·6C.	—	19·4mm.	— 9
752·2	—	—	—	—0·1C.	26th	—	—	—	—23·0C.	—	17·4mm.	— 10
753·5	—	—	—	—0·2C.	26th	—28·7C.	—47·8C.	1st	—23·5C.	—	24·8mm.	— 11
—	—	—	—	—	—	—	—	—	—	—	—	— 12
—	—	—	—	—	—	—	—	—	—	—	—	— 13
No Bar.	—	—	—	51·0F.	3rd	Not given.	—22·0F.	13th	13·4F.	—7·0F. (10)	Not given.	— 14
—	—	—	—	—	—	—	—	—	—	—	—	— 15
—	—	—	—	—	—	—	—	—	—	—	—	— 16
—	—	—	—	—	—	—	—	—	—	—	—	— 17
—	30·34	—	—	46·0F.	2nd	Not given.	—28·0F.	14th	10·0F.	—1·9F. (21)	1·04 in.	+0·55 in. 18
—	30·31	—	—	28·0F.	18th	Do.	—49·5F.	10th	—4·3F.	+0·5F.	0·20 in.	—0·67 in. 19
—	30·34	—	—	30·0F.	4th	Do.	—28·5F.	10th	—0·3F.	+0·6F. (22)	0·52 in.	—0·08 in. 20
—	—	—	—	—	—	—	—	—	—	—	—	— 21
—	—	—	—	—	—	—	—	—	—	—	—	— 22
—	—	—	—	—	—	—	—	—	—	—	—	— 23
—	—	—	—	—	—	—	—	—	—	—	—	— 24
—	—	—	—	—	—	—	—	—	—	—	—	— 25
754·0	—	—	—19·2C.	—7·7C.	—	—28·5C.	—35·3C.	—	—24·5C.	—	Not recorded.	— 26
752·6	—	—	—19·0C.	—6·0C.	—	Missing.	Missing.	—	—22·3	—	Do.	— 27
—	—	—	—	—	—	—	—	—	—	—	—	— 28
30·142	—	—	48·9F.	52·6F.	14th	43·2F.	33·0F.	18th	—	—	4·56 in.	— 29
29·898	—	—	44·7F.	53·7F.	28th	36·4F.	30·4F.	17th	—	—	0·62 in.	— 30
30·101	—	—	43·6F.	54·0F.	7th	32·4F.	19·5F.	1st	38·0F.	—0·5	1·00 in.	—0·99 in. 31
764·0	—	—	2·5C.	6·8C.	29th	—2·9C.	—9·6C.	2nd	—0·2C.	—	39·9mm.	— 32
768·08	—	—	4·0C.	9·7C.	7th	—2·2C.	—12·4C.	2, 3	1·5C.	—	32·0mm.	— 33
—	—	—	—	—	—	—	—	—	—	—	—	— 34
757·2	—	—	—1·1C.	7·0C.	30th	—7·9C.	—17·1C.	14th	—4·4C.	—	25·7mm.	— 35
759·34	—	—	+1·5C.	5·4C.	9, 12	—4·8C.	—15·6C.	3rd	—1·58C.	—	30·4mm.	— 36
763·3	—	—	2·2C.	7·2C.	30th	—1·7C.	—9·8C.	1st	0·7C.	—	24·0mm.	— 37

† Gravity correction not applied to the readings of pressure.

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.
1	Warsaw	52° 13′N.	21° 2′E.	120·7m.	Ann. Obs. Phys. Cent. St. Pet., p. 64.		
2	Iouriev	58° 23′	26° 43′	75·0m.	Do., p. 20		
3	St. Petersburg ..	59° 56′	30° 16′	4·8m.	Do., p. 26		
4	Moscow	55° 50′	37° 33′	165·7m.	Do., p. 50		
5	Kiev	50° 27′	30° 30	182·9m.	Do., p. 94		
6	Kazan	55° 47′	49° 8′	79·8m.	Do., p. 56		
7	Saratov	51° 32′	46° 3′	59·9m.	Do., p. 116		
8	Orenbourg	51° 45′	55° 6′	114·1m.	Do., p. 60		
9	Perm	58° 1′	56° 16′	159·3m.	Do., p. 40		
10	Ekaterinbourg ..	56° 50′	60° 38′	285·6m.	Do., p. 42		
11	Tobolsk	58° 12′	68° 14′	108·3m.	Do., p. 142		
12	Omsk	54° 58′	73° 23′	90·0m.	Do., p. 154		
13	Akmolinsk	51° 12′	71° 23′	350m.	Do., p. 158.	*See* above, Russia.	*See* above, Russia.
14	Barnaoul	53° 20′	83° 47′	162m.?	Do., p. 168.		
15	Tomsk	56° 30′	84° 58′	124·9m.	Do., p. 162.		
16	Eniseisk	58° 27′	92° 11′	85m.?	Do., p. 144.		
17	Minousinsk	53° 43′	91° 41′	255m.?	Do., p. 148.		
18	Irkoutsk	52° 16′	104° 19′	470·5m.	Do., p. 174.		
19	Kirensk	57° 47′	108° 7′	270m.?	Do., p. 172.		
20	Blagovechtchenskii Prlisk.	58° 10′	114° 17′	490m.?	Do., p. 150.		
21	Nertchinsk	51° 59′	116° 35′	488·4m.	Do., p. 182.		
22	Blagovechtchensk	50° 15′	127° 38′	150m.?	Do., p. 184.		
23	Nikolaevsk - sur - Amour.	53° 8′	140° 45′	32·5m.	Do., p. 186.		
24	Okhotsk	—	—	—	—		
25	Petropavlovsk ..	52° 53′	158° 47′E.	111·1m.	Ann. Obs. Phys. Cent. St. Pet., p. 285.		
26	Portland (Oreg.) ..	45° 32′	122° 43′W.	153 ft.	M. W. R. Washington, p. 23.	"Reduced to 24 hours." Gravity correction applied to both values.	(Max. + Min.)/2
27	Victoria B.C.* ..	48° 24′	123° 19′	85 ft.	Canada, M. W. R., p. 4	*See* above.	—
28	Helena	46° 34′	112° 4′	4,110 ft.	M. W. R. Washington, p. 23.		
29	Salt Lake City ..	40° 46′	111° 54′	4,365 ft.	Do., p. 23.		
30	Bismarck	46° 47′	100° 38′	1,674 ft.	Do., p. 23.		
31	Cheyenne	41° 8′	104° 48′	6,088 ft.	Do., p. 23.		
32	North Platte ..	41° 8	100° 45′	2,821 ft.	Do., p. 23.		
33	Duluth	46° 47′	92° 6′	1,133 ft.	Do., p. 22.	*See* above under Portland.	—
34	Winnipeg	49° 53′	97° 7′	760 ft.	C.M.W.R., p. 5 ..		
35	Chicago	41° 53′	87° 37′	823 ft.	M.W.R., p. 22		
36	Port Arthur ..	48° 27′	89° 12′	644 ft.	C.M.W.R., p. 6 ..		
37	New York	40° 43′	74° 00′	314 ft.	M.W.Rev., p. 22 ..		
38	Toronto	43° 40′N.	79° 24′W.	350 ft.	C.M.W.R., p. 6 ..		

* No information regarding gravity correction.

Pressure.		Diff. from Av.	Temperature.								Rainfall.	
Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.
755·4	—	—	—	3·7C.	31st	—7·3C.	—21·5C.	2nd	—4·4C.	—	73·8mm.	— 1
754·1	—	—	—	2·8C.	9th	—12·4C.	—24·3C.	1st	—8·4C.	—	56·2mm.	— 2
759·0	—	—	—	2·2C.	9th	—12·3C.	—23·8C.	1st	—8·5C.	—	31·5mm.	— 3
746·6	—	—	—	1·0C.	10th	—16·7C.	—33·6C.	1st	—12·1C.	—	24·8mm.	— 4
748·7	—	—	—	2·6C.	31st	—11·0C.	—26·9C.	3rd	—7·3C.	—	21·3mm.	— 5
754·7	—	—	—	—0·9C.	10th	—18·7C.	—34·4C.	1st	—14·6C.	—	14·9mm.	— 6
No Bar.	—	—	—	1·4C.	7th	—16·2C.	—25·7C.	20th	—11·9C.	—	27·6mm.	— 7
754·1	—	—	—	—0·1C.	8th	—21·0C.	—35·0C.	20th	—15·5C.	—	48·7mm.	— 8
744·4	—	—	—	—3·4C.	11th	—20·8C.	—36·8C.	20th	—16·3C.	—	40·8mm.	— 9
732·2	—	—	—	—1·8C.	11th	—20·2C.	—32·3C.	20th	—15·9C.	—	11·1mm.	— 10
747·8	—	—	—	—5·4C.	5th	—	—	—	—18·7C.	—	22·5mm.	— 11
752·8	—	—	—	—1·0C.	9, 10	—25·8C.	—44·7C.	20th	—17·2C.	—	20·2mm.	— 12
732·3	—	—	—	—0·7C.	10th	—20·8C.	—40·4C.	21st	—16·4C.	—	40·3mm.	— 13
751·0	—	—	—	1·5C.	7th	—20·0C.	—40·5C.	1st	—14·8C.	—	47·1mm.	— 14
751·0	—	—	—	0·9C.	11th	—20·2C.	—39·4C.	20th	—16·1C.	—	47·7mm.	— 15
754·0	—	—	—	2·2C.	11th	—21·4C.	—40·6C.	17th	—16·6C.	—	39·9mm.	— 16
742·8	—	—	—	3·2C.	8th	—17·2C.	—31·5C.	28th	—12·3C.	—	Not recorded.	— 17
722·2	—	—	—	0·4C.	13th	—23·4C.	—34·3C.	23rd	—16·4C.	—	2·5mm.	— 18
737·9	—	—	—	1·7C.	12th	—23·1C.	—41·1C.	19th	—16·5C.	—	16·8mm.	— 19
715·3	—	—	—	—15·2C.	10th	—36·0C.	—49·2C.	20th	—31·3C.	—	17·3mm.	— 20
718·4	—	—	—	—4·4C.	6th	—27·6C.	—37·7C.	24th	—21·7C.	—	2·3mm.	— 21
750·2	—	—	—	—7·4C.	14th	—	—	—	—18·3C.	—	17·5mm.	— 22
758·3	—	—	—	—10·0C.	12th	—27·2C.	—37·8C.	31st	—21·5C.	—	Not obs.	— 23
—	—	—	—	—	—	—	—	—	—	—	—	— 24
No Bar.	—	—	—	0·3C.	—	—10·8C.	—18·2C.	—	—8·6C.	—	6·0mm.	— 25
29·95	30·12	+·04	45F.	58F.	27th	36F.	25F.	12th	40·4F.	+2·0F.	3·66 in	—3·5 in. 26
—	30·10	—	—	51·3F.	2nd	—	27·4F.	13th	41·0F.	+1·7F.	3·34 in.	—1·67 in. 27
25·94	30·32	+·17	29F.	50F.	25th	14F.	—12F.	31st	21·2F.	+4·1F.	0·20 in.	—1·2 in. 28
25·72	30·19	+·04	40F.	57F.	25th	26F.	14F.	12th	33·2F.	+5·3F.	0·65 in.	—0·8 in. 29
28·50	30·43	+·30	11F.	38F.	4th	—8F.	—27F.	31st	1·8F.	—2·7F.	0·31 in.	—0·2 in. 30
24·04	30·25	+·20	33F.	51F.	27th	14F.	—20F.	11th	23·7F.	—1·3F.	0·84 in.	+0·5 in. 31
27·28	30·36	+·24	30F.	59F.	3rd.	19F.	—20F.	13th	19·8F.	—0·2F.	0·90 in.	+0·4 in. 32
28·96	30·27	+·18	14F.	36F.	1st	—3F.	—21F.	10th	5·5F.	—4·5	0·78 in.	—0·3 in. 33
—	30·34	—	—	29·5F.	18th	—	—39·1F.	10th	—5·2F.	—0·1	0·20 in.	—0·63 in. 34
29·31	30·24	+·14	25F.	48·F.	1st	11F.	—5F.	14th	11·4F.	—2·9	1·33 in.	—0·8 in. 35
—	30·24	—	—	42F.	1st	—	—21F.	10th	4·4F.	—0·3	0·22 in.	—0·58 in. 36
29·76	30·11	+0·1	34F.	52F.	7th	22F.	0F.	26th	27·5F.	—3·0	3·93 in.	—0·1 in. 37
—	30·15	—	—	42·2F.	1st	—	—7·1F.	26th	17·8F.	—4·8	3·27 in.	+0·39 in. 38

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.
1	St. John, N.B. ..	45° 17′N.	66° 4′W.	70 ft.	C.M.W.R., p. 7 ..	See above under Portland.	—
2	S.W. Point Anticosti	49° 24′	63° 35′	30 ft.	Do. p. 7 ..		
3	St. John's, Newfoundland.	47° 34′	52° 42′	125 ft.	Do. p. 7 ..		
4	Sable Island.. ..	43° 58′	59° 46′	25 ft.	Do. p. 7 ..		
5	Madrid	40° 24′	3° 43′	655m.	1901 last received ..	—	—
6	Nantes*	47° 15′	1° 34′W.	41·4m.	Annal. du Bureau Central, Paris, p. B50.	6, 12 and 21 reduced to true mean for 24 hours.	6, 12, 21 reduced to true mean for 24 hours.
7	Paris (Montsouris)*	48° 50′	2° 20′E.	77m.	Do. p. B52		
8	Marseilles*	43° 18′	5° 23′	75m.	Do. p. B47		
9	Zürich*	46° 12′	6° 9′	405m.	Swiss Annalen, p. 83	(7+13+21)/3 ..	(7+13+2×21)/4.
10	Vienna	48° 15′	16° 21′ 6″	202·5m.	Aust. Jahrbuch, p. 28	—	—
11	Rome	41° 54′	12° 59′	—	1901 last received ..	—	—
12	Buda-Pesth* ..	47° 30′	19° 3′	112·5m.	Jahrbuch U. Met. Cent., p. 95.	(7+14+21)/3 ..	(7+14+21)/3 + a monthly correction.
13	Bukarest†	44° 25′	26° 6′	82m.	Bul. Lunar, p. 9, 10. Obs. Met.	(8+14+20)1/3 ..	m=n−h(n−Min) (n=(8+14+20)/3) Mean Max. Mean Min. not given.
14	Scutari	41° 0′	29° 3′	60 ft.	—	—	—
15	Hermannstadt (Nagyszeben).‡	45° 47′	24° 9′	411·4m.	Jahrbuch Ung. C.A., p. 125.	See above, Buda-Pesth.	—
16	Odessa (Université)	46° 26′	30° 46′	65·3m.	Annales Obs. Phys. Cent. St. Pet., p. 123.		
17	Kharkov (Université).	50° 0′	36° 14′	140·4m.	Do., p. 109.		
18	Novorossiisk ..	44° 40′	37° 49′	37·1m.	Do., p. 196.		
19	Tiflis	41° 43′	44° 48′	403·8m.	Do., p. 208.		
20	Astrakhan	46° 21′	48° 2′	−13·8m.	Do., p. 128.		
21	Fort Alexandrovsk	44° 31′	50° 16′	24m.	Do., p. 217.	See Russia.	—
22	Krasnovodsk ..	48° 0′	52° 59′	−14·5m.	Do., p. 217.		
23	Tashkent	41° 20′	68° 52′	478·3m.	Do., p. 225.		
24	Irgiz	—	—	—	—		
25	Vernyi	43° 16′	76° 53′	782·9m.	Do., p. 218.		
26	Narynskoe	41° 26′	76° 2′	? 2,015m.	Do., p. 220.		
27	Ourga	47° 55′	106° 50′	? 1,325m.	—	—	—
28	Mukden‡	41° 48′	123° 23′	57·5m.	Monthly Report of the Cent. Met. Obs. of Japan. Observations commence May, 1905.	(2 + 6 + 10 + 14 + 18 + 22)/6. Values at M.S.L. corrected for gravity.	Same as pressure *and* (Max. + Min.)/2.
29	Josui‡	40° 40′	129° 20′	4·0m.	Do.	Do.	Do.
30	Vladivostok	43° 7′	131° 54′	16·9m.	Annales Obs. Phys. Cent. St. Pet., p. 188.	See Russia.	—
31	Kushiu Kotan (Saghalien).‡	46° 40′	142° 46′	32·0m.	Monthly Report from Japan. Commences October, 1905.	See Mukden.	See Mukden.
32	Nemuro‡	43° 20′	145° 35′E.	26·7m.	Monthly Report from Japan, p. 133.	Hourly M.S.L. at 45°.	Hourly.
33	San Francisco ..	37° 48′	122° 26′W.	155 ft.	M.W.R., p. 23.. ..	See above under Portland.	See above, under Portland.
34	San Luis Obispo ..	35° 18′	120° 39′	201 ft.	Do. p. 23.. ..		
35	Modena	37° 30′N.	119° 49′W.	—	Do. p. 23.. ..		

* Gravity correction not applied to the readings of pressure.
† No information regarding gravity correction.

Pressure.		Diff. from Av.	Temperature.								Rainfall.		
Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.	
—	30·03	—	—	47·5F.	8th	—	−11·0F.	15th	15·8F.	−2·8	5·59 in.	0·74 in.	1
—	—	—	—	—	—	—	—	—	—	—	—	—	2
—	—	—	—	—	—	—	—	—	—	—	—	—	3
—	No Bar, 1905.	—	—	47·0F.	4th	—	10·0F.	18th	29·4F.	−1·8	4·52 in.	+0·62 in.	4
—	—	—	—	—	—	—	—	—	—	—	—	—	5
767·9	—	—	6·9C.	11·2C.	8th	0·0C.	−9·0C.	2nd	3·1C.	—	42·1mm.	—	6
763·8	—	—	4·9C.	11·9C.	7th	−1·0C.	−9·4C.	2nd	1·9C.	—	23·2mm.	—	7
760·2	—	—	9·5C.	16·5C.	8th	0·8C.	−10·0C.	3rd	4·7C.	—	37·4mm.	—	8
725·9	—	—	—	11·4C.	9th	—	−16·5C.	3rd	−2·6C.	—	51mm.	—	9
750·33	—	—	0·3C.	6·2C.	10th	−5·8C.	−17·0C.	2nd	−2·6C.	—	14mm.	—	10
—	—	—	—	—	—	—	—	—	—	—	—	—	11
758·2	—	—	—	5·9C.	31st	—	−12·8C.	1st	−3·2C.	—	17mm.	—	12
760·4	—	—	—	5·2C.	8th	—	−20·8C.	5th	−6·9C.	—	42mm.	—	13
—	—	—	—	—	—	—	—	—	—	—	—	—	14
730·1	—	—	—	4·3C.	31st	—	−24·2C.	18th	−7·4C.	—	23mm.	—	15
760·5	—	—	—	3·7C.	31st	−11·1C.	−17·9C.	2nd	−5·3C.	—	29·5mm.	—	16
752·2	—	—	—	1·3C.	31st	−13·9C.	−24·9C.	4th	−9·5C.	—	17·1mm.	—	17
761·2	—	—	—	7·8C.	1st	−8·1C.	−23·7C.	21st	−4·4C.	—	48·5mm.	—	18
729·1	—	—	—	13·0C.	3rd	−4·1C.	−10·0C.	22nd	0·0C.	—	15·5mm.	—	19
768·1	—	—	—	5·3C.	1st	−13·9C.	−26·9C.	21st	−9·0C.	—	18·9mm.	—	20
763·3	—	—	—	5·2C.	7th	−8·0C.	−19·5C.	21st	−4·5C.	—	12·7mm.	—	21
766·5	—	—	—	14·0C.	9th	−1·0C.	−13·5C.	21st	2·0C.	—	11·1mm.	—	22
723·7	—	—	—	12·0C.	7th	−6·4C.	−22·8C.	22nd	−1·9C.	—	86·8mm.	—	23
—	—	—	—	—	—	—	—	—	—	—	—	—	24
696·9	—	—	—	7·3C	1st	−12·9C.	−27·4C.	25th	−8·0C.	—	60·4mm.	—	25
595·1	—	—	—	−6·4C.	3rd	−30·9C.	−22·0C.	26th	−16·4C.	—	15·8mm.	—	26
—	—	—	—	—	—	—	—	—	—	—	—	—	27
—	—	—	—	—	—	—	—	—	—	—	—	—	28
—	—	—	—	—	—	—	—	—	—	—	—	—	29
762·2	—	—	—	4·0C.	20th	−11·6C.	−18·0C.	25th	−6·6C.	—	2·4mm.	—	30
—	—	—	—	—	—	—	—	—	—	—	—	—	31
756·82	759·3	—	−0·45C.	5·4C.	14th	−6·05C	−11·2C.	12th	−3·56C.	—	9·1mm.	—	32
29·96	30·13	+·02	56F.	63F.	27th	46F.	40F.	6th	51·2F.	+1·1F.	4·04 in.	−0·7 in.	33
29·87	30·09	00	64F.	76F.	29th	45F.	35F.	2nd	54·5F.	+3·4F.	2·35 in.	−2·3 in.	34
24·67	30·15	+·05	42F.	57F.	29th	20F.	−4F.	2nd	30·7F.	+1·6F.	0·86 in.	+0·2 in.	35

‡ Gravity correction not applied, but *see* Column 6.

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.
1	San Diego	32° 47′N.	117° 8′W.	87 ft.	M.W.R., p. 23.. ..	*See* above, under Portland.	*See* above, under Portland.
2	Denver	39° 45′	105° 0′	5,291 ft.	Do., p. 23.. ..		
3	Santa Fé	35° 41′	105° 57′	7,013 ft.	Do., p. 23.. ..		
4	Abilene	32° 23′	99° 40′	1,738 ft.	Do., p. 23.. ..		
5	Saint Louis	38° 38′	90° 12′	567 ft.	Do., p. 23.. ..		
6	Mobile	30° 41′	88° 2′	57 ft.	Do., p. 22.. ..		
7	Nashville	36° 10′	86° 47′	546 ft.	Do., p. 22.. ..		
8	Charleston	32° 47′	79° 56′	48 ft.	Do., p. 22.. ..		
9	Washington	38° 54′	77° 3′	112 ft.	Do., p. 22.. ..		
10	Bermuda	32° 17′	64° 30′	151 ft.	Can. M.W.R., p. 137..	Same as Canadian Stations.	Same as Canadian Stations.
11	Ponta Delgada* ..	37° 44′	25° 40′	17m.	Annaes do Obs. do Infante D. Luiz.	(9 + 15 + 21)/3 Separate values available.	(9 + 21 + Mx. + Mn.)/4.
12	Fayal*	38° 23′	28° 48′	—		—	—
13	Horta*	38° 22′	28° 38′	28m.		(9 + 15 + 21)/3 Separate values available.	(9 + 21 + Mx. + Mn.)/4.
14	Madeira*	32° 28′	16° 55′	25m.	Obs. dos "Postos Met."	Do.	--
15	Lisbon*	38° 48′	9° 9′	95·4m.	Ann. do Obs. do Infanta D. Luiz, p. 118.	24 (separate available).	24.
16	Gibraltar*	30° 6′	5° 21′	53 ft.	Army Med. Dep. & M.O.	(9+15)/2? (no information given).	(Max. + Min.)/2.
17	Casablanca.. ..	33° 37′	7° 35′	—	—	—	—
18	Palma..	39° 4′	8° 34′W.	—	Resum. de las Obs. Met. Instituto Central Met. (Spain). 1905 not published, '06, '07, '08 received.	—	—
19	Algert	36° 47′	3° 4′E.	38·5m.	Annales Bur. Cent. France, B. 65.	(7 + 13 + 19)/3	¼ [7 + 13 + 19 + (19 + Min.)/2]
20	Mzab, Laghout ..	—	—	—	—	—	—
21	Catania	37° 28′	15° 3′	—	1901 last received ..	—	—
22	Tunis	36° 48′	? 10° 30′	43m.	—	—	—
23	Malta	35° 54′	14° 31′	112 ft.	Army Med. Dep. ..	*See* Gibraltar..	*See* Gibraltar.
24	Athens	37° 58′	23° 43′	107·7m.	Last received 1903 ..	—	—
25	Alexandria†.. ..	31° 12′	29° 53′	32m.	Survey Dept. Met. Obs. in Egypt.	(8 + 14 + 20)/3	(8+14+20+Min.)/4
26	Beirut†	33° 54′	35° 29′	33m.	Jahrbuch K. K. Central Anst. Wien, p. 57.	(8½+14½+20½)/3	⅓ [(8½ + 20½)/2 + (8½ + 14½ + 20½)/3]
27	Nicosia†	35° 11′	33° 22′	493 ft.	Cyprus Blue Book ..	(9 + 21)/2	(Max. + Min.)/2 —
28	Suez	29° 56′	32° 33′	3·2m.	Survey Dep. from 1906.	*See* Alexandria	—
29	Cairo	30° 4′	30° 17′	33m.	Egyptian Survey Dept.		
30	Lenkoran	38° 46′	48° 52′	—19m.	Russ. Annales, p. 214	*See* Russia ..	—
31	Baghdad†	33° 21′	44° 28′	220 ft.	Ind. W.R., p. XIII. ..	Gravity correction not applied to mean at 8 a.m. at station level, but it is applied to mean at sea level.	—
32	Babylon†	—	—	—	—	—	—
33	Busrah†	28° 59′N.	50° 50′E.	—	Ind. W.R., p. XIII. ..	*See* above under Baghdad.	—

* No information regarding gravity correction.

Pressure.		Diff. from Av.	Temperature.								Rainfall.		
Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.	
29·95	30·04	—·03	66F.	73F.	14th	51F.	46F.	1st	58·1F.	+4·5F.	2·16 in.	+0·1 in.	1
24·79	30·24	+·19	37F.	60F.	3rd	18F.	—13F.	13th	27·4F.	—0·8F.	0·99 in.	+0·4 in.	2
23·28	30·22	+·18	38F.	48F.	31st	19F.	8F.	2nd	28·2F.	+0·3F.	1·28 in.	+0·7 in.	3
28·40	30·28	+·19	48F.	73F.	1st	29F.	10F.	15th	38·4F.	—4·4F.	1·11 in.	+0·2 in.	4
29·66	30·30	+·16	32F.	65F.	1st	17F.	—6F.	25th	24·2F.	—6·3F.	2·47 in.	+0·3 in.	5
30·20	30·26	+·11	54F.	70F.	12th	38F.	17F.	26th	45·8F.	—4·7F.	5·53 in.	+0·4 in.	6
29·70	30·30	+·14	38F.	64F.	1st	22F	– 2F.	25th	30·3F.	—7·9F.	3·17 in.	—1·9 in.	7
30·15	30·20	+·05	54F.	69F.	1st	38F.	17F.	26th	45·8F.	—4·2F.	1·32 in.	—2·7 in.	8
30·04	30·16	+·03	38F.	65F.	1st	21F.	—2F.	31st	29·8F.	—3·4F.	3·59 in.	+0·1 in.	9
—	30·11	—	—	74F.	16th	—	54F.	22nd	64·7F.	0·0F.	2·12 in.	—2·94 in.	10
765·97	—	—	16·73C.	18·4C.	3rd	12·57C.	8·0C.	14th	14·64C.	—	117·7mm.	—	11
—	—	--	—	—	—	—	—	—	—	—	—	--	12
764·35	—	—	—	19·2C.	3rd	—	6·6C.	20th	14·32C.	—	84·0mm.	—	13
766·75	—	—	18·36C.	20·3C.	16th	10·22C	8·4C.	26th	15·38C.	—	13·3mm.	—	14
760·52	—	—	12·68C.	17·8C.	31st	6·99C.	1·3C.	4th	9·68C.	—	66·7mm.	—	15
30·146	—	—	55·9F.	69·0F.	1st	45·4F.	39·2F.	7th	50·6F.	—	4·09 in.	—	16
—	—	—	—	—	—	—	—	—	—	—	—	—	17
—	—	—	—	—	—	—	—	—	—	—	—	—	18
765·1	—	—	15·1C.	19·0C.	10th	8·4C.	0·8C.	3rd	11·2C.	—	110·6mm.	—	19
—	—	—	—	—	—	—	—	—	—	—	—	—	20
—	—	—	—	—	—	—	—	—	—	—	—	—	21
—	—	—	—	—	—	—	—	—	—	—	—	—	22
29·984	—	—	55·7F.	59·4F.	17th	48·3F.	39·0F.	29th	52·0F.	—	2·51 in.	—	23
—	—	—	—	—	—	—	—	—	—	—	—	—	24
762·33	—	—	17·81C.	20·0C	4th	8·23C,	6·0C.	2nd	11·58C.	—	45·8mm.	—	25
—	764·00	—	15·5C.	17·2C.	2nd	9·1C.	6·5C.	26th	12·0C.	—	159mm.	—	26
—	30·131	—	55·9F.	65·0F.	4th	36·8F.	28·0F.	26th	45·6F.	—	1·62 in.	—	27
—	—	—	—	—	—	—	—	—	—	—	—	—	28
762·57	—	—	17·90C.	21·0C.	21st	4·97C.	3·0C.	2nd	—	—	15·8mm.	—	29
767·2	—	—	—	14·4C.	9th	--0·5C.	—8·9C.	30th	2·6C.	—	34·5mm.	—	30
30·069	30·282	+·043	56·6F.	66·2F.	3rd	34·5F.	20·8F.	27th	45·5F.	—3·7F.	0·48 in.	—0·90 in.	31
—	—	—	—	—	—	—	—	—	—	—	—	—	32
30·300	—	—	59·1F.	68·2F.	8th	—	—	—	—	—	0·10 in.	—	33

† Gravity correction not applied, but *see* Column 6.

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.
1	Askabad	35° 57′N.	58° 23′E.	226m.	Russian Annales, p. 217.	*See* Russia ..	—
2	Meshed*	36° 16′	59° 35′	3,104 ft.	Ind. W.R., p. XIII. ..	*See* above, under Baghdad.	(Mx.+Mn.)/2.
3	Robat*	30° 14′	36° 34′	? 80 ft.	India .. .. .. Not in 1905.		
4	Quetta*	30° 11′	67° 3′	5,502 ft.	Ind. W.R., p. XI. ..		
5	Samarkand* ..	39° 49′	67° 18′	—	Not in 1905		
6	Merv*	37° 37′	61° 50′	—	Not in 1905		
7	Lahore*	31° 34′	74° 20′	900 ft.	Ind. W.R., p. VII. ..		
8	Simla*	31° 7′	77° 8′	7,224 ft.	Do., p. XIII. ..		
9	Leh*	34° 10′	77° 42′	11,503 ft.	Do., p. XI. ..		
10	Dehra Dun*	30° 20′	78° 0′	2,000 ft.	Do., p. VII. ..		
11	Hang-Kow* ..	30° 35′	114° 17′	—	Monthly Report C. Met. Obs., Japan begins January, 1905.	*See* Mukden ..	—
12	Pekin	39° 57′	116° 29′	4·4m.	—	—	—
13	Shanghai†	31° 11′	121° 16′	—	Bull. des Obs., Zikawei, p. 21.	24 hours ..	24 hours.
14	Nagasaki*	32° 44′ 28″	129° 51′ 30″	56·7m.	Monthly Rep. C.M. Obs., Japan, p. 7.	24 hours M.S.L. at 45°.	24 hours.
15	Chemulpo*	37° 29′	126° 37′	70·0m.	Results Met. Obs. in Korea (Chemulpo).	*See* Mukden, M.S.L. at 45°.	—
16	Kioto*	35° 1′	135° 46′	49·4m.	Monthly Report of the Central Met. Obs. of Japan, p. 7.	*See* Mukden, M.S.L. at 45°, Individual.	—
17	Tokio*	35° 40′	139° 45′	21·3m.		24 hours M.S.L. at 45°.	24 hours.
18	Miyako*	39° 38′	141° 59′E.	30·4		*See* Mukden, M.S.L. at 45°.	—
19	Honolulu	21° 19′	157° 52′W.	38 ft.	M.W. Rev., p. 40. ..	8 a.m. (8 p.m. also given).	(Mx.+Mn.)/2.
20	Leon†	21° 07′	101° 30′	1,798·6m.	Bol. Mensuel del Obs. Met. de Leon.	7 a.m. (14+21) also.	(Mx.+Mn.)/2 7, 14, 21 given.
21	Mazatlan†	23° 11′	106° 23′	7·5m.	Obs. Ast. Met. de Maz. Monthly Sheets.	No information	No information.
22	Galveston	29° 18′	94° 50′	54 ft.	U.S.M.W.R., p. 22 ..	*See* above, under Portland.	
23	New Orleans ..	29° 58′	90° 4′	51 ft.	Do.		
24	Mexico†	19° 26′	99° 8′	2,280m.	Bol. Mens. del Obs. Met., p. 102, 97. 71.	24 hours, each hour given.	24 hours, each hour given.
25	Havanah	23° 10′	82° 22′	57 ft.	U.S.M.W.R., p. 23 ..	*See* above, under Portland.	
26	Key West	24° 33′	81° 48′	22 ft.	Do., p. 22 ..		
27	Nassau (Bahamas)	25° 4′	77° 20′	44 ft.	M.S. at M.O.	—	—
28	Turks Island ..	21° 24′	71° 10′	11 ft.	U.S.M.W.R., p. 23 ..	*See* above, under Portland.	
29	Las Palmas	27° 28′	15° 28′	9m.	Resumen de las Obs. Met. Inst. Cent. Met. Madrid. 1906-8 received.	—	—
30	La Paz Botanica (Teneriffe).	28° 25′	16° 32′W.	100m. ?	Deutsche Üb. Met. Beob., p. 37. 1905 incomplete.	—	—
31	Insalah*	27° 17′	2° 27′E.	300m.	Annales Bureau Cent. Met. France, p. B. 73.	(7+13+19)/3 ..	¼ [7+13+19 +(19+Min.)/2]
32	Dakhla Oasis* ..	25° 29′	29° 0′	1,300m.	Survey Dept. Met. Obs. in Egypt begins Feb. 1905.	(8+14+20)/3 ..	(8+14+20+Mn.)/4
33	Aswan*	24° 2	32° 53′	99·6m.	Do.	(8+14+20)/3 ..	(8+14+20+Mn.)/4
34	Wady Halfa* ..	21° 55′	31° 19′	128·3m.	Survey Dept. Egypt. Not in 1905.	(8+20)/2 ..	(8+20)/2
35	Bushire*	28° 59′N	50° 49′E.	14 ft.	Ind. M.W.R., p. XIII.	*See* above, under Baghdad.	—

* Gravity correction not applied, but *see* Column 6.

Pressure.			Temperature								Rainfall.	
Mean at Level of Station.	Mean at M.S.L.	Diff. from Av.	Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.
745·0	—	—	—	17·8C.	9th	—4·2C.	—19·2C.	23rd	0·2C.	—	17·7mm.	— 1
—	—	—	—	—	—	24·5F.	—1·0F.	22nd	—	—	1·11 in.	+0·70 in. 2
—	—	—	—	—	—	—	—	—	—	—	—	— 3
24·655	—	—0·33	45·7F.	63·2F.	11th	26·6F.	8·8F.	23rd	36·2F.	—4·1F.	5·04 in.	+3·01 in. 4
—	—	—	—	—	—	—	—	—	—	—	—	— 5
—	—	—	—	—	—	—	—	—	—	—	—	— 6
29·356	30·096	+·007	61·9F.	68·8F.	10th	42·3F.	31·1F.	31st	51·6F.	—3·3F.	1·86 in.	+0·74 in. 7
23·071	—	—·041	41·5F.	51·1F.	9th	31·4F.	18·2F.	23rd	36·5F.	—3·1F.	3·14 in.	+0·43 in. 8
19·548	—	—·113	27·3F.	39·5F.	29th	7·6F.	—6·1F.	31st	17·5F.	—1·9F.	0·60 in.	+0·29 in. 9
27·767	30·101	+·005	60·7F.	69·0F.	29th	42·7F.	32·0F.	24th	51·7F.	—3·8F.	3·37 in.	+0·99 in. 10
—	—	—	—	—	—	—	—	—	—	—	—	— 11
—	—	—	—	—	—	—	—	—	—	—	—	— 12
765·44	—	—4·93	10·51C.	17·7C.	5th	2·50C.	—4·6C.	28th	6·0C.	+3·0C.	96·6mm.	+44·4mm. 13
752·12	763·5	—	12·36C.	18·4C.	18th	4·88C.	—0·2C.	31st	8·42C.	—	80·2mm.	— 14
759·3	765·5	—	4·2C.	8·5C.	22nd	—1·8C.	—11·4C.	31st	0·9C.	—	13·1mm.	— 15
759·4	763·3	—	10·9C.	15·4C.	23rd	—0·9C.	—5·9C.	12th	4·3C.	+1·9C.	56·9mm.	—0·2mm. 16
760·2	761·5	—	9·2C.	13·8C.	23rd	0·1C.	—3·9C.	26th	4·3C.	+1·5C.	59·8mm.	+4·7mm. 17
758·8	761·0	—	7·2C.	11·9C.	5th	—3·0C.	—7·2C.	31st	1·1C.	+1·9C.	113·3mm.	+53·7mm. 18
—	30·032	—	72·8F.	76F.	22, 23	61·6F.	58F.	Various.	67.1F.	—	0·80 in.	— 19
620·93	—	—	19·8C.	23·5C.	23rd	5·9C.	1·8C.	16th	12·9C.	—	1·54mm.	— 20
761·12	—	—	24·58C.	28·30C.	—	18·71C.	15·80C.	—	22·09C.	—	2·93mm.	— 21
30·19	30·25	+·12	56F.	69F.	1st	46F.	27F.	26th	51·0F.	—1·7F.	5·40 in.	+1·7 in. 22
30·20	30·26	+·13	58F.	73F.	1st	42F.	22F.	26th	49·6F.	—4·2F.	6·31 in.	+1·1 in. 23
587·55	—	—	17·2C.	20·4C.	24th	4·5C.	0·4C.	16th	13·9C.	—	6·9mm.	— 24
30·08	30·14	+·09	73F.	83F.	12th	62F.	51F.	27th	67·1F.	—3·2F.	1·20 in.	—1·5 in. 25
30·14	30·16	+·06	68F.	83F.	13th	58F.	44F.	26th	63·4F.	—6·3F.	0·69 in.	—1·4 in. 26
?	—	—	73F.	80F.	14th	64·1F.	52F.	26, 27	68·6F.	—	3·92 in.	— 27
30·05	30·06	+·03	75F.	77F.	7th	69F.	65F.	29th	71·8F.	—	3·30 in.	— 28
—	—	—	—	—	—	—	—	—	—	—	—	— 29
—	—	—	—	—	—	—	—	—	15·2C.	—	—	— 30
741·7	—	--	19·9C.	27·0C.	24th	2·8C.	—1·0C.	4th	10·3C.	—	0·0mm.	— 31
—	—	—	—	—	—	—	—	—	—	—	—	— 32
756·20	—	—	22·34C.	28·5C.	6th	8·11C.	4·0C.	16th	13·67C.	—	5·13mm.	— 33
—	—	—	—	—	—	—	—	—	—	—	—	— 34
30·128	30·101	—·006	63·3F.	75·6F.	2, 11	48·9F.	34·4F.	25th	56·1F.	—1·8F.	0·32 in.	—2·80 in. 35

† No information regarding gravity correction.

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.
1	Jask*	25° 44′N.	57° 47′E.	13 ft.	Ind. M.W.R., p. XIII.	*See* above, under Baghdad.	—
2	Kurrachee*	24° 47′	67° 4′	30 ft.	Do. p. VII.		
3	Hyderabad*	25° 25′	68° 27′	96 ft.	Do. p. VII.		
4	Nagpur*	21° 9′	79° 11′	1,025 ft.	Do. p. IX.		
5	Jaipur*	26° 55′	75° 50′	1,431 ft.	Do. p. VII.		
6	Calcutta*	22° 32′	88° 20′	21 ft.	Do. p. III.		
7	Allahabad*	25° 25′	81° 51′	309 ft.	Do. p. V.		
8	Cherrapunjee* ..	25° 19′	91° 50′	4,309 ft.	Do. p. XIII.		
9	Shillong*	25° 35′	91° 51′	4,920 ft.	Do. p. XIII.		
10	Akyab*	20° 11′	92° 56′	20 ft.	Do. p. III.		
11	Gauhati*	26° 10′	91° 45′	195 ft.	Do. p. III.		
12	Phu-Lien* .. .. or	20° 48′	106° 36′	115·7m.	Annales Bur. Cent. Mét. France, p. c. 93.	10 a.m. (16 = 4 p.m. also given.	(Mx. + Mn.)/2.
13	Moncay*	21° 31′	107° 51′	10m.	Do. p. c. 93.	Do.	Do.
14	Hong-Kong* ..	22° 15′	114° 12′	109 ft.	Hong Kong Obs. Met. Obs.	24 hours (each hour given).	24 hours.
15	Taihoku Formosa*	25° 2′	121° 30′	9·3m.	Ind. M.W.R. p. 5 ..	24 hours at M.S.L. and 45°.	24 hours.
16	Naha*	26° 13′	127° 41′E.	10·4m.	C. Met. Obs. of Japan, p. 5.		
17	Revilla	19° 25′	110° 30′W.	—	—	—	--
18	Zapotlan	19° 50′	103° 4′	—	—	—	—
19	Oaxaca† .. .	16° 57′	94° 42′	---	Bol. Mensuel del Obs. de Oaxaca.	(7 + 14 + 21)/3 separate hours.	(7 + 14 + 21)/3 Mx. and Mn. and separate hours given
20	Tacubuya	19° 24′	99° 12′	—	—	—	—
21	Belize†	17° 29′	88° 12′	2 ft.	Gov. Gaz.	Prob. at sea level 10 a.m. (4 p.m. also given.)	(Mx. + Mn.)/2.
22	Culebra	18° 20′	65° 20′	—	U.S.M.W.R.	—	—
23	Jamaica (Negril Point).	18° 10′	77° 20′	33 ft.	J.W.R.	7 a.m. (3 p.m. also.)	(Mx. + Mn.)/2.
24	Port au Prince* ..	18° 34′	72° 22′	37m.	Fr. Annales p. c. 81 ..	7 a.m. (13, 21, also.)	Do.
25	Curacao	12° 10′	69° 0′	—	—	—	—
26	Eustantius	—	—	—	—	—	—
27	St. Vincent† ..	16° 54′	25° 4′	11m.	Ann. Obs. Inf. D. Luis Post. Met., p. 36.	—	(9 + 21 + Mx. + Mn.)/4.
28	Bathurst	13° 24′	16° 36′	—	Government Gazette Commences 1907 ?	—	—
29	Timbouctoo ..	16° 43′	2° 58′	250m.	Annales Bur. Cent. Mét. France, p. C.75.	No Bar. 1905 ..	(Mx. + Mn.)/2 (7, 13, 21 available
30	Bammakou	11° 55′	7° 57′W	—	—	—	—
31	Zinder	13° 46′	10° 01′E.	500m. ?	Annales Bur. Cent. Mét. France, p. C.78. Commences Feb., 1905. No Barometer in 1905.	—	8 a.m. only in 190
32	Sokoto	13° 2′	5° 14′	1,160 ft.	1907. No Barometer as yet.	—	—
33	Lake Tchad	13° 30′	14° 0′	—	Not in French Annales.	—	—
34	Sudan. Darfur ..	13° 0′	25° 0′	—	—	—	—
35	French Congo ..	—	—	—	—	—	—
36	El Obeid†	13° 11′N.	30° 14′E.	585m.	Survey Dept. Met. Obs. in Egypt.	(8 + 14 + 20)/3	(8+14+20+Mn.)/

* Gravity correction not applied, but *see* Column 6.

	Pressure.		Diff. from Av.	Temperature.								Rainfall.	
	Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.
1	30·087	30·057	—·040	71·5F.	77·3F.	9, 12, 10	59·4F.	44·3F.	29th	65·5F.	—1·6F.	0·39 in.	—0·48 in.
2	30·116	30·098	+·035	72·9F.	80·9F.	2, 13, 14	52·6F.	40·2F.	24th	62·8F.	—3·0F.	1·50 in.	+0·84 in.
3	30·057	30·115	+·044	71·4F.	82·0F.	11, 16	47·8F.	33·5F.	30th	59·6F.	—4·4F.	0·69 in.	+0·45 in.
4	29·027	30·062	+·006	83·5F.	89·6F.	29th	54·9F.	47·2F.	25th	69·3F.	—0·4F.	0 in.	—0·26 in.
5	28·627	30·120	+·012	69·1F.	78·7F.	28th	46·9F.	28·1F.	31st	58·0F.	—3·3F.	0·17 in.	—0·43 in.
6	30·086	30·054	+·021	75·8F.	83·9F.	30th	55·2F.	47·9F.	27th	65·5F.	—0·7F.	0·94 in.	+0·62 in.
7	29·785	30·074	+·012	69·9F.	80·2F	29th	48·0F.	39·1F.	24th	59·0F.	—2·2F.	0·67 in.	—0·09 in.
8	25·768	25·719	—	56·9F.	61·7F.	6th	43·5F.	34·5F.	25th	50·2F.	—	0·10 in.	—0·73 in.
9	25·215	25·169	—	58·4F.	64·5F.	6th	38·1F.	27·0F.	25th	48·3F.	—	0 in.	—0·53 in.
10	30·052	30·016	+·018	78·9F.	83·9F.	6th	59·3F.	51·1F.	27th	69·1F.	—1·3F.	0 in.	—0·06 in.
11	29·910	30·076	—	72·2F.	76·6F.	5th	49·4F.	43·1F.	21, 31	60·8F.	—	0·50 in.	—0·14 in.
12	753·79	—	—	25·77C.	33·0C.	—	16·60C.	8·5C.	—	—	—	4·5mm.	—
13	763·27	—	—	23·79C.	29·4C.	25, 26	17·63C.	10·0C.	31st	—	—	6·2mm.	—
14	29·937	—	—	69·0F.	79·3F.	23rd	60·7F.	46·8F.	31st	64·3F.	—	1·80 in	—
15	763·2	762·7	—	22·0C.	28·3C.	18th	13·1C.	7 8C.	3rd	17·0C.	1·5C.	159·7mm	+78·0mm.
16	763·3	763 0	—	20·7C.	25·2C.	21st	14·1C.	11·8C.	28th	17·3C.	1·1C.	122·4mm.	—17·7mm.
17	—	—	—	—	—	—	—	—	--	—	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	—	—
19	637·62	—	—	25·39C.	29·9C.	2nd	5·49C.	1·90C.	27th	15·36C.	—	13·8mm.	—
20	—	—	—	—	—	—	—	—	—	—	—	—	—
21	—	30·039	—	79·9F.	85·5F.	3rd	66·4F.	57·0F.	6th	73·2F.	—	3·45 in.	—
22	—	—	—	—	—	—	—	—	—	—	—	—	—
23	—	30·013	—	83·4F.	88·0F.	31st	69·4F.	62·9F.	27th	76·4F.	—	0·81 in.	—
24	—	764·22	—	30·06C.	32·3C.	—	20·73C.	18·4C.	—	25·40C.	—	72·7mm.	—
25	—	—	—	—	—	—	—	—	—	—	—	—	—
26	—	—	—	—	—	—	—	—	—	—	—	—	—
27	763·00	—	—	24·40C.	26·5C.	1st	20·43C.	18·2C.	28, 29	22·46C.	—	0·0mm.	—
28	—	—	—	—	—	—	—	—	—	—	—	—	—
29	—	—	—	32·01C.	36·6C.	22nd	12·23C.	5·6C.	1st	22·12C.	—	0·0mm.	—
30	—	—	—	—	—	—	—	—	—	—	—	—	—
31	—	—	—	—	—	—	—	—	—	—	—	—	—
32	—	—	—	—	—	—	—	—	—	—	—	—	—
33	—	—	—	—	—	—	—	—	—	—	—	—	—
34	—	—	—	—	—	—	—	—	—	—	—	—	—
35	—	—	—	—	—	—	—	—	—	—	—	—	—
36	713·19	—	—	—	—	—	11·33C.	4·4C.	25th	19·56C.	—	0·0mm.	—

† No information regarding gravity correction.

1905, January.

	Name of Station.	Latitude	Longitude.	Height.	References.	Barometer.	Temperature.
1	Khartoum*	15° 37′N.	32° 33′E.	382·9m.	Survey Dept. Met. Obs. in Egypt.	(8 + 14 + 20)/3	(8+14+20+Mn.)
2	Erithrea	15° 40′	39° 30′	383m.	—	—	—
3	Addiugu	—	—	—	Not in latest Egyptian Volumes.	—	—
4	Aden†	12° 45′	45° 3′	94 ft.	Ind. M.W.R., p. XIII.	*See* above, under Baghdad.	—
5	Sokotra†	12° 30′	54° 0′	—	—	—	—
6	Italian Somaliland	—	—	—	—	—	—
7	Bombay†	18° 54′	72° 49′	37 ft.	Ind. M.W.R., p. IX.	*See* above, under Baghdad.	—
8	Kodaikanal† ..	10° 13′	77° 32′	7,688 ft.	Do., p. XIII.	Do.	—
9	Mysore†	12° 18′	76° 40′	2,518 ft.	Do., p. XI.	Do.	—
10	Madras†	13° 4′	80° 14′	22 ft.	Do., p. XI.	Do.	—
11	Waltair†	17° 41′	83° 19′	226 ft.	Do., p. XI.	Do.	—
12	Rangoon†	16° 46′	96° 12′	57 ft.	Do., p. III.	Do.	—
13	Port Blair	11° 40′	92° 40′	58 ft.	Do., p. III.	Do.	—
14	Saigon‡	10° 47′	106° 42′	10m.	Annales Bur. Cent. Mét. France, p. C. 88.	10 a.m. (16 hours also available).	(Mx. + Mn.)/2 10 and 16 also available.
15	Nhatrang‡	12° 16′	109° 32′	9m.	Do., p. C. 89, 61	Do.	Do.
16	Manila‡	14° 34′ 41″	120° 58′ 33″	14m.	Phil. W. Bur. Bulletin, p. 3.	24 hours ..	24 hours
17	Ormoc‡	11° 00′	124° 36′	—	Do., p. 9	6 observations each day.	—
18	or Vigan‡	11° 34′	120° 23′	—	Do., p. 8	Do.	—
19	Guam	13° 20′	144° 35′	—	—	—	—
20	Marshall Islands ..	10° 0′	170° 0′E.	—	—	—	—
21	Fanning Island ..	3° 54′	159° 23′W.	—	M.O. MS.	—	—
22	San José (Costa Rica).	9° 56′	83° 52′	—	—	—	—
23	Colombia	4° 0′	75° 0′	—	—	—	—
24	Caracas (Venezuela)	10° 28′	67° 2′	—	—	—	—
25	Georgetown* ..	6° 49′	58° 8′	4 ft.	Georgetown Blue Book.	9 a.m. (4 p.m. also given).	(Mx. + Mn.)/2
26	Cayenne‡	4° 56′	52° 20′	6m.	Annales Bur. Cent. Mét. France, p. C. 84.	9 a.m. (15 also available), observations doubtful.	(Mx. + Mn.)/2 9 and 15 also.
27	Paramaribo	6° 44′	54° 59′	—	—	—	—
28	Sierra Leone* ..	8° 30′	13° 9′	224 ft.	Army Med. Dept. M.O.	?	(Mx. + Mn.)/2
29	Conakry	9° 4′	13° 42′	16m.	Annales Bur. Cent. Mét. France, p. C. 76.	—	(Mx. + Mn.)/2 6, 12, 18 also.
30	Accra	5° 35′	0° 6′	—	MS. at M.O.	—	(Mx. + Mn.)/2 9 and 17 also.
31	Cape Coast Castle ..	5° 10′	1° 13′W.	—	Do.	—	Do.
32	Lagos*	6° 28′	3° 38′E.	?	Gov. Gaz. (Feb. 11, 1905).	9 a.m., 3 p.m., also prob. at M.S.L.	Abs. extreme only. "Mean" given as 82·2. Not stated how obtained 9 a.m.?
33	Libreville‡	0° 23′	9° 26′	35m.	Annales Bur. Cent. Mét. France, p. C. 79.	8 a.m. (16 also)	(Mx.+Mn)/2 (8 and 16 also).
34	Zungeru	9° 40′	6° 10′	530 ft.	Blue Book from 1906	—	—
35	Fernando Po? ..	4° 0′	9° 0′	—	—	—	—
36	Cameroons and French Congo.	4° 13′N.	9° 12′E.	—	—	—	—

* No information regarding gravity correction.
† Gravity correction not applied, but *see* column 6.

Pressure.		Diff. from Av.	Temperature.								Rainfall.		
Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.	
728·24	—	—	32·81C.	37·5C.	5th	14·76C.	9·0C.	26, 28	21·76C.	—	0·0mm.	—	1
—	—	—	—	—	—	—	—	—	—	—	—	—	2
—	—	—	—	—	—	—	—	—	—	—	—	—	3
30·006	30·033	+·024	79·4F.	81·8F.	22nd	71·3F.	64·5F.	29th	75·4F.	—1·4F.	1·77 in.	+1·45 in.	4
—	—	—	—	—	—	—	—	—	—	—	—	—	5
—	—	—	—	—	—	—	—	—	—	—	—	—	6
30·036	30·014	+·025	81·1F.	87·0F.	9th	66·7F.	56·0F.	31st	73·9F.	—1·4F.	0 in.	—0·10 in.	7
22·873	22·808	—	61·2F.	67·4F.	31st	44·9F.	39·8F.	29th	51·7F.	—	0·56 in.	—0·61 in.	8
27·540	30·034	+·018	85·2F.	88·4F.	20th	60·7F.	57·4F.	2, 29	73·0F.	+1·3F.	0 in.	0 in.	9
30·058	30·011	+·017	83·2F.	87·0F.	25th	65·2F.	57·5F.	29th	74·2F.	—1·9F.	1·92 in.	+1·40 in.	10
29·873	30·046	+·022	80·3F.	83·8F.	30th	67·7F.	64·4F.	3rd	74·0F.	—	0·0 in.	—0·16 in.	11
29·953	29·954	+·033	87·1F.	89·0F.	19th	64·4F.	58·7F.	27, 28	75·8F.	—0·8F.	0·0 in.	—0·12 in.	12
29·994	29·986	+·057	84·9F.	88·0F.	21st	74·1F.	68·6F.	27th	79·5F.	—1·5F.	0·05 in.	—0·97 in.	13
760·84	—	—	31·29C.	33·3C.	28th	22·04C.	20·3C.	14th	—	—	3·6mm.	—	14
763·23	—	—	29·84C.	32·2C.	29th	18·71C.	16·6C.	8th	—	—	24·8mm.	—	15
—	761·71	+0·45	31·1C.	33·5C.	25th	18·8C.	16·2C.	11th	24·4C.	—0·7C.	0·0mm.	—28·3mm.	16
—	761·19	—	29·8C.	31·6C.	26th	19·4C.	13·3C.	30th	24·3C.	—	96·8mm.	—	17
—	761·96	—	32·5C.	26·6C.	1, 22	19·1C.	17·4C.	10th	25·1C.	—	1·6mm.	—	18
—	—	—	—	—	—	—	—	—	—	—	—	—	19
—	—	—	—	—	—	—	—	—	—	—	—	—	20
—	—	—	85·7F.	—	—	80·6F.	—	—	—	—	19·0 in.?	—	21
—	—	—	—	—	—	—	—	—	—	—	—	—	22
—	—	—	—	—	—	—	—	—	—	—	—	—	23
—	—	—	—	—	—	—	—	—	—	—	—	—	24
—	? 30·015	—	81·9F.	84·3F.	1st	75·5F.	73·8F.	Var.	79·9F.	—	3·81 in.	—	25
763·37	—	—	28·76C.	30·4C.	—	23·91C.	22·1C.	—	26·33C.	—	350·0mm.	—	26
—	—	—	—	—	—	—	—	—	—	—	—	—	27
29·746	—	—	90·7F.	95·0F.	30th	73·3F.	67·0F.	2nd	82·0F.	—	0·64 in.	—	28
—	—	—	30·05C.	32·4C.	30th	22·30C.	20·2C.	3rd	26·5C.	—	0·0mm.	—	29
?	—	—	87·0F.	92F.	31st	71·1F.	65F.	3rd	79·1F.	—	0·62 in.	—	30
?	—	—	84·4F.	87F.	16th	73·4F.	71F.	5th	78·9F.	—	Nil.	—	31
29·981	—	—	?	92 F.	7th	?	71F.	15th	?	—	·04 in.	—	32
757·19	—	—	30·91C.	32·7C.	—	23·46C.	20·2C.	—	27·18C.	—	335mm.	—	33
—	—	—	—	—	—	—	—	—	—	—	—	—	34
—	—	—	—	—	—	—	—	—	—	—	—	—	35
—	—	—	—	—	—	—	—	—	—	—	—	—	36

‡ Gravity correction not applied to the readings of pressure

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature	Pressure. Mean at Level of Station.	Pressure. Mean at M.S.L.	Diff. from Ave.	Temperature. Mean Max.	Abs. Max.	Date.	Mean Max.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Rainfall. Total.	Diff. from Av.	
1	Mamfe or Tinto ..	—	—	—	D. Über. Beob. Incomplete. No Bar. in 1905.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
2	Yola	9° 15′N.	12° 28′E.	—	N. Nig. Blue Book, 1906.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
3	Bahr el Ghazel (Sudan.)	9° 0′	27° 0′	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
4	Wau	7° 42′	28° 3′	440m.	Survey Dep., Egypt, Commences 1906.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
5	Entebbe*	0° 4′	32° 27′	3,863 ft.	Report of Bot. Dep., Uganda.	7 a.m. (2 p.m. and 9 p.m. also) readings not corrected for temp. in printed returns. Figure quoted from MS. at M.O.	(Mx.+Mn.)/2	26·191	—	—	78·0F.	82·5F.	9th	63·9F.	61·4F.	31st	—	—	2·16 in.	—	5
6	Colombo	6° 56′	79° 52′	40 ft.	Ind. M.W.R., p. XIII.			29·976	29·942	+·026	86·7F.	91·0F.	27th	72·2F.	67·0F.	14th	79·5F.	−0·4F.	3·85 in.	+0·65 in.	6
7	Cothin	9° 56′	76° 15′	9 ft.	Do., p. IX.			30·015	29·954	+·024	90·0F.	93·8F.	6th	72.3F.	69·7F.	16, 18	81·2F.	+0·9F.	0 in.	−0·54 in.	7
8	Candy..	7° 18′	80° 41′	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	8
9	Car Nicobar.. ..	9° 21′	92° 56′	25 ft.	Ind. M.W.R., p. III.	*See* India ..	—	29·925	29·881	—	85·2F.	86·4F.	4 days	76·6F.	70·5F.	29th	80·9F.	—	1·59 in.	—	9
10	Singapore	1° 15′	103° 51′	10 ft.	Do., p. XIII.			29·996	29·927	—	87·9F.	91·6F.	29th	72·9F.	71·3F.	19th	80·4F.	—	4·93 in.	—	10
11	Penang	5° 18′	100° 4′	20 ft.	Do., p. XIII.			29·947	29·892	—	89·4F.	91·0F.	6 days	73·2F.	70·0F.	7th	81·3F.	—	1·66 in.	—	11
12	Tagbilarau	9° 38′	123° 53′	—	Bulletin of Philippine W. Bureau, p. 4.	*See* Philippines.	—	—	760·80	—	31·0C.	33·0C.	27th	21·7C.	19·5C.	30th	25·7C.	—	11·2mm.	—	12
13	Surigao	9° 48′	125° 29′	—	Do.	Do.	—	—	760·93	—	29·3C.	31·3C.	29th	22·4C.	19·6C.	30th	25·8C.	—	105·3mm.	—	13
14	Caroline Islands ..	10° 0′	148° 0′	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
15	Uyelang†	9° 42′	161° 3′	10m.	Deutsche Übs. Beob., p. 6. 1905 incomplete. January missing.	(7 + 14 + 21)/3	No. temps	—	—	—	—	—	—	—	—	—	—	—	—	—	15
16	Apaiang†	2° 50′N.	173° 2′E.	?	Do., p. 8.	—	Not stated.	Bar. unsatisfactory 1905.			33·8C.	36·3C.	—	24·6C.	22·4C.	—	27·3C.	—	357·9mm.	—	16
17	Malden Island† ..	3° 59′S.	155° 0′W.	6 ft.?	MS. at M.O.	(9 + 20)/2 ..	(Mx. + Mn.)/2 (9 and 20 also)	29·840	29·846	—	87·8F.	93·0F.	1st	74·8F.	73·0F.	6 days	81·3F.	—	15·45 in.	—	17
18	Galapagos Islands..	0° 56′	91° 0′	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18
19	Ecuador and Peru	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19
20	Quito	0° 13′	78° 23′	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
21	Manaos*	3° 8′	60° 0′	32·4m.	Bol. Mensal do Obs. de Rio, p. 4.	—	—	755·79	—	—	34·0C.	?	—	22·9C.	—	—	27·6C.	—	219·4mm.	—	21
22	Belem*	1° 28′	48° 27′	7·1m.	Bol. das Obs. Met. at Noon G.M.T. Min. da Marina.	Observations at Noon G.M.T. about 9 a.m. L.M.T. No and Mn. Thermometers.		760·88	—	—	—	—	—	—	—	—	—	—	—	—	22
23	Fortaliza*	3° 44′	38° 30′	1·2m.				761·56	—	—	—	—	—	—	—	—	—	—	—	—	23
24	Fernando Noronha	3° 50′	32° 25′	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24
25	Ascension	7° 57′	14° 28′W.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
26	Brazzaville	4° 25′	15° 22′E.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26
27	Mayumba	3° 20′	12° 40′	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	27
28	Leanda	8° 49′	13° 7′	59·2 ft.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	28
29	Congo State	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	29
30	Usumbura	3° 21′	29° 32′	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30
31	Zanzibar	6° 10′	39° 11′	73 ft.	Ind. W.R., p. XIII. ..	*See* India ..	—	29·927	29·925	+·016	87·3F.	90·6F.	18th	79·8F.	76·6F.	19th	83·6F.	+0·8F.	2·36 in.	−1·01 in.	31
32	Tanga	5° 4′	39° 7′	28m.	Deutsche Übs. Beob., p. 49.	No Bar. 1905 ..	(8a, 10a, and 4 available.)	—	—	—	31·6C.	33·1C.	15th	24·4C.	20·4C.	31st	—	—	2·5mm.	—	32
33	Tabora†	5° 1′S.	32° 49′E.	1,230m.	Do., p. 43, 115.	24 hours ..	(Mx. + Mn.)/2 ?	659·3	—	—	—	—	—	—	—	—	—	—	187·6mm.	—	33

* No information regarding gravity correction.

† Gravity correction not applied to the readings of pressure.

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.
1	British East Africa	—	—	—	—	—	—
2	Seychelles	4° 0′S.	55° 0′E.	7·45 ft.	—	India	—
3	Dago Garcia ..	5° 0′	72° 0′	—	Not in 1905		
4	Batavia*	6° 11′	106° 50′	7m.	Obs. made at R. Mag. and Met. Obs., pp. 82, 92, 94.	24 hours (each hour separate).	24 hours. (Mx. and Mn.)
5	Port Moresby* ..	9° 29′	147° 9′	126 ft.	New Guinea Gov. Gaz.	9 a.m.	(Mx. + Mn.)/2.
6	Daru*	9° 4′	143° 13′	25 ft.	Do.	Do.	No abs. extremes
7	Bismarck Archipelago.	4° 0′	150° 0′	—	—	—	—
8	Ocean Island* ..	0° 52′	169° 35′	104 ft.	MS. at M.O.	9 a.m.	(Mx. + Mn.)/2.
9	Tulagi..	9° 5′	160° 8′	163 ft.	MS. at M.O. Commences 1909.	—	—
10	Fanfanuti (Ellie Isles).	8° 0′	178° 0′E.	—	Commonwealth Met. Bur.	—	—
11	(Samoa) Apia* ..	13° 49′	171° 45′W.	4m.	Deutsche Üb. Beob., p. 11.	(7 + 14 + 21)/3	? pub.
12	(Tahiti) Papeiti ..	17° 32′	149° 34′	6m.	Ann. Bur. Cent. Mét. France, p. C. 98	No Bar. in 1905	(7 + 14 + 2 × 21)/4 (Mx. + Mn.)/2 (8 and 16 available.
13	Low Islands.. ..	16° 0′	140° 0′	—	—	—	—
14	Puerto de Arica† ..	18° 28′	70° 20½′	5m.	Annario del Serv. Met. de la Dir. del Terr. Maritimo Chile, pp. 2, 3.	8 a.m. (14 and 21 also).	(Mx. + Mn.)/2. (8, 14, 21 given.)
15	Bolivia	—	—	—	—	—	—
16	Cujaba†	15° 36′	56° 6′	235m.	Obs. Met. Matto-Grosso. Special publication. Bol. Minist. da Marina.	(7 + 14 + 21)/3	Not stated
17	Bahia (San Salvador).†	13° 0′	38° 31′	45·2m.	Do.	Noon G.M.T., *see* above.	—
18	St. Helena*	16° 0′	5° 40′W.	1,887 ft.	MS. at M.O.	9 a.m.	(Mx. + Mn.)/2.
19	Salisbury	17° 48′	31° 3′E.	—	Report of Statist. Not received for 1905.	—	—
20	Zomba*	15° 23′	35° 18′	2,948 ft.	Gov. Gaz. and Blue Book.	7 a.m. (14 and 21 also).	(Mx. + Mn.)/2 fixed hours also.
21	Tananarivo* ..	18° 55′	47° 18′	1,400m.	Annales Bur. Cent. Mét. France, p. C. 85.	7 a.m. (13 and 18 also).	(Mx. + Mn.)/2 (7, 13, 18 also).
22	Comoro	11° 30′	43° 30′	—	—	—	—
23	Rodriguez	19° 40′	63° 25′	—	—	—	—
24	(Keeling Islands) Cocos Islands.	12° 05′	96° 54′	—	—	—	—
25	Christmas Island*	10° 25′	105° 43′	18 ft.	J. Scot. Met. Soc., p. 45, and Straits Settlements Gaz.	9 a.m. and 9 p.m. (not separate).	(Mx. + Mn.)/2.
26	Derby†	17° 18′	123° 40′	53 ft.	Monthly Sheet for W. Australia.	(9 + 15)/2 ..	Do.
27	Hall's Creek.. ..	18° 13′	127° 46′	—	Do.	Do.	Do.
28	Daly Waters† ..	16° 16′	133° 23′	700 ft.	Met. Obs. made at Adelaide and other places in S.A.	Do.	(Mx. + Mn.)/2 or (Mx. + Mn. + 21)/4
29	Port Darwin† ..	12° 28′	130° 51′	97 ft.	Do.	Three-hourly..	(Mx.+Mn.)/2 or three-hourly Abs extremes only. Mean Mx. and Mn. not given.
30	Mein	—	—	—	—	—	—
31	Georgetown† ..	18° 23′	142° 33′	—	—	—	—
32	New Hebrides ..	17° 0′	168° 0′	—	—	—	—
33	Samarai	10° 27′	150° 26′	—	—	—	—
34	Fiji†	18° 8′S.	178° 26′E.	10 ft.	Met. Obs. at Suva ..	9 a.m.‡	(Mx. + Mn.)/2

* Gravity correction not applied to the readings of pressure.

Pressure.		Diff. from Av.	Temperature.								Rainfall.	
Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean. Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.
—	—	—	—	—	—	—	—	—	—	—	—	— 1
—	—	—	—	—	—	—	—	—	—	—	—	— 2
—	—	—	—	—	—	—	—	—	—	—	—	— 3
759·73	—	+1·01	—	31·4C.	—	—	22·5C.	—	78·61F.	0·45C.	338mm.	−60mm. 4
—	29·906	—	83·4F.	—	—	66·9F.	—	—	75·2F.	—	3·85 in.	— 5
29·883	—	—	88·2F.	—	—	73·9F.	—	—	81·0F.	—	15·00 in.	— 6
—	—	—	—	—	—	—	—	—	—	—	—	— 7
29·72 ?	—	—	93·5F.	92·0F.	6 days	74·0F.	71·0F.	13th	82·3F.	—	22·23 in.	— 8
—	—	—	—	—	—	—	—	—	—	—	—	— 9
—	—	—	—	—	—	—	—	—	—	—	—	— 10
757·2	—	—	29·9C.	31·9C.	—	24·4C.	22·6C.	—	27·1C.	—	324·1mm.	— 11
—	—	—	31·43C.	33·2C.	25th	21·82C.	20·2C.	29, 30, 31	—	—	153·9mm.	— 12
—	—	—	—	—	—	—	—	—	—	—	—	— 13
763·2	—	—	25·5C.	31·0C.	21st	18·5C.	16·3C.	15th	22·0C.	—	—	— 14
—	—	—	—	—	—	—	—	—	—	—	—	— 15
744·58	—	—	28·91C.	32·2C.	1st	23·99C.	19·5C.	5th	25·85C.	—	336·3mm.	— 16
758·09	—	—	—	—	—	—	—	—	—	—	—	— 17
28·029	—	—	67·6F.	74·0F.	31st	57·6F.	55·0F.	18th	62·6F.	—	2·56 in.	— 18
—	—	—	—	—	—	—	—	—	—	—	—	— 19
—	29·756	—	78·2F.	84·0F.	31st	63·2F.	57·0F.	1st	70·7F.	—	8·31 in.	— 20
648·56	—	—	26·45C.	30·3C.	—	16·36C.	14·5C.	—	—	—	394·4mm.	— 21
—	—	—	—	—	—	—	—	—	—	—	—	— 22
—	—	—	—	—	—	—	—	—	—	—	—	— 23
—	—	—	—	—	—	—	—	—	—	—	—	— 24
29·880	—	—	88·0F.	91·2F.	—	71·9F.	67·9F.	—	80·0F.	—	0·05 in.	— 25
—	29·835	+·039	94·6F.	100·0F.	—	77·7F.	70·0F.	—	86·2F.	—	5·35 in.	— 26
—	29·809	−·001	102·0F.	109·0F.	—	76·3F.	64·8F.	—	89·2F.	—	1·47 in.	— 27
—	29·756	—	101·1F.	106·0F.	9, 14	74·9F.	69·0F.	2, 7	88·0F.	—	5·89 in.	−0·6 in. 28
—	29·826	—	—	92·0F.	11th	—	70·2F.	10th	82·4F. 81·7F.	—	21·17 in.	+5·4 in. 29
—	—	—	—	—	—	—	—	—	—	—	—	— 30
—	—	—	—	—	—	—	—	—	—	—	—	— 31
—	—	—	—	—	—	—	—	—	—	—	—	— 32
—	—	—	—	—	—	—	—	—	—	—	—	— 33
—	29·744	—	85·7F.	91·5F.	27th	74·2F.	70·3F.	2nd	—	—	13·55 in.	— 34

† No information regarding gravity correction.

‡ Readings marked as reduced to 32°, but the readings of the attached are also printed.

	Name of Station.	Latitude.	Longitude.	Height.	References	Barometer.	Temperature.
1	New Caledonia ..	22° 30′S.	165° 30′E.	—	—	—	—
2	Rarotonga*	21° 12′	159° 47′W.	4·5m.?	D. Üb. Beob., XV., p. 13.	7 a.m. only ..	(Mx. + Mn.)/2
3	Puerto de Antofagasta.†	23° 39′	70° 25′	4m.	Chile Anuario, p. 107. Begins January 25th, 1905.	8 a.m. (14 and 21 also available).	(Mx. + Mn.)/2 (8, 14, 21 also given)
4	Punta Tortuga, Coquimbo†.	29° 56½′	71° 21½′	26m.	Chile Anuario, p. 107	Do.	Do.
5	Goya	29° 9′ 6″	59° 15′	—	1900 last received ..	—	—
6	Porto Alegre ..	30° 02′	51° 11′	45·7m.	Bol. Mens. Ministerio de Marine.	Noon, G.M.T...	—
7	Rio de Janeiro† ..	22° 54′ 24″	43° 10′ 15″	?	Bol. Mens. d. Obs. R. J., pp. 27-33.	(1+4+7+10+13 +16 + 19 + 22)/8	Same. No means for extremes.
8	Curityba	25° 25′ 12″	49° 17′W.	908m.	Bol. Mens. Ministerio de Marine.	Noon, G.M.T. *See* above.	—
9	Windhuk	22° 32′	17° 15′E.	—	—	—	—
10	Johannesburg ..	26° 11′	28° 3′	5,760 ft. 1755·6m.	Transvaal Met. Dep. Annual Report, pp. 6, 46, 65, 109.	24 hours (separate).	24 hours (separate values given).
11	Pretoria*	25° 53′	29° 6′	4,387 ft.	Do., pp. 6, 21.	8 a.m. (13½ and 19 also).	(Mx. + Mn.)/2 (8 and 19 also).
12	Kimberley†	28° 43′	28° 46′	4,042 ft.	Cape Met. Com. Rep., p. 111.	8.30 a.m. (time of 30°E.).	(Mx. + Mn.)/2
13	Bulawayo	20° 2′	28° 58′	—	Cape Com. or Bul. Obs. or Statist.	—	—
14	Durban†	29° 51′	30° 30′ 00″	262 ft.	Rep. Gov. Astronomer, p. 22.	9 a.m. (3 p.m, also).	(Mx. + Mn.)/2 (9 and 15 also.)
15	Natal and Mozambique.	15° 2′	40° 48′	—	—	—	—
16	Fianarantzoa ..	—	—	—	—	—	—
17	Mauritius†	20° 5′ 39″	57° 33′ 15″	181 ft.	Results of Mag. and Met. Obs., p. XVIII.	24 hours (not separate).	24 hours (not separate).
18	Reunion	21° 0′	55° 30′	—	—	—	—
19	Onslow	21° 43′	114° 57′	—	Western Australia, Monthly Sheet.	*See* above, Western Australia.	—
20	Peak Hill	25° 38′	118° 47′	—	Do.	Do.	—
21	Nullagine	21° 53′	120° 5′	1,265 ft.	Do.	Do.	—
22	Lavertar	28° 40′	122° 22′	—	Do.	Do.	—
23	William Creek ..	28° 55′	136° 21′	250 ft.	*See* Adelaide, pp. 35, 83.	*See* above, South Australia (Adelaide).	—
24	Alice Springs ..	23° 38′	133° 37′	2,100 ft.	*See* Adelaide, pp. 33, 82.	Do.	—
25	Boulia..	—	—	—	—	—	—
26	Mitchell	—	—	—	—	—	—
27	Brisbane	27° 32′	153° 2′	137 ft.	Queensland Gov. Gaz.	(9 + 15)/2 (separate).	(Mx. + Mn.)/2
28	Rockhampton ..	23° 24′	150° 30′	37 ft.	—	—	—
29	Norfolk Island ..	28° 58′	168° 3′E.	—	—	—	—
30	Gomen	—	—	—	—	—	—
31	Noumea	—	—	—	Ann. Bur. Cent. Mét. France, p. C., 98.	No Bar. ..	(Mx. + Mn.)/2 (9 and 15 also).
32	Punta Anjelas (Valparaiso).†	33° 1′	71° 38′W.	41m.	Chile Anuario, p. 132	8 a.m. *See* Chile	(Mx. + Mn.)/2
33	Cordoba	31° 25′	64° 12′	439m.	—	—	—
34	Santiago	33° 26′	70° 41′	520m.	—	—	—
35	Juan Fernandez† ..	33° 37′	78° 50′	10m.	Chile Anuario, p. 158	8 a.m.	(Mx. + Mn.)/2
36	Buenos Ayres ..	34° 16′	64° 11′	—	—	—	—
37	Estancia San Juan	34° 49′	58° 3′	—	—	—	—
38	Punta Lavapie† ..	37° 9′S.	73° 35½′W.	46m.	Chile Anuario, p. 222	8 a.m.	(Mx. + Mn.)/2

* Gravity correction not applied to the readings of pressure.

Pressure.			Temperature.								Rainfall.	
Mean at Level of Station.	Mean at M.S.L.	Diff. from Av.	Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date.	Mean.	Diff. from Normal.	Total.	Diff. from Av.
—	—	—	—	—	—	—	—	—	—	—	—	— 1
759·6	—	—	29·0C.	30·6C.	—	22·9C.	19·2C.	—	—	—	122·0mm.	— 2
—	—	—	—	—	—	—	—	—	—	—	—	— 3
760·2	—	—	22·8C.	25·2C.	4th	15·6C.	13·4C.	24th	19·2C.	—	?	— 4
—	—	—	—	—	—	—	—	—	—	—	—	— 5
756·35	—	—	—	—	—	—	—	—	—	—	—	— 6
756·946	—	—	—	35·9C.	26th	—	19·0C.	7th	24·84C.	—	192·95mm.	— 7
686·10	—	—	—	—	—	—	—	—	—	—	—	— 8
—	—	—	—	—	—	—	—	—	—	—	—	— 9
616·58	—	—	75·8F.	82·1F.	13th	55·7F.	51·5F.	19th	64·9F.	3·60F.	—	— 10
25·655	—	—	85·2F.	91·6F.	7th	59·2F.	54·0F.	20th	—	—	2·27 in.	— 11
26·021	—	—	95·3F.	102·3F.	—	61·1F.	54·0F.	—	78·2F.	—	1·19 in.	— 12
—	—	—	—	—	—	—	—	—	—	—	—	— 13
—	30·017	—	83·7F.	89·8F.	—	69·0F.	62·1F.	—	—	4·44F.	—	— 14
—	—	—	—	—	—	—	—	—	—	—	—	— 15
—	—	—	—	—	—	—	—	—	—	—	—	— 16
29·714	—	—·036	84·6F.	87·7F.	15th	74·1F.	71·0F.	12th	78·7F.	—0·2F.	21·16 in.	+12·8 in. 17
—	—	—	—	—	—	—	—	—	—	—	—	— 18
—	29·802	+·018	97·6F.	117·0F.	—	72·7F.	63·0F.	—	85·2F.	—0·3F.	0·48 in.	— 19
—	29·785	+·019	99·0F.	109·0F.	—	74·0F.	53·0F.	—	86·5F.	0·0F.	1·42 in.	— 20
—	29·753	—·006	105·6F.	117·0F.	—	74·5F.	65·0F.	—	90·0F.	+2·0F.	0·75 in.	— 21
—	29·827	—·032	96·1F.	110·2F.	—	70·3F.	56·0F.	—	83·2F.	+0·6F.	0·83 in.	— 22
—	29·842	—	100·2F.	110·0F.	1st	72·4F.	61·2F.	25th	86·3F.	—	0·47 in.	—0·19 in. 23
—	29·777	—	99·0F.	106·0F.	23rd	70·7F.	61·4F.	7th	86·6F. 3 hourly	—	0·85 in.	—1·19 in. 24
—	—	—	—	—	—	—	—	—	—	—	—	— 25
—	—	—	—	—	—	—	—	—	—	—	—	— 26
—	29·910	—	85·3F.	102·4F.	2nd	69·3F.	63·7F.	25th	77·3F.	—	9·09 in.	— 27
—	—	—	—	—	—	—	—	—	—	—	—	— 28
—	—	—	—	—	—	—	—	—	—	—	—	— 29
—	—	—	—	—	—	—	—	—	—	—	—	— 30
—	—	—	28·71C.	32·0C.	5th	20·76C.	19·4C.	14, 17	—	—	58·2mm.	— 31
758·7	—	—	23·8C.	29·9C.	2nd	15·5C.	13·2C.	26th	—	—	?	— 32
—	—	—	—	—	—	—	—	—	—	—	—	— 33
—	—	—	—	—	—	—	—	—	—	—	—	— 34
764·3	—	—	22·3C.	26·4C.	12th	16·4C.	13·4C.	16th	—	—	39·6mm.	— 35
—	—	—	—	—	—	—	—	—	—	—	—	— 36
—	—	—	—	—	—	—	—	—	—	—	—	— 37
758·5	—	—	22·3C.	35·8C.	4th	12·0C.	6·5C.	24th	—	—	?	— 38

† No information regarding gravity correction.

	Name of Station.	Latitude.	Longitude.	Height.	References.	Barometer.	Temperature.
1	Monte Video* ..	34° 53′S.	56° 10′W.	29·34m.	Bol. del Obs. Met. Municipal de M. V.	(7 + 2 + 9)/3 (Hourly available.)	(7 + 14 + 21)/3 (Mx. and Mn. given.)
2	Tristan d'Acunha ..	—	—	—	—	—	—
3	Cape Town* ..	33° 56′	18° 29′E.	40 ft.	Cape Met. C. Rep., p. 97.	8.30 a.m. ..	(Mx. + Mn.)/2
4	East London* ..	32° 59′	27° 52′	33 ft.	Do., p. 108.	Do. ..	8.30 a.m. also. Do.
5	New Amsterdam, St. Paul.	—	—	—	—	—	—
6	Perth	31° 57′	115° 52′	—	Western Australia Monthly Sheet.	*See* above, Western Australia.	—
7	Katanning	33° 40′	117° 33′	—	Do.	Do.	—
8	Coolgardie	30° 45′	121° 16′	—	Do.	Do.	—
9	Eucla	31° 39′	128° 55′	—	Met. Obs. at Adelaide and other places, pp. 45 and 91.	*See* above, Southern Australia.	—
10	Adelaide	34° 56′	138° 35′	—	Do., pp. 2 and 89.	Do.	—
11	Streaky Bay ..	32° 48′	134° 13′	—	Do., pp. 47 and 92.	Do.	—
12	Melbourne	37° 50′	144° 58′	91·3 ft.	Western Australia Monthly Sheet.	—	—
13	Bourke	30° 3′	145° 32′	—	—	—	—
14	Sydney	33° 52′	152° 12′	155 ft.	—	—	—
15	Lord Howe's Island	—	—	—	—	—	—
16	Auckland	36° 52′	174° 42′E.	—	New Zealand Gazette.	No. Bar. given	Doubtful whether readings are absolute or mean extremes, probably the former. The "absolute mean" is given but the term is not explained.
17	Ancut	—	—	—	—	—	—
18	Bahia Blanca ..	39° 25′	61° 25′W.	—	—	—	—
19	Punta Galera* ..	40° 1′	73° 44′	38 m.	Chile Anuario, p. 275.	8 a.m., Chile ..	(Mx. + Mn.)/2
20	Puerto de Ancud* ..	41° 51′	73° 50′W.	48 m.	Do., p. 301.	Do. ..	Do.
21	Kerguelen . ..	—	—	—	—	—	—
22	Hobart	42° 53′	147° 20′E.	—	—	—	—
23	Launceston	—	—	—	—	—	—
24	Dunedin	45° 53′	170° 27′	—	—	—	—
25	Wellington*	41° 14′	174° 44′	140 ft.	New Zealand Gov. Gaz.	9 a.m. only ..	(Mx. + Mn.)/2
26	Christchurch ..	43° 30′	172° 30′E.	—	—	—	—
27	Islote de los Evanjelistas.*	52° 24′	75° 6′W.	53m.	Chile Anuario, p. 327	8 a.m.	(Mx. + Mn.)/2
28	Puerto de Punta Arenas.*	53° 10′	70° 54′	10m.	Do., p. 353.	Do.	Do.
29	Punta Dungeness*	52° 24′	68° 25′	3m.	Do., p. 379.	Do.	Do.
30	Staten Island ..	54° 40′	64° 20′	—	—	—	—
31	Cape Pembroke† ..	51° 41′	57° 42′	70 ft.	MS. at M.O. published rainfall for 1909.	8 a.m.	(Mx. + Mn.)/2
32	South Georgia, Grytviken.	54° 14′S.	36° 33′W.	10 ft.	Begins 1906	—	—

* No information regarding gravity correction.

Pressure.		Diff. from Av.	Temperature.								Rainfall.	
Mean at Level of Station.	Mean at M.S.L.		Mean Max.	Abs. Max.	Date.	Mean Min.	Abs. Min.	Date	Mean.	Diff. from Normal.	Total.	Diff. from Av.
757·58	—	—	27·12C.	26·0C.	31st	14·51C.	7·6C.	6th	21·36C.	—	63·0mm.	— 1
—	—	—	—	—	—	—	—	—	—	—	—	— 2
29·945	—	—	77·7F.	98·1F.	—	61·1F.	53·3F.	—	69·4F.	—	0·604 in.	— 3
29·932	—	—	76·5F.	81·0F.	—	65·3F.	60·0F.	—	70·9F.	—	1·41 in.	— 4
—	—	—	—	—	—	—	—	—	—	—	—	— 5
—	29·994	+·044	80·2F.	97·1F.	—	60·1F.	51·1F.	—	70·2F.	−3·3F.	0·16 in.	— 6
—	29·974	+·017	83·9F.	100·0F.	—	54·2F.	43·0F.	—	69·0F.	−1·9F.	0·17 in.	— 7
—	29·894	−·008	93·2F.	108·5F.	—	61·6F	47·2F.	—	77·4F.	−0·2F.	0·46 in.	— 8
—	29·920	—	82·6F.	112·0F.	7th	63·9F.	51·2F.	3rd	73·2F.	—	0·25 in.	−0·49 in. 9
—	29·969	—	87·4F.	109·7F.	12th	62·3F.	51·3F.	31st	—	—	1·51 in.	+0·65 in. 10
—	29·956	—	85·8F.	111·0F.	12th	60·8F.	52·0F.	30th	73·3F.	—	0·44 in.	−0·13 in. 11
—	29·921	+·090	71·2F.	108·5F.	—	57·3F.	35·6F.	—	64·2F.	−3·1F.	1·47 in.	— 12
—	—	—	—	—	—	—	—	—	—	—	—	— 13
—	29·960	+·031	79·0F.	88·0F.	—	66·0F.	56·0F.	—	72·5F.	+1·0F.	1·74 in.	— 14
—	—	—	—	—	—	—	—	—	—	—	—	— 15
—	—	—	—	78·5F.	—	—	48·0F.	—	61·6F.	—	2·79 in.	— 16
—	—	—	—	—	—	—	—	—	—	—	—	— 17
—	—	—	—	—	—	—	—	—	—	—	—	— 18
759·7	—	—	18·8C.	22·2C.	31st	13·6C.	11·4C.	24th	16·2C.	—	22·0mm.	— 19
759·1	—	—	20·0C.	23·8C.	18th	10·0C.	7·0C.	24th	15·0C.	—	53·1mm.	— 20
—	—	—	—	—	—	—	—	—	—	—	—	— 21
—	—	—	—	—	—	—	—	—	—	—	—	— 22
—	—	—	—	—	—	—	—	—	—	—	—	— 23
—	—	—	—	—	—	—	—	—	—	—	—	— 24
—	29·848	−·048	64·8F.	75·6F.	17th	52·6F.	41·9F.	2nd	58·7F.	−4·1F.	2·32 in.	−1·22 in. 25
—	—	—	—	—	—	—	—	—	—	—	—	— 26
746·5	—	—	11·3C.	13·6C.	6 & 7	7·2C.	6·4C.	16th	9·2C.	—	232·5mm.	— 27
748·7	—	—	19·9C.	27·0C.	10th	6·9C.	4·0C.	29th	13·4C.	—	34·4mm.	— 28
751·4	—	—	15·7C.	21·0C.	4th	7·9C.	5·0C.		11·8C.	—	38·8mm.	— 29
—	—	—	—	—	—	—	—	—	—	—	—	— 30
29·466	—	—	53·0F.	62·0F.	5, 17, 18	44·1F.	40·0F.	3rd	48·6F.	—	—	— 31
—	—	—	—	—	—	—	—	—	—	—	—	— 32

† Gravity correction not applied to the readings of pressure.

APPENDIX V.

Report of the Proceedings of the International Commission for Réseau Mondial.

Meeting held at Monaco, 15th April, 1909, at 10.30 a.m.

Present: Messrs. Teisserenc de Bort, *President*, Hergesell, Rykatcheff, Ryder, Rotch, Deslandres, and Hildebrandsson, *Secretary*.

Visitors present: Messrs. Cave, Ferrari, Oddone, Ruggi, Polis, Stade and Colonel Vives y Vich.

(1.) M. Teisserenc de Bort stated the object of the meeting, and read letters from Messrs. Shaw, Hellmann, Stupart, Moore, Walker, and Captain Lyons, requesting to be excused for their inability to attend the meeting, and giving opinions on various points contained in the programme of the Commission. A summary of these letters is given in the appendices.

(2.) M. Teisserenc de Bort read a report on the Réseau Mondial which was to be organised.

(3.) M. Hildebrandsson, in support of his proposal already made at St. Petersburg in 1899 to organise meteorological stations near large centres of action, read a report and showed diagrams on the compensation of simultaneous types of weather in different regions.

(4.) The Commission considered which would be the most desirable stations for the formation of the Réseau Mondial. The following were chosen: —Dawson, Godthaab (Greenland), Seydisfjord (Iceland), Thorshavn, Gjesvær (North Cape), Beresov, Irkutsk (later Verkoïansk), Vladivostok, Petropavlovsk (Kamtschatka), Behring Island, Sitka (or a station on the Aleutian Islands), Newfoundland, Azores, Canaries, Cape Verde, Tashkent Zi-ka-wei, Tokio, a station in Upper Burmah, M'Zab (Algeria), Sandwich Islands, Quito, Fernando Po, Suez, a station on the Upper Nile, Kodaikanal (India), Batavia, Manila, Samoa or Tahiti, Cordoba (Argentine), St. Helena, Pretoria or Cape Town, Mauritius, Alice Springs (Australia), Dunedin (New Zealand), Punta Arenas or Falkland Islands, Kerguelen.

Second Meeting, 5.30 p.m.

Present: Messrs. Teisserenc de Bort, *President*, Ryder, Rykatcheff, Rotch, and Hildebrandsson, *Secretary*.

Visitors present: Messrs. Cave, Koustnezow, Palazzo, Colonel Vives y Vich.

After discussing the matter the Commission decided that besides the observations usually given such as temperature, pressure, &c., the following should also be transmitted:—solar radiation, the direction of upper clouds, and the temperature of the sea. According to the proposal of M. Teisserenc de Bort, radiation will be observed when the sun reaches certain heights, to be settled on beforehand, in order that it may be possible to compare observations taken at different stations, without having to make use of any hypothesis about the absorption of the atmosphere.

Current observations will be made in the morning at the usual hour adopted by the Meteorological Telegraphic Réseau in all countries; observations of radiation intensity, taken on the previous day, will be transmitted at the same time in the morning.

Third Meeting, April 6th, 3 p.m.

Present: Messrs. Teisserenc de Bort, *President*, Deslandres, Ryder, Rykatcheff, Rotch, and Hildebrandsson, *Secretary*.

(1.) The Commission examined first the way in which observations from stations, necessary for *the study of centres of action*, should be collected and summarised. The Commission requested the various institutes, willing to co-operate, to send means from their selected stations, at the end of each month to the President of the Commission who will arrange them in the form of a table, which will be sent to all those who co-operated. Data not arriving in time will be inserted the following month at the end of the other observations.

(2.) For the telegraphic Réseau Mondial, observations will be telegraphed daily or, if this is impossible, a summary for the week will be sent every seven days. These observations will be addressed to the central institute of each country and published in its report.

If an extraordinary phenomenon occurs, the observer should send particulars with the next telegram. For stations which only send a weekly summary, an unusual phenomenon might be made the subject of a special telegram sent as soon as possible after its occurrence.

(3.) M. Deslandres remarked that it would be preferable, especially in the case of distant stations, to have monthly means sent by telegram to the President of the Commission.

(4.) The Commission desired the officers to take all the steps necessary for the realisation of the aim of the Commission, and, with this end in view, to enter into communication with the various telegraphic offices and other institutions which might aid in this undertaking.

L. Teisserenc de Bort, President. H. H. Hildebrandsson, Secretary.

International Réseau Mondial Commission.

(Circular No. 1.)

My dear Colleague,

You know by the report of the proceedings at the meetings of the International " Réseau Mondial " Commission at Monaco in April, 1909, that the Commission had in view two different undertakings.

You know the principal aim of our Commission is to organise a Réseau Mondial which will allow us to follow on a large scale the modifications of the atmosphere and solar heat in the various regions of the globe.

Further, our Commission proposes to collect and publish those observations from stations which are necessary for the study of centres of action and for the compensation of simultaneous types of weather in different regions.

It is obvious that this second service is the simplest and easiest to establish. The organisation of the telegraphic Réseau Mondial is more difficult, and it seems as if some time will still be needed to take the necessary steps and to attain success.

While waiting for the realisation of the Réseau Mondial, which will enable one to follow almost daily and from different points of view all the large atmospheric variations, our Commission thinks that from now onwards observations, necessary for the study of fluctuations of centres of action, should be grouped together.

The aim of this circular, therefore, is to organise a Réseau of stations for the study of centres of action.

At the first meeting at Monaco, the undersigned Hildebrandsson read a preliminary communication on the compensation of simultaneous types of weather in different parts of the earth's surface, between Newfoundland in the west and Siberia in the east, that is to say for that portion of the earth from which sufficient observations are available. You have received an extract of this communication published in the acta of the Stockholm Academy.

By this you will see in what way we think that this question should be attacked from the beginning. It is a question of publishing as regularly as possible the *monthly means* for a certain number of stations distributed as uniformly as possible over the entire surface of the globe.

At Monaco we chose the most favourable stations, especially those outside the regular services. In order to obtain the desired réseau we have here completed the list by adding several stations from these services.

If we confine ourselves in the first instance to the three principal elements:—pressure, temperature, and rainfall, only three lines containing the monthly and annual means of these elements are needed for each station for each year.

Station.	——	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	Pressure													
	Temperature.													
	Rainfall													

This is sufficient to draw approximately the isobars for each month and for the year, the isotherms and isohyets for the greater part of the globe, and in the future one will be able to study the variations from year to year and thus find the compensation between the different centres of action. These three elements are sufficient for determining different types of weather.

We, therefore, request the Directors of Meteorological Services in all countries to be so good as to send at the end of each year, from 1910 onwards, to the Secretary of the Réseau Mondial Commission, monthly means for the stations given below.

The Bureau will publish a table containing these data and distribute copies to the various contributors. Observations from stations which are not yet in working order in 1910 will be inserted later, if and as soon as it has been possible to organise these stations.

Desired Stations.

ARGENTINE:—Cordoba.
AUSTRALIA:—Alice Springs, Sydney, Perth, Dunedin (New Zealand).
AUSTRIA HUNGARY:—Vienna, Debreczin, Lissa.
BELGIUM:—One station in the Congo.
BRAZIL:—Rio de Janeiro, Pernambuco.
CANADA:—Toronto, Bermudas, Newfoundland, one station in the north, Dawson.
CHILE:—Valparaiso, Punta-Arenas.
CHINA:—Zi-ka-wei.
DENMARK:—Godthaab, Seydisfjord, Thorshavn.
EGYPT:—Suez, one station on the Upper Nile.
ECUADOR:—Quito.
FRANCE:—Lyons, M'Zab, one station on the Niger, Tahiti, Kerguelen.
GERMANY:—Berlin, Hamburg, Samoa, one station in Labrador.
GREAT BRITAIN:—London, one or two stations in South Africa, Mauritius, St. Helena, Falkland Islands.
HOLLAND:—Batavia, Paramaribo (Guiana).
INDIA:—Aden, Zanzibar, one station in India and one in Upper Burmah.
ITALY:—Palermo, Massowah, or some other station on the Red Sea.
JAPAN:—One or two stations.
MEXICO.—Mexico.
NORWAY:—One or two stations near North Cape and, if possible, near Spitzbergen and one near to the Norwegian Whaling Station of South Georgia.
PORTUGAL:—Azores, Cape Verde Islands, St. Thomas.
RUSSIA:—Pavlovsk, Moscow, Batoum, Barnaul, Irkutsk, Tashkent, Vladivostock, Petropavlovsk (Kamtschatka) and, if possible, Verkojansk.
SPAIN:—Madrid, San Fernando, Teneriffe.
SWEDEN:—One station in Northern Lapland, Upsala, Wisby.
UNITED STATES:—Key West, St. Louis, San Diego, Manila, Sandwich Islands, Sitka, Behring Islands.

It goes without saying that neither the instruments nor their exposure should be changed from one year to another.

With kind regards,
Yours very truly,

LEON TEISSERENC DE BORT,
President.

H. HILDEBRAND HILDEBRANDSSON,
Secretary.

Paris and Upsala, December, 1909.

Paris,
20th September, 1910.

DEAR SIR,

With regard to the Réseau Mondial, I think there are two very distinct questions: the researches which one takes up after the lapse of a fairly long time, such as those of M. H. Hildebrandsson or of the Solar Commission, and investigations day by day which should be made at the actual time when the phenomena occur or very soon afterwards. In my opinion the latter investigations are of the utmost importance, and in spite of the difficulty of organising this Réseau, I think it should be actively prosecuted. This is the aim of my proposal, and I hope that this ideal will soon develop into a reality.

For the researches which are made after lapse of time, there should be a comparatively large number of stations. It is only a matter of making copies of the observations, and there is no doubt about the stations used by the Solar Commission being well placed and able to serve the purposes of Sir Norman Lockyer's investigations, or those of M. Hildebrandsson or other scientists. In copying the observations it would only be necessary to add one complete observation for each day, for example:—

7 a.m., 757·2 mm. 12·4° N.E.$_4$ overcast, rain, in the past 24 h., 0·8 mm. min. 4·2, max. of previous day 17·6, Cirrus from the S.S.E. at 6 a.m.

The minima and maxima are given separately because it is of importance to know whether the diurnal amplitude has been great or small and whether nocturnal radiation has influenced the low temperatures: these are characteristics which change with types of weather.

For data which should enable one in some way day by day to follow the principal features of the atmospheric circulation over the entire globe, it is obvious that the difficulty lies in the absence of telegraphic communication for many of the distant stations, and, in a smaller degree, in the cost of sending daily telegrams from these stations to their chief capital in Europe.

The only remedy for this is the organisation of the telegraphic réseau by wire, cable or wireless, which becomes every day more complete.

As the number of necessary stations, beyond those from which telegrams are already received, is limited to 30, there is hope that with a little perseverance this service may be established.

The International Committee would help this work greatly by recommending the various meteorological services to do their utmost to obtain daily telegrams from two or three well placed colonial stations. This would entail no great effort on the part of each one, and would render it possible subsequently to summarise the elements easily in the form of a table or chart giving the general meteorological state of the globe either daily or for every two or three days.

I am sure that when we see the general phenomena all together we shall discover connexions which now entirely escape us.

The choice of these telegraphic stations has already been broadly outlined by the Réseau Mondial Commission during the

meeting at Monaco, of which you have a printed report of the proceedings. Modifications will naturally be made in this choice arising from the greater or smaller scientific resources of a colony.

These are the remarks which I should have wished to communicate to the International Committee. I regret that the present state of my health prevents me from coming to Berlin, but I think that the question is simple enough to be considered as an organisation which it would be expedient to advance.

With kind regards,
Believe me, dear Sir,
Yours truly,

L. TEISSERENÇ DE BORT.

APPENDIX VI.

THE WORK OF THE INTERNATIONAL COMMISSION FOR SCIENTIFIC AERONAUTICS, DURING THE YEARS 1908-1910.

Since 1907 the International Commission for Scientific Aeronautics has carried on its regular work most successfully. As before, simultaneous ascents were carried out on the first Thursday of every month. Moreover, the so-called serial ascents have gradually become more extensive. According to the resolutions adopted at Milan, registering balloon ascents from well known upper air stations are made on three consecutive days four times a year.

Once a year one of these so-called small serial ascents is extended by carrying on the investigation of the upper air on at least six consecutive days. This is the so-called International Week. These operations have been carried out regularly since the year 1907. Those stations of ascent known from previous Reports are still co-operating, while various new ones have been added. Of the fresh places, where registering balloon ascents take place, special mention should be made of:—Aix-la-Chapelle, Puy de Dôme, Batavia, Ekaterinbourg, Tiflis, and Blue Hill with its substations. Thanks to the care and activity of Mr. Rotch, the upper strata of the atmosphere over America have now also been investigated by registering balloon ascents. The Weather Bureau of the United States has also done good service by establishing a permanent Observatory at Mount Weather. Kite ascents, registering balloon ascents and other aerological investigations are zealously carried out there.

This opportunity may be taken for stating that diplomatic negotiations have been in progress between Chile and Germany in order that the Meteorological Observatory there may co-operate in our aerological investigations. The Chilian Government has agreed to this. Similar negotiations with Japan have not as yet resulted in anything definite, nevertheless we hope that in future years Japan will also co-operate in our investigations. The Indian Meteorological Service has also occasionally co-operated by means

of pilot and registering balloon ascents. A new kite and pilot balloon station has been established in Samoa at the Geophysical Observatory there.

I should like to mention here that the Kite Observatory, established on Lake Constance by the German Government and neighbouring South German States, carries out regular ascents and, with the exception of Sunday, is continually working. In connexion with the work of this Institute the following fact is worthy of mention—that it is easier to work on board ship with small spherical balloons than with kites, at least so far as the climatic conditions of Lake Constance are concerned. For further details I would refer to the Reports of the Director of the Kite Station, Dr. Kleinschmidt.

I need hardly point out that other large aeronautical observatories have also been doing regular work.

The work at pilot balloon stations has become more regular and trustworthy since the last Report. By means of various experiments I have been able to prove to what extent the velocity of ascent is affected by the free lift of these small spherical rubber balloons. As this law is a very simple one—the result being on the whole a constant velocity—one can work very conveniently at a station and follow the conditions of atmospheric currents, by means of small balloons, up to very great heights with sufficient accuracy. It was, therefore, the aim of Members of the Commission and myself to increase, as far as possible, the number of pilot balloon stations. I will mention here the stations recently added:—Copenhagen, Christiania, Bergen, de Bilt, Aix-la-Chapelle, Friedrichshafen, Stuttgart, and Teneriffe. Later on I will report specially on the last-mentioned station.

The work of the Commission with regard to simultaneous ascents, mentioned above, has also resulted in an attempt to investigate the atmosphere over the sea by means of several expeditions. The enterprises mentioned in my previous Report of the "Princess Alice" (Prince of Monaco, Hergesell), and of the "Otaria" (Teisserenc de Bort and Rotch) have given rise to a number of expeditions, which I wish to refer to here. The Russian Institute arranged for kite and registering balloon ascents on ships in the Gulf of Finland and in the Bay of Bengal. In 1908 and 1909 Italy fitted out expeditions, under the direction of our colleague M. Palazzo, off the East Coast of Africa and in 1910 off the coast of Liguria. In 1908, at the suggestion of the Prince of Monaco, the French Admiralty gave instructions for registering balloon ascents to be carried out, in the Lesser Antilles (West Indies), on board the cruiser "Chasseloup Laubat," under the command of Lieut. Hautfeuille. In 1908 Austria for the first time arranged for registering balloon ascents in the Adriatic. Germany took a particularly active part in these investigations. Each year since 1908, through the interest shown by H.M. the German Emperor and the German Minister of Naval Affairs, battleships have been placed at the disposal of the President of the Commission for the purposes of aerological investigations. The survey ship "Planet," in the Pacific Ocean, has worked regularly in the interests of the International Commission at the international periods. In 1908

H.I.M.S. "Möwe" once more took part in our simultaneous ascents from the North Sea. In the summer of 1908, H.I.M. cruiser "Victoria Louise," under my direction, accomplished a number of registering balloon ascents in the neighbourhood and to the south of Teneriffe, for the purpose of investigating the trade winds of the East Atlantic Ocean. In the following year the same ship, again under my direction, made some winter ascents in the western trade region of the Atlantic Ocean. In this year also, a cruiser will once more be prepared to carry out registering balloon ascents in West Indian waters. I should like to refer here to the assistance we have received in our work from the North German Lloyd Shipping Company. Last year this Company placed at my disposal, as President of the Commission, three Lloyd steamships for the investigation of the winter conditions of the trades to the extent that the scientific experts were given free accommodation on board, and the officers of these ships had instructions to assist in the work. The ships all went through the Atlantic trade and had on board Dr. Stade, Dr. Wegener, and M. Frobese. Numerous pilot balloon ascents took place with interesting results. The success of these results, however, suffered slightly on account of the impossibility of diverting the ships' course and on account of the small sized pilot balloons chosen for the investigations. I should like to make special mention here of the expedition sent by the Aerological Observatory at Lindenberg to the tropics in 1908, under the direction of M. Berson, which organised a number of aerological investigations, especially high registering balloon ascents from Victoria Nyanza, that huge lake in the very heart of Africa. In enumerating the pilot and captive balloon ascents the de Quervain-Stolberg expedition to West Greenland must not be forgotten. The latter completed my measurements in the Arctic regions of Spitzbergen in 1906 and 1907 in an interesting way. In conclusion I will just mention my investigations this year *à propos* of the Zeppelin expedition to Spitzbergen. The meteorological conditions of the atmosphere over the Arctic Ocean were closely investigated by means of captive and registering balloons.

In June, 1909, at the suggestion of the English scientists Cave and Gold, a number of simultaneous ascents were arranged for the same day, in order, if possible, to determine the daily variation of temperature. In May, 1910, there were, especially in Germany, numerous ascents of manned balloons for the purpose of determining whether the passing of the Comet would in any way be productive of changes in the atmosphere. The chief duty of the manned balloons was to take samples of air from various heights. For these investigations the excellent method of M. Teisserenc de Bort, who had already brought down samples of air from great heights by means of registering balloons, was followed. He was also good enough to draw up a special note of instructions on the subject.

The investigation of the trade regions by means of simultaneous ascents and expeditions suggested to me the desirability of attempting a continuous determination of these conditions. Already in 1908 I had sent my assistants, Dr. Wenger and

Dr. Stoll, to the Peak of Teneriffe for the purpose of making experiments and investigating the conditions simultaneously with my ascents from the "Victoria Louise." Since then it has been possible, thanks to the kindness of the Spanish Government, to establish a permanent Observatory on the Peak of Teneriffe. His Majesty the German Emperor and several important manufacturers placed at my disposal the necessary funds and also the Observatory which had been erected, at great cost, on the so-called Canadas and placed at the service of the Spanish Government, so that it may be used in future by foreign scientists for carrying out scientific measurements.

One of my Assistants has been at this Observatory since November, 1909, for the purpose of making actinometrical observations and aerological investigations, principally by sending up pilot balloons, and also to study the nature of the currents by means of other measurements. The Observatory on the Canadas has lately been supplemented by neighbouring Observatories on Mount Guajara and on the Peak of Teneriffe itself. The results are exceedingly interesting, and I will produce them in a short report at no distant date. We welcome most thankfully the proposal of the Spanish Government to complete the rather provisional arrangement of barrack buildings by erecting strong houses of stone in suitable positions.

The International observations continue to be published regularly with the assistance of the funds mentioned in the previous Report. The results of all upper air stations have now been published up to November, 1908. Besides these the publications contain the results of numerous mountain stations and cloud observations. In my opinion this publication has been of special value in placing our measurements at the disposal of a wider range of scientists. And we have not been unsuccessful; a number of discussions of our ascents have been published and appeared mostly in the Journal "Beiträge zur Physik der freien Atmosphäre," edited by Professor Assmann and myself. I should like to mention particularly the work of M. Wagner. Amongst further very important work, that of Messrs. Humphreys and Gold on the Upper Isothermal Layer deserves particular attention.

Since the last Report our Commission has had one reunion, and that was at the instigation of our noble patron and fellow-worker, His Highness the Prince of Monaco, at Monaco. The minutes of these discussions have been printed, and I beg to hand several copies of it to the Conference for their information. The most important resolutions are as follows:—

Resolutions.

2. The Commission, at the suggestion of M. Rykatcheff has decided to conduct once a year a small series of ascents according to M. Bjerknes' proposals. The July series was chosen for 1909, and the instructions given by M. Bjerknes will be strictly adhered to with the exception of one alteration, namely, that the principal

observation—sending up of ballons-sondes containing instruments—will take place at 7 o'clock, G.M.T., instead of at 1 p.m. (*See* pp. 82-84, Monaco report.)

3. The International Commission for Scientific Aeronautics, while appreciating the importance of the aerological results furnished by permanent stations for kites and captive balloons, especially when these investigations are conducted systematically, regrets that comparative simultaneous and continuous study of these observations, which alone will show up their entire value, is still rendered impossible by the small number of observatories in existence, and the frequent interruptions in the work to which many of these are subject. The Commission is, therefore, of opinion that aerological observations for continuous investigation by means of kites and captive balloons should be instituted in positions suitable for these observations, and especially in those countries where none are yet in existence.

4. The International Commission for Scientific Aeronautics is of opinion that regular aerological observations by means of captive balloons and kites in the Lower Hungarian Plain will be of the utmost interest both from a scientific and practical point of view, and is of opinion that a permanent Observatory should be installed, with the least possible delay, in the above-mentioned region (in the neighbourhood of the town of Kecskemet).

5. The International Commission for Scientific Aeronautics, appreciating the great importance of a continuous study of atmospheric currents at different levels from the point of view of theoretical and practical meteorology, and acknowledging that the method of sending up small rubber balloons called "Pilots" renders it possible to investigate the currents up to very great heights with sufficient accuracy and at no great cost, desires that numerous pilot balloon stations be established in all countries and that their results be communicated by telegram to the centres from which forecasts are issued.

H. Hergesell.

September, 1910.

APPENDIX VII.

Professor J. Maurer, Zürich, on the Use of Captive Pilot Balloons for Determining Wind Velocity in the Upper Atmosphere.

For several practical purposes, and particularly as regards aviation, it is frequently desirable to be able to measure, as simply and quickly as possible in direct sequence up to a certain maximum height, the large variations in the course of a day in wind velocity in the lower atmosphere.

A reliable method for this purpose is furnished by the pilot balloon, of which the rate of ascent can be determined beforehand, held captive by a tough but exceedingly light hemp cord (absolute breaking-strength = 6 kg., weight per 100 m. = 15—20 g.). For some time past these pilot balloons, flying free, have

been used in aeronautics with great advantage for the determination of currents in the upper air. Let v denote the rate of ascent of the small balloon (proper to a definite free lift A) and V the wind velocity to be measured at a height of $h = l. \cos a$ above ground (l = length of cord, a = angle it makes with the vertical). Thus for the pilot balloon the lifting force P_1 becomes proportional to the square of the vertical velocity v, and may be represented by $\gamma. v^2$, where γ represents a factor dependent on pressure and temperature. For the pressure of wind P_2 on the balloon (corresponding to the wind velocity V) the relation $P_2 = \gamma. V^2$ is obtained.

If the pilot balloon is in equilibrium at a certain angle a with the vertical, when the wind velocity is V, then,

$$\gamma v^2 \sin a = \gamma V^2 \cos a,$$

or

$$\tan a = \left(\frac{V}{v}\right)^2$$

If the velocity of ascent v, corresponding with a certain lifting force be known by the results of experiments and a is measured (the determination of the angle is obtained by means of an ordinary pocket protractor with a plumb-line), then by a simple calculation, the correct wind velocity V at the height $h = l \cos a$ may be obtained according to the above formula.

For a few experiments which I made in August and September of this year at the top of the Simplon Pass (2010 m.), with an upward force of 250 g. the vertical velocity during calm weather was found to be nearly 4·0 metres per second,* and thus the following values were obtained:—

a =	30°	45°	60°	70°	80°	84°
V =	3·0	4·0	5·3	6·6	9·5	12·3 m.p.s.

This simple method is equally suitable for ascertaining slight eddies which often exist in the lower atmosphere, and though these are not visible otherwise, yet, by means of captive pilot balloons, their direction and strength are easily distinguishable.

APPENDIX VIII.

H. Mohn.—On New Isothermal Charts for the Globe.

In the Report of the Meeting of the International Meteorological Committee at Paris in 1907, Resolution No. 3 (p. 10) is given as follows:—M. Pernter proposed, in the name of M. Hann, that a Commission be appointed for the preparation of new isothermal charts of the world.

M. Pernter's proposal was adopted, and the following gentlemen were appointed members of this special Commission:—M. Hann (President), M. Mohn and Sir John Eliot.

Sir John Eliot died on March 18th, 1908. On June 16th, 1908, M. Hann wrote to me as follows:—

"Much as I desire the preparation of new, carefully prepared isothermal charts for the world, yet I no longer feel myself

* Compare also the experiments of A. de Quervain in the "Annalen der Schweiz. Meteor. Centralanstalt" for the year 1907, Appendix No. 6.

able to take a share in such an extensive undertaking. The energies of younger men are wanted for this sort of thing. Should these be found, I would willingly assist them in the work, as far as my strength will permit."

On April 9th, 1909, I wrote to M. Hann regarding the isothermal charts, and submitted the following provisional suggestion to him:—

I. The Directors are requested to prepare temperature tables for their réseaux.

To this M. Hann adds the following remarks:—"I beg to request that consideration may be given to the question as to whether, either by means of specialising or restriction, a choice should be made in the case of the denser réseaux; only the Directors themselves are capable of judging which stations are most suitable for *general* purposes (not local climatological) with regard to reliability, position (not influenced too greatly by local conditions), &c. Perhaps one could even state the number of stations desired to cover a certain area."

II. The reduction of true monthly and yearly means must be calculated according to accepted dependable methods, and these must be stated.

M. Hann remarks:—"Reductions of true means (*i.e.*, for 24 hours) are desired. Every Director will doubtless have a few stations in his réseau from which the daily variation is available. A note should be made of the stations thus employed, and, if the daily course of temperature is not already contained in a universally available publication, it would be very desirable if these tables showing deviations of the hourly from the monthly means could be published or distributed in manuscript. It would be most desirable for notes to be prepared of those stations, from which the daily range of temperature has been calculated, with particulars of latitude, longitude, and height above mean sea-level, in order that the most suitable stations for comparison might always be chosen.

"An important matter is the question of the corrections to be applied to the mean of daily extremes, which, apart from errors due to the instruments and their exposure, vary enormously. An investigation of this subject would be most welcome. I have lately often found that means may be fairly reliable even in the tropics, but that they may also be too high by one degree or more, even at good stations. These errors are less considerable in temperate latitudes, but in lower latitudes they are often very great and entirely misrepresent the annual range by a marked yearly period. That is generally the case at places having a high rainfall—the temperature rises for a few hours, at and after noon, considerably above the mean for the day, the minimum (in the diurnal range) falls very little below the mean; and the cooling at night is hindered—the mean of the maximum and minimum is, therefore, far too high, not only that of the extreme thermometer readings, but the mean of the hourly extremes as well."

III. The Committee must determine the period of years to which these means should be reduced, as well as the rule for reduction to mean sea-level.

IV. The temperature tables thus prepared (containing latitude, longitude and height above mean sea-level of the stations, together with other remarks) will be communicated to the Committee, and the Committee will then see how the charts can be drawn and published.

With regard to temperature tables of the sea, a special Conference would be advisable.

APPENDIX IX.

Commission for Weather Telegraphy.

(Abstract of Replies.)

Letters commenting on the resolutions adopted by the Commission have been received from the following offices:—

Copenhagen.	Athens.
Hamburg.	De Bilt.
Brussels.	Helsingfors.
Strassburg.	Stockholm.
Munich.	Stuttgart.
Carlsruhe.	

All approve the recommendations of the Commission in principle. Only resolutions 4 and 8 raise protest in some quarters. 4* demands information as to "barometric tendency" for a three-hour interval. Denmark and Sweden uphold the demand for a six-hour interval, Sweden supporting the demand by lengthy arguments based on Ekholm's work on isallobars. On the other hand, Württemberg (A. Schmidt) puts in a plea for a two-hour interval, as giving better material for the construction of maps of dp/dt.

Recommendation 8* recommends two figures for coding the barometric tendency, and $\frac{1}{4}$ millimetre as the unit of measurement for Continental messages. This unit is regarded as unsatisfactory on the ground that it is too troublesome for the observers by Bavaria, Denmark, Sweden, Holland. Denmark and Sweden advocate the proposal made by M. Angot (pp. 31, 32 of the report), Holland makes a new proposal, and so does Bavaria.

Holland dissents from resolution 11, and proposes a code for transmission of cloud observations in two figures (in place of wet bulb).

Greece makes a point which is not mentioned in the report, though it probably was kept in view at the meeting. It is pointed out that many stations transmit only the third and fourth group of a full morning message, and that these two groups should remain self-contained as heretofore.

Denmark does not approve of the first part of resolution 7 (uniformity of code for all stations, whether international or not).

Denmark approves Prof. Willis Moore's limitation to resolution 3, that it is only desirable to report barometric tendency if the changes exceed 0·1 inch in two hours.

(*) Report of Proceedings at a Meeting of the Commission for Weather Telegraphy, p. 6.

APPENDIX X.

Extract of a Letter from Captain Ryder.

"To the third point which has been discussed by the Commission, viz., '*Telegraphic Reports from Iceland*' (page 7 in the Report), I must remark, that as the observing stations on Iceland are now situated, it will be impossible to get information as to sea disturbances.

All the five stations now used are situated at the bottom of fjords or bays sheltered from the disturbances of the ocean; and their observations in that direction would be no use. When the telegraph system on Iceland has been expanded to include the Westmann Islands on the south Coast, what is intended to be done in short time, it would perhaps be best to establish a station here, instead of the station at Blonduos. If that was done, good informations about the sea disturbances could be had from Westmann Islands.

Regarding the method of expressing negative temperatures in the Iceland telegrams, it is now (from 1st January this year) brought into line with the practice of other bureaux as communicated to the bureaux in a circular of December 2nd, 1909, from the Danish Institute."

APPENDIX XI.

To the International Meteorological Committee.

The undersigned begs leave to draw the attention of the International Committee to the difficulties in obtaining suitable data for investigations in dynamical meteorology. It is largely due to these difficulties that so little progress is made in dynamical meteorology. It seems, therefore, absolutely imperative that measures should be taken to remove these difficulties.

I consider that the following should be the chief aim of dynamical meteorology:—

(1) To prepare charts of the actual instantaneous conditions of the atmosphere. (2) Comparison of the charts corresponding with consecutive epochs, in order to deduce laws according to which subsequent conditions are evolved from those which precede.

The chart of an instantaneous condition of the atmosphere can only be worked out on the basis of strictly simultaneous observations. If the observations are not simultaneous, then the chart will only show a combination of conditions and changes of condition, which will not be of any practical use.

The only publications which give simultaneous observations to a certain extent are the daily weather charts. In individual réseaux, such as those of the United States, the principle of simultaneity is carried through most rigorously; this is not yet the case, however, in regard to the European réseaux. To the lack of simultaneous observations is also added the defect that the interval of time separating the successive epochs of observation is too great to render successful work in connection with the

second of the dynamical problems here defined. For by comparing charts separated by an interval of 24 or 12 hours, it is impossible to determine how the changes of the various meteorological elements have been effected.

All one has at one's disposal with which to complete the observations entered on the daily charts, and to draw charts for the intermediate intervals, are observations published in the Year Books of various Institutes. It is, however, extremely troublesome to gather material from these sources. For not only are there a great number of books, but the arrangement of data in each book is as inconvenient as possible for the investigator. Two sets of observations belonging to the same epoch of observation are never to be found on the same page. This difficulty can, however, be overcome by patience. But the worst is that published observations are taken at totally different times. And if, as a last resource, one tries to find the probable values of meteorological elements for the desired period by interpolation, then even the necessary data for this are often wanting; for in many cases there is nothing to indicate what time-meridian has been used by the different stations.

The lack of such fundamental data as these need, of course, only to be mentioned in order to have the defect remedied in future. A slight improvement of this nature will, however, not satisfy the investigator. Sooner or later it will be seen that an entire reform is absolutely necessary. In case this matter should be discussed at the present Committee Meeting, I beg leave to make the following suggestion in regard to those principles which, in my opinion, must be followed.

There is a great demand for observations, both from those investigating dynamics and those investigating climatology. The utmost economy must, therefore, be practised in regard to the choice of observations to be published. Not a single observation which cannot be used by dynamical meteorologists as well as by climatologists should be contained in the publication. This does not strike me as being impossible.

The principal demand for dynamical meteorology is as follows:—All observations must be taken at simultaneous epochs, and the intervals separating the epochs of simultaneous observations must be so short that there can be little change in the atmospheric conditions during an interval. I think that an hour, which is the interval used by climatological stations of the first order, would be a suitable interval. All reasonable requirements of dynamical investigators would thus be met, if the Year Books contained hourly observations taken simultaneously, which can be deduced from the curves of self-recording instruments at a sufficient number of stations of the first order. As it is only a question of obtaining strictly synchronous readings from curves already existing, no other change need be made in regard to the employment of observations. There will be a sufficient number of stations if synoptic charts can be drawn from the published observations. If one omits from the Year Books all observations other than those of use in dynamics, and

introduces in their stead the observations of a greater number of first order stations than at present, the result will doubtless be successful without increasing the size of the Year Books.

These simultaneous hourly observations would have their full value for the climatologist. The chief desire of the climatologist is to be able, by means of the observations, to follow the diurnal range of meteorological elements, to form reliable means, to determine the extremes, &c. Published hourly values would be of use for these purposes, quite apart from the fact whether they are taken according to local or zonal time.

On this general foundation, I beg to submit the following proposal for the consideration of the International Committee:—

The Year Books shall contain simultaneous hourly observations of a sufficient number of first order stations.

A reform, such as the one proposed, would open up an enormous field for dynamical investigations. Naturally, however, it will never be possible to issue an exhaustive publication of the observations. For purposes of special research, investigators will still find it necessary to search through unpublished observations for supplementary data. It is as important that ways and means should be discovered for facilitating the access of investigators to unpublished observations, as it is of consequence that published observations should be universally profitable. I have no decided opinion as to how this can be best brought about quite generally. It would, however, offer no great difficulty to compile such data and reproduce them cheaply in a limited number of copies, if dealing only with single days or with a group of a few days. The days to which attention is, for obvious reasons directed, are those on which International meteorological ascents are made. It would, of course, be of the utmost importance to receive as complete data as possible, also from ordinary stations, for these days. I, therefore, beg leave to submit the following proposal for the consideration of the International Committee:—

The various Central Meteorological Institutes are requested to collect as abundant data as possible of hourly observations taken simultaneously on the days of meteorological ascents, and to have inexpensive copies made of these. At special request copies should be placed at the disposal of investigators. It would also be desirable that copies of the curves of self-recording instruments could be added.

This more detailed suggestion is quite independent of the previous general one. I wish to lay stress on the fact, especially if the general suggestion is not adopted, that the adoption of a proposal, such as the second one, would render it possible for investigators at least for certain days, to receive data available for dynamical investigation.

Christiania, June, 1910.

V. Bjerknes,
Professor of Mechanics and Mathematical Physics.

APPENDIX XII.

Proposals made by the Bureau Central Météorologique de France with Reference to Storm Warning Signals at Night.

These signals should answer the following requirements:—

(1) They should be very simple so that they can be easily understood by all sailors and fishermen, even the most illiterate.

(2) They should correspond as nearly as possible with the day signals.

(3) The materials used should be plain and strong.

(4) As with the day signals, they should present the same aspect from all points on the horizon.

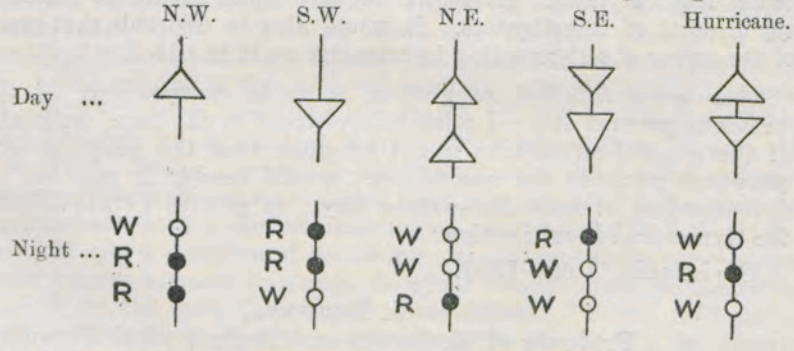
(5) There should not be the slightest cause for confusion with other night signals, already in use.

The French Bureau Central Météorologique suggests the following system which seems to satisfy the above-mentioned conditions. At my request this system was put forward by a naval officer, after giving special attention to the note published by the Deutsche Seewarte ("Annalen der Hydrog. und Marit. Meteorologie," 1910, Heft III.) and the lists of lighthouses and signal stations, to make sure that condition (5) was as nearly as possible satisfied.

The five night signals correspond with the five day signals, and are composed of three white or red lanterns placed vertically one above the other (the only means of fulfilling condition (4)). The interpretation of the signal, corresponding with the day signals is as follows:—

The white lantern represents the *point* of a cone of a day signal. The number of white lights (one or two) gives the corresponding number of day signal cones. White lights at the top of the signal indicate that the cones are pointing upwards; situated at the bottom of the signal, they indicate that the cones are pointing downwards. The red lanterns are only used to complete the number three of the lanterns and do not interfere with the interpretation.

We have thus the following table for day and night signals:—



This system seems to answer perfectly to the first four conditions. As to the fifth, there are only five ports in the North

Atlantic and adjacent seas which use signals similar to some of those suggested above.

In three German ports of the North Sea—Bremerhafen, Fünfhausen, and Vegesack—the following signals are used:—

R
R
W
} The water level does not exceed 0·20 metre above the local scale.

W
R
R
} Interruption in the service of signals of height of water.

At Burntisland (Scotland), the signal—

R
W
W
} signifies: "Enter at the West port."

At Dundee (Scotland) the signals—

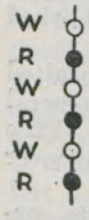
R W W
W W R
W R R
} indicate the water level in Camperdown dock.

These are the only places where confusion might be feared. Moreover, it seems that it will be easy to obtain at these five ports a slight modification of their respective signals; for instance, the substitution of green lanterns for red or white ones.

In the signals suggested, the white and red could be inverted, but in this case one would have a signal R W R which has already been adopted as an international signal in the "Rules for the prevention of collisions": it is the night signal which distinguishes cable ships.

Further, it may be mentioned that these signals always present a mixture of red and white lights, which is a great advantage. At a distance and under certain atmospheric conditions, it is often difficult to recognise isolated red and white lanterns one from the other; but the distinction is far clearer when the two lanterns are side by side.

In conclusion, this system does not necessitate the construction of any special apparatus, red and white lanterns are available at all ports; allowing one spare lantern of either colour in case of accident, six lanterns in all will suffice, three red and three white.



At stations where electricity is available one could effect a very simple installation, by arranging the six lanterns vertically in three groups composed each of one red and one white. A switch board with three commutators will enable one to light at will one of the lanterns in each group.

The Director,
Bureau Central Météorologique de France,

A. Angot.

APPENDIX XIII.

Supply of Manuscript Data for Special Researches.

Memorandum by Mr. R. G. K. Lempfert.

For many meteorological investigations the present arrangements for putting data at the disposal of those who want to use them are inadequate. As M. Bjerknes has pointed out, the ordinary publications which give hourly values for a few stations and monthy summaries or daily values of observations at fixed hours for stations of the second order, do not give sufficient information for the prosecution of researches in dynamical meteorology. His suggestion to publish additional hourly values for special periods, to be agreed on in advance, meets the difficulty only partially. It is open to the objections:

(1.) That hourly values give but an inadequate representation of the information afforded by the record of an autographic instrument. In many researches, *e.g.*, those with which the Commission on Squalls concerns itself, the sudden changes which find no expression in hourly values, are the most important. For such purposes facsimilies of the records, prepared either by photography or by tracing, are essential.

(2.) Most researches in dynamical meteorology concern themselves with special types of weather. If the occasions for which additional hourly values are printed are selected beforehand, an investigator may have to wait for years before the type of conditions which he desires to study occur on one of the selected days.

All Meteorological observatories and Offices accumulate more information than it is possible, or even desirable, to publish. Thus, at the Meteorological Office, London, there are received, in addition to the records from the four observatories for which hourly values are published, complete returns from two additional observatories, as well as records from 39 barograph stations, and 17 anemograph stations. In addition there are, in the British Isles, several observatories which file their own records. It seems desirable to provide facilities for enabling investigators to obtain access to the information contained in these unpublished records.

At the Meteorological Office all documents may be consulted and copied in the Office free of cost by members of the general public, subject to the approval of the Director. If the Office staff is called upon to prepare abstracts a charge is made to cover the cost of time spent in selecting and preparing them.

I have the honour to request the Committee to take into consideration the desirability of extending this system on an organised basis, to the supply of special data to individual investigators for use in scientific researches. Under present circumstances investigators feel diffident about asking their colleagues to supply copies of unpublished records, as they recognise that their requests often involve a good deal of work on the part of him to whom they are addressed, and on the other hand

Observatories and Offices cannot allow members of their staffs to work for private individuals without undue interference with routine work. If a payment be made to cover the cost of time occupied, the work can be done without disturbance of routine work, if necessary as "overtime," and the applicant need not feel that he is trespassing on the kindness of his colleagues.

Meteorological Office,
London, S.W.
May, 1910.

APPENDIX XIV.

Proposals for the Consideration of the International Meteorological Committee in Berlin, September, 1910.

I. *Publication of Scattered Meteorological Observations from Uncivilised Countries.*

It is of great importance for the advance of meteorology that scattered meteorological observations from uncivilised countries be collected systematically and published regularly.

Meteorological organisations already exist to some extent in the important Colonies and Protectorates of European powers and of North America, and are responsible for the maintenance and publication of meteorological observations in accordance with the corresponding arrangements in the mother country. In other colonies no such system exists, but at the same time they contain no inconsiderable number of isolated meteorological stations, the observations from which seldom fall into the hands of scientists. Either they are not published at all or—mostly in the form of abstracts, seldom in extenso—in such entirely local reports and journals, that only a very few meteorologists of the mother country are able to make use of them. Added to this these isolated observations often do not conform as they should do with those taken elsewhere.

Apart from purely climatological studies—for which new data would be gladly welcomed, especially from the districts under discussion, as little is known of their climatology—such observations would be used for a variety of meteorological investigations, for which it is desirable to have as large an area under survey as possible. For there is not the slightest doubt that meteorology must always aim at extending its range of vision and must undertake researches which will embrace the whole earth, or at least a very great portion of it.

With regard to such studies, many a meteorologist will have felt keenly the lack of observations from some one or other district. He knows perhaps that these exist, but there is no possibility of getting them for himself. I have in mind, for instance, the numerous English Blue Books, which contain more or less complete abstracts of meteorological observations from the smaller English Colonies. Only a meteorologist living in London would be in a position to examine and eventually use the meteorological contents of all official reports, journals, &c., which are collected there.

On the other hand, there are isolated meteorological stations in countries outside Europe, which are not Colonies, the observations from which do not come to the knowledge of meteorologists, and remain without having been profitably reduced. It would be a great step forward to rescue and publish these also for general use. Thus, to refer to a few instances only, the Vienna and Paris Institutes have published extensive observations from Further Asia, while the Deutsche Seewarte in Hamburg issues regularly observations from Labrador and the South Sea. Those countries, therefore, are mostly concerned where on the whole restricted intellectual or material conditions exist.

My proposals and wishes are, therefore, as follows:—

(1.) Every civilised country which already has a meteorological service of its own and possesses Colonies should hold itself responsible for the establishment and publication of regular meteorological observations in its Colonies and Protectorates, according to international agreement.

For great organisations this publication should be issued by a special Institute, for smaller ones it could be arranged for by the Meteorological Institute of the mother country.

(2.) All Meteorological Institutes should make a point of publishing regularly meteorological observations from isolated spots in those countries which have as yet no meteorological organisation.

II. *Publication of Monthly Weather Reports.*

The investigation of meteorological anomalies and unusual atmospheric occurrences has always proved successful and beneficial. It is most efficient if undertaken soon after the occurrence of the phenomena concerned, because interest in the phenomena is greater when the impression of them is fresh than later on, and personal observations may be turned to better account.

The daily synoptic weather charts provide ample material for the study of numerous meteorological occurrences of shorter duration, such as storms, squalls, &c., but more extensive data and a comparison with normal conditions are necessary for anomalies of longer duration (great heat, cold, drought, humidity, &c.). Both are generally published in the monthly weather reports issued in various forms by many of the Meteorological Institutes; but I make the following suggestion because there are still several which issue no such monthly publication:—

It is desirable that all Central Meteorological Institutes should publish a monthly weather report for their district, and make the data contained therein as copious as possible.

These monthly reports are also very useful from a practical point of view, especially for agriculturists, who value them very highly. Moreover, they keep the observers' interest in the observations more alive than the annual publications which appear much later.

III. *Improvement of International Symbols and Abbreviations.*

1. At the Vienna Meteorological Congress a four-barbed arrow () was adopted as a symbol for strong wind (vent fort, starker wind), while on the basis of half the Beaufort or land scale of wind force and as used on synoptic weather charts, the symbol () signifies a gale (force 8 of the Beaufort scale).

The official meteorological instructions of the various réseaux have either adhered strictly to the Vienna decision (= strong wind), or have altered it so that they give either for gale or introduce the new symbol for strong wind. A few even commit the error of interpreting the symbol by "strong wind, gale."

For the sake of uniformity it is desirable that the Vienna resolution be amended, and that the symbol be used for winds of gale force.

2. According to a former resolution adopted by the Congress the height of the barometer above sea-level is denoted by H, while no special term for the height of the station is provided. Generally both these heights are taken as being identical, which, in many cases, gives rise to mistakes in the evaluation of the other observations.

If, for instance at a station in low lying country the barometer is hung in the topmost storey of a high house between 20 and 30 metres above sea-level, while the thermometer and rainguage are only a few metres above sea-level, one would make a considerable error in reducing the temperature to mean sea level if, in ignorance of the height of the station, one used the height of the barometer above mean sea level.

It is recommended, therefore, to make a special term (H) of the height of the station, *i.e.*, the position of the thermometer and raingauge, and to give besides the height of the barometer above mean sea level by means of the abbreviation H_b.

Including the abbreviations adopted previously we would have:—

H	the height of the station		} above mean sea level.	
H_b	„	„ barometer		
h_a	„	„ anemometer	} above the ground.	
h_r	„	„ raingauge		
h_s	„	„ autographic sunshine recorder.		
h_t	„	„ thermometer.		

G. Hellmann.

Berlin, July, 1910.

APPENDIX XV.

Remarks by Mr. Lempfert on Proposals by M. Hellmann.

I. *Meteorological Organisation in the Colonies.*

In 1907 a memorandum on the organisation of meteorological observations and on the publication of meteorological data was prepared by the Director of the Meteorological Office at the request of the Secretary of State for the Colonies, and circulated

from the Colonial Office to the Governments of those British Possessions or Protectorates which are not self-governing. The memorandum is reprinted as an Appendix to "Hints to Meteorological Observers in Tropical Africa" (Edition, 1907, M.O. No. 162). Correspondence has passed between the Director of the Meteorological Office and various Colonial authorities since the issue of the memorandum. At the present day many Colonial Blue Books contain a section giving meteorological data, in the arrangement of which the international forms of publication have been more or less closely followed.

With a view to rendering these data generally available the Meteorological Office has suggested the desirability of printing off additional copies of these meteorological reports, and has offered to undertake the duty of distributing them among the various institutions which receive copies of the Office's own publications. The suggestion has been approved by the Secretary of State for the Colonies, and on June 28th, 1910, a circular on the subject was addressed from the Colonial Office to the Officers Administering the Governments of British Crown Colonies and Protectorates. Up to the present copies of the data for the year 1909 have been received from seven Colonies. These will be distributed in due course.

Returns in manuscript are also received at the Meteorological Office from a number of stations in distant parts of the British Empire or in foreign countries. Since the beginning of 1909 these have been examined immediately on receipt, and summaries in international form have been prepared from them. These will in future be published regularly. It is hoped that the summaries for 1909 will be in print before the end of the current year or early in 1911. Among the places from which data are available are:—

Gibraltar.	Suva, Fiji.
Cape Spartel.	Fanning Island.
Falkland Islands.	Malden Island.
St. Helena.	Ocean Island.
South Georgia.	

III. *International Symbols and Abbreviations.*

1. Since the commencement of 1906, the Meteorological Office has acted on the proposal made by M. Hellmann and has used the symbol ⸗ to indicate "gale," force 8 of the Beaufort scale. Formerly the symbol was used to indicate "strong wind," and in their manuscript returns some observers still persist in using the symbol to indicate winds which do not exceed force 7 or even force 6 on the Beaufort scale. In all publications of the Office ⸗ is now reserved for occasions of gale.

2. In Meteorological Office publications it has been customary to give as the "height of the station" the height above Ordnance Datum (mean sea level at Liverpool) of the ground on which the raingauge stands. The heights above the ground of the other instruments are quoted in the headings of the tables in the annual volume of "Observations at Stations of the Second Order." The height of the barometer above ground, h_b, is so selected that when applied to the "height of the station" it will give the

height of the barometer cistern above mean sea level. At a station in undulating country, the barometer may be fixed in a house which stands at a level below that of the raingauge. In such cases the "height of the barometer above ground" is given by a negative quantity.

APPENDIX XVI.

Meteorological Units.

U.S. Department of Agriculture,
Weather Bureau,
Washington, D.C., May 24, 1910.

Memorandum No. 77.

A board is hereby created to consider the matter of meteorological units and to recommend what action the Bureau shall suggest on that subject to the International Meteorological Committee.

The board shall consist of the following-named officials:

Professors Charles F. Marvin, Frank H. Bigelow, William J. Humphreys, Cleveland Abbé, Herbert H. Kimball; Mr. Charles F. Talman, secretary.

(Signed) W. L. Moore,
Chief U.S. Weather Bureau.

Washington, D.C., June 22, 1910.

Chief of Bureau:

The Board on Meteorological Units constituted by Memorandum No. 77, of May 24, 1910, has the honour to submit the following report:

While a change of the system of measures and instruments now in use by the Weather Bureau has been informally considered on a number of occasions it does not appear that the subject has been formally reported upon heretofore, and it therefore seems appropriate to state with some fullness the views of the members of the Board upon the important questions involved.

The Board recognizes that there would be great advantages in a world-wide uniformity in meteorological instruments, units, and data published, and believes that the general introduction of the metric system of units would be the most practical method of securing this desirable uniformity.

The Board finds, however, that to change the existing stock and equipment of meteorological instruments of the Weather Bureau from the English to the metric or other units would involve an expenditure of about $35,000. This estimate is based upon the economic plan of using the present instruments as far as possible, and effecting the change gradually by altering only a small number of instruments at a time. If entirely new instruments were purchased the cost would be nearly $70,000. These changes of course *could* be made, though, in the opinion of the Board, if decided upon, it would be advisable to secure specific Congressional authority for doing so before incurring the expense and possible public dissatisfaction incident to an abrupt introduction of unfamiliar units.

For some years it has been the policy of the Weather Bureau to publish the results of special researches, such as the international cloud observations, the kite and balloon data, observations of solar radiation, studies of evaporation, &c., in the metric measures. The Board thoroughly approves of this policy and recommends its continuance and extension to include all the work of the Bureau addressed more particularly to the specialist. The Board, however, is opposed to the use of new or special units, *which tend to increase the existing confusion* rather than bring about uniformity.

When fairly considered any scale in the abstract has both advantages and disadvantages according to the application made of it, and, apart from the importance of world-wide usage, the advantages sometimes urgently advocated for a particular scale are more or less fanciful, and only a relatively small number of individuals are benefited by its use; whereas, many are subject to a distinct inconvenience.

(A) *Atmospheric Pressure.*

The proposal to measure atmospheric pressure in megadynes or absolute units of force was submitted by a Committee of the British Association in 1888, suggesting the name "barad." Guillaume proposed the same unit under the name "barye" to the International Congress of Physicists, meeting at Paris in 1900. Subsequently, the names *bars, millibars,* etc., have been employed. So far as known to the Board, this unit of pressure has not, as yet, become current in any branch of physics. Moreover, the Board is of the opinion that only a comparatively small number of persons are benefited by the advantages of such a scale, and it does not seem likely that the proposed scale will ever wholly displace the mercury scale in millimeters now almost universal.

The Board therefore is opposed to the substitution of this absolute scale in general meteorological publications for existing scales, but it recognizes that the C. G. S. system of absolute units is peculiarly appropriate to the publication of aerological observations, and commends its use in such work.

In general, the measure of air pressure in megadynes or bars is open to a number of grave objections, of which a few are mentioned below:

(1.) The natural working subdivision of the scale, the millimegadyne or millibar, is too small a unit to be engraved conveniently for daily use on the customary meteorological instruments, and is too small for the observer to read readily. On the other hand, *ten* of these units, the centibar is too large a unit for accurate meteorological, physical, and chemical observations. The centibar is, no doubt, a good unit for aerological work, where the accuracy required in terrestrial observations is not necessary or attainable.

Recognizing the difficulty due to minuteness of this scale, Doctor Shaw has proposed his scale of "degrees of pressure," each unit of which has a value of two millibars. In other words, to get an actual working instrument in the absolute units we must create a new arbitary scale that is convenient to use. However

simple and successful these or some other artifices may be they nevertheless introduce confusion and constitute real objections to the adoption of the proposed scale.

(2.) Whatever scale of temperature is employed, the whole structure of thermometry is built upon two fixed points—the melting point of ice and the temperature of saturated water vapour under a pressure of 760 millimeters of mercury at zero and standard gravity. If the new pressure scale of megadynes is employed the simple number "760" entering into the fundamental definition of temperature, stated above, must give place to a number like 1013·303 millimegadynes.

(The two objections following have an important bearing upon the practical and every-day work of telegraphing reports and the drawing of maps for forecasting and similar purposes:)

(3.) The millibar scale, because of its small subdivisions, can not be made to conform readily and satisfactorily to the present telegraphic code of the Weather Bureau. In fact, it is believed the code would have to undergo extensive revision to adapt it to the new scale, and it may be fairly asked: Do the advantages of the proposed change justify all this?

(4.) Our daily weather maps are now drawn with isobars for each tenth of an inch of pressure, and such a gradient serves its purpose in a very satisfactory manner. The numerical relation between inches and millibars is such that if the new scale is employed this gradient can not be retained without the use of awkward fractional steps and intervals, and we shall have to familiarize ourselves with a new gradient that, for all practical purposes, would be like drawing *twice* as many isobars on our maps as we now do. Obviously, this would make a map of moderate atmospheric gradients took very stormy; on the other hand, probably all the lines could not be drawn during actual stormy conditions. The other alternative would consist in drawing about two isobars where we now draw three, probably resulting in a flatness alike unsatisfactory to the forecaster and the public. These objections to the millibar, or megadyne, scale do not apply to the millimeter scale which readily admits of isobars on maps on about the same scale as those now in use.

(B) *The Pressure of Aqueous Vapor.*

No single statement concerning the state of water vapor present in the atmosphere is adequate to convey all the information required for many purposes. At least two separate data are necessary. The Board is of the opinion that in publishing data upon atmospheric moisture the *pressure* of the vapor should always be given, either in inches or in millimeters of mercury under standard gravity, according as accompanying data are stated in English or metric measures. The pressure of aqueous vapor should be expressed in the same units as those employed for the pressure of air. To this statement of vapor pressure should be added either (1) the relative humidity or (2) the actual temperature of the vapor. A mere statement of air temperature is not adequate for this purpose, as it may or may not accurately represent the temperature of the vapor when the observation was made; therefore, it is better in the judgment of the Board

to publish (1) the vapor pressure and (2) the relative humidity. This is in accord with the policy of the Weather Bureau for many years, and the policy should not be changed.

The datum "saturation deficit," standing by itself, conveys no more explicit information concerning the atmospheric moisture than the term relative humidity, and it is a less explicit datum than the vapor pressure or the dew-point temperature.

(C) *Temperature.*

In the abstract the Centigrade thermometer scale is particularly unsuited to general meteorological observations, and distinctly inferior to the Fahrenheit scale. The use of the Centigrade scale in meteorology is favoured only in the interest of world-wide uniformity, and involves a number of important concessions.

The proposal to obviate minus signs by the use of the absolute Centigrade scale involves the necessity of dropping a scarcely needed digit to save cost and space in printing. While the use of this scale of temperature is particularly helpful to students of the thermodynamics of the atmosphere, yet the omission of the third digit in published data compels the reader to exercise a certain mental alertness that would not be needed if the scale were appropriate for its purpose.

All recognize that the great majority of climatological observers can not be relied upon and should not be obliged to read fractions of degrees upon their thermometer scale. The discontinuance of the Fahrenheit thermometers among the climatological observers of the Weather Bureau is therefore certain to involve an important reduction in the accuracy of the observations we now realize. Even if the climatological observers should read their instruments to the nearest half degree, the printed reports would require three figures and a decimal point where we now get equal accuracy with only two digits and save cost and space in printing besides.

In view of all the important advantages that must be relinquished in order to adopt the Centigrade scales of temperature in general climatology, the Board is opposed to discarding the Fahrenheit thermometer among the climatological observers of the Weather Bureau until it is certain that world-wide uniformity will be directly brought about by such a course.

(D) *Velocity.*

Should the metric system of units be adopted, the Board invites attention to the advantages of expressing velocities of winds, clouds, storms, etc., in kilometers per hour. This datum can be expressed with all necessary accuracy and for all ordinary ranges of meteorological conditions with two integral digits, whereas the datum meters per second involves the use of a decimal point, and three digits are frequently required to produce a homogeneous accuracy throughout miscellaneous data. The Board regards it as unfortunate that the datum meters per second has been given the preference over kilometers per hour by the International Conference and is now widely used.

(E) *Directions.*

Angular directions as of wind, clouds, etc., can often not be observed with greater accuracy than the cardinal points and customary subdivisions, and these are adequate for the purpose in many cases, but where greater accuracy is attainable or necessary, the directions should be expressed in degrees of arc, preferably with zero at the north, and increasing thence eastwardly.

The existing policy of the International Meteorological organisation, as stated in the Codex (English edition, p. 32), sanctions the use of the ordinary units of either the English or the continental systems, according to the preference of the individual countries, but looks to the ultimate adoption of the metric system (and presumably the Centigrade temperature scale) as the one the most suitable for universal use.

The views of the Board are in harmony with this policy except as above noted in connection with the Centigrade scale; and it does not appear opportune for the Weather Bureau to urge upon the International Committee any change therein at this time, in view of the practical difficulties in the way of the general adoption of the metric system within our own service.

Respectfully submitted:

C. F. Marvin, Chairman.
W. J. Humphreys,
Frank H. Bigelow,
Cleveland Abbe,
Herbert H. Kimball,
C. F. Talman, Secretary.
Board on Meteorological Units.

APPENDIX XVII.

On the Opportunity of Promoting Researches on Atmospheric Polarisation and Especially Determinations of Neutral Points for the Purpose of Obtaining Consequential Rules for Weather Forecasting.

As is well known, neutral points in the vertical plane passing through the sun may be observed in the sky from which non-polarised light reaches our eyes. The point named after Babinet is situated above the sun and is seen with difficulty when the sun is above the horizon, whereas the other point, named after Arago, is situated on the opposite side to the sun at a height of from 17° to 18° when the sun is on the horizon.

There is also a third point named after Brewster below the sun, but it can only be seen with difficulty. We say *points*, but as a matter of fact it is a question of small zones which emit diffused, non-polarised light; these zones have occasionally a perceptible extension and, in any case, this extension is not always constant.

Many scientists have observed the aforesaid points and determined their mean heights. It was noticed from the first that the change in height of the Arago and Brewster points and

the extension of the regions of unpolarised light are considerably influenced by meteorological conditions at observing stations. It is, therefore, extremely interesting to carry out the determinations indicated above in order to have better knowledge of the importance of these influences, and also to see whether it would not be possible to obtain some useful rules from the variable magnitude of the influences themselves for forecasting the weather of the ensuing days.

Moreover, it is not only atmospheric conditions over an observing station which affect the change in the neutral points, but also the weather conditions in the neighbouring regions; in order, therefore, to recognise these influences, it is necessary that the determinations of neutral points should at the same time be extended to different localities; thus one here feels the necessity of an understanding amongst scientists for co-operative research.

With these ideas as a basis, Chr. Jensen drew up a programme of research to be carried out at several points on the globe, and all the data collected and scientifically discussed would illustrate the true value of the influence of meteorological conditions on the alteration of the positions of neutral points.

In order to ensure the data collected at different places being comparable, Jensen thought out an apparatus: a Savart polariscope, mounted on a dial with an indicating pendulum, very simple and easy to use, for the purpose of rapidly determining the position of the neutral points.

These investigations have already been initiated in various parts of Europe, and it appears that, since January, 1910, ten observers have responded to M. Jensen's appeal. In Italy observations have been carried on with a certain amount of regularity at Rome and Catania.

I take this opportunity of recalling that a similar appeal had already been made here, in Italy, by the late M. G. Basso, Professor of Physics and Mathematics at the University of Turin, and my own dear master; Basso's appeal appeared in an article published in the Italian Meteorological Society's Year-book for 1889. Professor Basso indicated as a suitable instrument a Savart polariscope placed inside a telescope in such a way that the surfaces of the polariscope are normal to the axis of the tube, and that the polariscope can be turned in its plane, around this axis.

I remember also that so far back at 1862 M. Rubenson made, at Rome, the first systematic measurements of atmospheric polarisation, measurements which were very instructive and important, for amongst the towns selected by Rubenson, Rome is the one which has the largest number of calm, fine days.

As I have just said, at Rome these investigations were renewed once more about a year ago, namely, since September, 1909, by Dr. F. Eredia, assistant at the central bureau of Meteorology and Geodynamics, by means of an apparatus constructed for us by Dörffel and Färber (Berlin), conforming to M. Jensen's instructions. M. Eredia has conceived the idea of uniting with these quantities, the determinations of the diurnal range of the degree of polarsation at the zenith (the relation of the intensity of polarised light to that of the total diffused light) by means of Weber's photometer.

From the measurements carried out hitherto, it is obvious that there is an intimate connexion between the diurnal range of polarisation at the zenith and the alteration of the neutral points. In addition, the diurnal range of polarisation varies greatly in relation with atmospheric variation, in such a way that from the range obtained during one day, it has been possible to forecast the meteorological conditions of the following day. The determination of the diurnal range of polarisation has been very interesting for the purpose of studying the vertical distribution of fogs in the atmosphere. If the variation of polarisation is gradual during the day, it signifies that the upper atmosphere is homogeneous; if, on the contrary, the variation is intense and rapid, it indicates that the lower layers are foggy while the upper are clear.

As regards the climate of Rome, these continuous measurements could throw a good deal of light on the distribution of fogs. Moreover, they might produce sufficiently valuable results for studying the distribution of fogs in other special regions. In fact, next year M. Eredia intends carrying out regular measurements of the diurnal range of polarisation at our observatories on Monte Rosa at different heights, that is to say at Alagna, Col d'Olon, at the Gnifetti Hut, and at the observatory " Regina Margherita " situated at the summit; he hopes thus to get to know the vertical distribution of fogs in these Alpine regions, a meteorological element little known up to the present, the knowledge of which will contribute greatly to the value of many geophysical researches.

If the positions of the Arago and Brewster points are determined at intervals of a few minutes, from an hour before sunset until an hour after, and if the positions thus found are joined by a curve on a system of Cartesian axes, lines are obtained which are not always identical, and of which the range is confirmed by Eredia's measurements as varying with the variation of the meteorological conditions of the place. By merely inspecting these curves, M. Eredia has sometimes found it possible to forecast the meteorological conditions for ensuing days.

In view of the importance of these researches, I beg to suggest that our Committee should encourage them, namely, by increasing, as far as possible, the number of places where continuous and systematic observations are made of the Arago and Babinet points. It is desirable that the diurnal range of the extent of atmospheric polarisation be determined as well as the positions of neutral points.

Thus, while having data which may facilitate the explanation of causes which influence the position of the neutral points by rendering them more variable, one will also have very useful observations for forecasting weather. Endeavours have already been made to draw up several other criteria for the forecasting of weather, by making spectroscopic observations (see for example the work of M. Arendt); to spectroscopic observations there may now be added observations also of an optical nature, referred to above, namely, those relative to atmospheric polarisation.

L. Palazzo.

Is it not time that the International Meteorological Committee Established as Uniform Rules as Possible for the Measurement of Snowfall?

When a fall of snow occurs, it is necessary to determine the depth of the fall on the ground and its equivalent in liquid water in order to be able to use the observation to calculate the total precipitation of water over one locality during a definite period. In certain districts snowfall is frequent during a good part of the year, and thus essentially governs the supply of springs and determines the hydrological system of certain regions; it is for this reason extremely important to know the value of snow in terms of water.

There is no lack of instruments invented by various scientists which give the measurement of snowfall with considerable accuracy. Vallot used funnels capable of holding a large quantity of snow, at the same time registering the amount; Hellmann invented an instrument for collecting snow and registering the amount automatically, the details of construction being similar to those of his raingauge; Angot invented snow-scales, consisting of a metal cylinder which, when full of snow, is weighed by means of a balance; Sprung also constructed self-recording snow-scales, taking as a fundamental idea the principle of his barometer.

But if in the case of these instruments used by competent observers at the most important meteorological stations the quantity of snow can be measured with the desired accuracy, one cannot say as much for secondary stations where the custom is to calculate the equivalent of snow in water, by adopting the observation of the height of the layer of snow and by an assumed value of the density of the latter. It is generally admitted that the density of snow is equal to 0·1, that is to say that a cubic decimetre of melted snow weighs 100 grammes, or again that snow having a height of one centimetre corresponds to one millimetre of rain. But this is only an approximate mean value.

At several places where observations are taken all that is recorded is the result of measurements of the height of snow obtained during many years; these measurements cannot be reduced to water except when the density of the snow is sufficiently well known.

At the meeting at Munich in 1891, the International Meteorological Committee was already turning its attention to the reduction of measurements of snow to water; a circular was then sent to all the directors of central meteorological institutes and of meteorological societies to learn the means employed for transforming snowfall into rainfall. The replies received were published in the minutes of the Munich meeting.

No decision, however, was made in this respect, and there is still doubt as to the way in which measurements of height of snow can be transformed into those of water in case one should wish to apply general criteria which are universally acceptable.

I think the Committee should once more consider the question and endeavour to issue rules which can be used at all institutes.

I can quite understand that at present the solution of the problem is still a difficult matter, on account of the small knowledge we have of the variations in the density of snow influenced by so many causes.

Dr. Eredia, of the Meteorological Bureau at Rome, called the attention of scientists to this evidence in 1908; he examined measurements taken periodically for the last ten years at Sestola in the Central Apennines and could thus deduce the value of the mean co-efficient of reduction to be applied to measurements of the height of snow to transform them to those of water. This co-efficient resulted in a mean equal to 0·078 and Dr. Eredia considered it very approximately applicable to the whole of Italy. But at the meeting on the 13th February, 1909, of the Roman section of the Italian Physical Society, in order to have more complete data, Dr. Eredia submitted a programme of research, according to which measurements of the density of snow could be collected for several places in Italy, and the discussion of which would have furnished more accurate criteria for determining the mean value of the reduction co-efficient.

I, therefore, think it expedient to invite the Committee to promote determinations of the density of snow in different localities and then to provide uniform rules, either for measuring direct the quantity of snow, or for the reduction of snow to water, rules which could be adopted by the majority of observers.

L. Palazzo.

APPENDIX XVIII.

Wireless Telegraphic Stations in the Azores and Practical Means of Profiting Thereby for International Meteorological Communication.

The Azores archipelago, considered as a centre of meteorological communication, may be divided into three groups of islands; the Eastern, and least important, of which S. Miguel is the principal island; the Central, with the island of Fayal; and the Western, and most important, with that of Flores.

The Island of S. Miguel is situated in the Atlantic, 750 miles to the West of the most Westerly point of Europe; and the Island of Flores is situated 300 miles to the West of S. Miguel; the Island of Fayal is just half-way between S. Miguel and Flores.

During 1893 six of the Islands of the Eastern and Central groups of the Archipelago were united by means of a telegraphic cable to the Portuguese mainland, the cable touching the land near Lisbon.

In the contract concluded between the Portuguese Government and the Europe-Azores Telegraph Company, by whom this cable was laid, it was agreed that observations from the Azores could be sent free of charge by not more than three meteorological telegrams daily of ten words each. Taking advantage of this clause in the contract, we began in the same year, 1893, to send meteorological telegrams from the Azores to Europe by this cable to Lisbon. By this route (still in use for telegrams despatched from the Observatories of Ponta Delgada and Angra)

telegrams cannot be sent from the Archipelago before 8 a.m., local mean time (about 9.54 G.M.T.); because the Azores-Portugal cable is open for telegraphic communication only between that hour and 8 p.m.

Since 1901 a number of cables have been operated from the town of Horta, connecting directly and permanently the Island of Fayal with continental stations in Germany (cable joins the land at Emden), England (Waterville), Canada (Canso), and the United States (New York).

In the contracts established between the Portuguese Government and the Telegraphic Companies, to whom the cables belong, the clause indicated above has been inserted, namely the despatch of meteorological telegrams free of charge to where the respective cables join the land in the continents of America and Europe.

In consequence of this concession and of agreements made with various Meteorological Institutes of Europe and the Weather Bureau of the United States, the Observatory at Horta despatches telegrams, via the Central Telegraphic Station at Fayal, giving the meteorological conditions existing in the centre of the Azores; these arrive at the observatories of Germany, England and France, &c., an hour and a half before communication can be opened up by means of the Lisbon cable! On this account meteorological conditions telegraphed from Ponta Delgada and Angra can only be compared later on at European observatories with those from Horta, which come to hand much earlier.

To this defect in the simultaneous comparison of meteorological telegrams must be added another far more important one as regards the forecast service at continental observatories: namely, the lack of telegraphic communication for the Western group the furthest of the Azores from Europe. This defect has just been remedied by the establishment of radio-telegraphic stations (the property of the Portuguese Government) on the Islands of Flores and Fayal. Thus radio-telegrams from Flores received at Fayal may, from now onwards, be despatched without delay to Europe and America by submarine cables which land at Horta.

Other radio-telegraphic stations have also been established on the Islands of Santa Maria and S. Miguel in order to connect these two islands; and also on the Island of Corvo, 16 miles from the station at Flores.

The five radio-telegraphic stations of the Azores are under the direct control of the Inspection Générale des Télégraphes du Portugal. They have a minimum range of 150 miles.

Radio-telegraphic stations are not yet in working order on the mainland of Portugal; and wireless telegraphy has been installed on only four Portuguese battle-ships, while our mercantile marine is still entirely without it.

In the neighbourhood of the Azores there are already quite a number of ships passing on their way either to or from America which comunicate with stations in the Azores by means of radio-telegraphy.

Portugal was represented at the Radio-telegraphy Conference held in Berlin in 1906, and adopted (June 22nd, 1909), the

regulations for telegraphic communication drawn up by International agreement. No clause relating to the gratuitous transmission of meteorological telegrams can be found in the regulations. Under these circumstances I applied for assistance to M. le Conseiller Benjamin Cabral, Inspector General of Telegraphy in Portugal, who has always given me his strong support in matters relating to telegraphic communications of the Meteorological Service of the Azores. I have just had a conference with M. le Conseiller Cabral at Lisbon, who has assured me of his earnest desire to bring about the co-operation of the radio-telegraphic stations of the Azores in meteorological communcations.

We have, therefore, agreed to ask the International Meteorological Committee (as I am doing by this Memorandum) to indicate:—

(1) What are the meteorological communications which should be sent daily from the Observatory at Flores to the one at Horta, and conversely from Horta to Flores, and at what hours?

(2) Whether it is necessary to send off on certain days or at a fixed hour each day from the radio-telegraphic stations on the Atlantic, short meteorological communications or chronometrical signals despatched by the Meteorological Service of the Azores.

I beg to point out for the information of the Committee:—

(1) That I could have meteorological telegrams, in the international code or others, sent daily from the meteorological station at Flores (which has recording instruments for barometric pressure, wind direction and velocity, &c.) as I have done for some time past from the Observatories at Ponta Delgada, Angra and Horta.

(2) That the chronometrical station of the Meteorological Observatory at Ponta Delgada has not yet got an apparatus for transmitting the time to the radio-telegraphic station on the Island of S. Miguel, which is about five kilometres distant from the Observatory.

(3) That all information, meteorological telegrams, &c., supplied by the Institutes of the Meteorological Service of the Azores shall continue to be free of charge, the whole Service being supported solely by Portugal.

F. A. Chaves,
Director of the Meteorological Service
of the Azores.

Ponta Delgada,
25th July, 1910.

APPENDIX XIX.

Proposals Submitted to the International Meteorological Committee, Berlin, 1910, by Professor Willis L. Moore.

1. The desirability of maintaining in many parts of the world (1) a continuous record of the quality or spectral distribution of solar energy, and (2) a continuous record of the amount of ozone in the atmosphere.

The quality of solar energy is of much importance in its bearing upon plant growth and probably upon the ozone content

of the upper atmosphere. It also appears to vary greatly, and therefore needs to be systematically studied at many places. See:

C. G. Abbot and F. E. Fowle, "Improvements and new results in solar constant determinations." Astrophysical Journal, 29, 281, 1909.

In view of the spectral distribution of the absorption bands of ozone and their relative intensities in the regions, respectively, of solar and terrestrial radiation, any change in the amount of this gas in the atmosphere must be followed by changes in the surface temperature of the earth. Ångström has shown that these bands are well marked in the solar spectrum, but their systematic study has hardly been begun. This field of investigation is recommended by Prof. W. J. Humphreys, as likely to shed much light upon the thermal phenomena of the atmosphere. See:

K. Ångström, "Die Ozonbänder des Sonnenspektrums und die Bedeutung derselben für die Ausstrahlung der Erde." Arkiv för Matematik, Astronomi och Fysik, 1, 395, 1904.

W. J. Humphreys, "The isothermal layer and the temperature of the earth." Bul. of the Mount Weather Observatory, 2, 286, 1910.

W. J. Humphreys, "Solar disturbances and terrestrial temperatures." Astrophysical Journal, July, 1910.

2. The desirability of designating a central observatory where an international pyrheliometric standard shall be maintained, and of arranging for the comparison of secondary standards submitted by the central observatories of meteorological services.

The report of the Commission on Solar Radiation presented at the last meeting of the International Meteorological Committee contained a recommendation to the above effect, and Upsala was suggested as the place for maintaining the proposed international pyrheliometric standard, but no definite action was taken thereon by the Committee. At the instance of Prof. H. H. Kimball, I now bring this matter again to the attention of the Committee, with the new suggestion that, in case it is not feasible to have this work done at Upsala, some one of the national bureaux of standards, at Kew, Sèvres, Charlottenburg, Pavlovsk, or Washington, would probably undertake this task, if authoritatively requested.

3. Attention is called to the lack of uniformity in the methods of reducing and tabulating pyrheliometric observations. It is recommended that all observatories adopt the method of tabulation (Professor Kimball's) shown in Table 1, Bulletin of the Mount Weather Observatory, Vol. I., p. 208, and that the necessary interpolations be accomplished graphically by plotting the observations as shown in fig. 2, Bulletin of the Mount Weather Observatory, p. 221.

The air mass is here computed from the equation

$$m = \frac{\text{atmospheric refraction (in seconds)}}{58{\cdot}36 \sin Z}$$

where Z = sun's zenith distance. This equation has been evaluated with sufficient accuracy for ordinary purposes by A. Bemporad in Rendiconti della R. Accademia dei Lincei, Roma, Ser. 5, Vol. 16, 2 sem., 1907, p. 66-71.

With the data tabulated as above suggested it is an easy matter not only to compute monthly averages for the place of observation, but also to compare pyrheliometric measurements made in different localities.

4. In view of the present great diversity of usage, it is requested that the International Meteorological Committee again consider the best definition of a positive and negative gradient.

The Commission for Scientific Aeronautics, meeting at Monaco, 1909, decided to call the temperature gradient positive when the temperature decreased with altitude, and negative when it increased with altitude. Prof. Cleveland Abbe has requested me to urge that both barometric and temperature gradients should uniformly express the ratio between changes of pressure or temperature and changes of distance in such a way that the sign of the ratio shall be determined by the ordinary rules of algebra as applied to the ratio of positive and negative numbers. For instance, if distances are measured positively toward the east and south and the zenith, then an increase of temperature upward will give a positive gradient, but a decrease upward will give a negative gradient, and the same rule must apply to all other gradients. This is the only rule that can be admitted in mathematical theory and our daily practice should agree with it.

5. Inasmuch as modern meteorology embraces the whole atmosphere to its utmost limit, it is recommended that a commission be appointed to report upon the state of our knowledge of the upper air, as revealed to us by meteors, notilucent clouds, and auroras, and to suggest the best means of further research along these lines.

This suggestion is made at the instance of Prof. Cleveland Abbe.

6. The greatest possible degree of uniformity is desirable in the methods of reducing free air data, as published by the International Commission for Scientific Aeronautics, and in connection with the published results of each ascension there should be given short statements of the probable errors of the data or at least of the extent to which the meteorographs have been standardized, in order to forestall any misleading dependence on their accuracy by theoretical investigators.

This proposal, which is self-explanatory, is brought forward at the instance of Dr. W. R. Blair, in charge of the aerological work at the Mount Weather Observatory.

7. There is need of greater uniformity in the use of meteorological terms, and all such terms as are common, with slight idiomatic modifications, to the principal European languages should be officially defined. This matter is important enough to be entrusted to an International Commission on Meteorological Terminology, which should be further charged with the ultimate task of compiling an international meteorological glossary, as was proposed at the Second International Meteorological Congress at Rome.

This suggestion is due to the recommendation of Mr. C. Fitzhugh Talman, Librarian of the United States Weather Bureau,

who is compiling an extensive glossary of the meteorological terms used in English, and finds great diversity of usage among different writers. He also finds that while for some meteorological conceptions many needless synonymous expressions exist, others can not be expressed without awkward circumlocution, because the corresponding specific term either has not been introduced, or has been so rarely used as to be unfamiliar to most readers. Thus, many additions are needed to the list of "isograms," while several of the names already proposed for "isograms" of various phenomena should be brought to more general notice.

It is recognized that the proposed commission will need to be guided in its work by the advice of specialists in every department of the science, and that its definitions, when formulated, must obtain the approval of the International Meteorological Conference before they are promulgated as authoritative.

WILLIS L. MOORE,
Chief U.S. Weather Bureau.

Washington, D.C., July, 1910.

APPENDIX XX.

Ponta Delgada,
10th September, 1910.

DR. W. N. SHAW,

President of the International Meteorological Committee.

MY DEAR COLLEAGUE,

For several years past I have, in my country, advocated the necessity of rapid but not very voluminous and *crude* publication of the results of meteorological observations.

These are my ideas and as I greatly appreciate the remarkable meteorological atlases of M. Eiffel, President of the French Meteorological Society, it occurred to me to ask him to submit to the society (of which I am a member) a proposal to publish a European meteorological atlas, in keeping with M. Eiffel's plan, but of an International character, for them to lay before the International Meteorological Committee. Unfortunately my request arrived in Paris during the society's vacation . . . .

I would therefore beg you to consider this proposal regarding the publication of such an atlas, and, if you think it feasible, to put it before the Committee (either in your name or coupled with mine if you prefer it) at the approaching Conference.

I hope that you will agree with us as regards the desired publication, and trust you will give it your support.

With kind regards, Believe me,
My dear Colleague,
Yours very truly,
F. A. CHAVES.

SIXTH MEETING

OF THE

INTERNATIONAL COMMISSION FOR TERRESTRIAL MAGNETISM AND ATMOSPHERIC ELECTRICITY.

BERLIN.

September 23rd to 24th, 1910.

MINUTES OF THE MEETINGS.

First Meeting, Friday, September 23rd, 1910.

Members of the Commission present: Messrs. Rykatcheff, *President*; Schmidt, *Secretary;* Angot, Carlheim-Gyllensköld, Chree, Dubinsky, von Kesslitz, Liznar, Messerschmitt, Palazzo, Stupart. Also Messrs. Bigelow, Brückmann, van Everdingen, Hellmann, Lecointe, Lüdeling, Luyken, Melander, Mohn, Schering and Venske.

1. **Report. Changes in the Committee.**—M. Rykatcheff, as President, opened the meeting at 10h. 15m. a.m. by referring to the invitation (Appendix I., p. 99) which had been sent to the Members. He informed the meeting that Messrs. Bauer and Schuster had expressed their regret at being unable to attend the meetings, and read a Report on the work of the Commission and the Managing Committee since the last meeting at Innsbruck (Appendix II., p. 101). During this time the Commission has lost through death Messrs. von Bezold, Brunhes, Mascart, Paulsen and Snellen, and M. Moureaux has retired from the Commission on resigning his official position. Messrs. Angot, Faris and Tanakadate were elected Members of the Commission to fill these vacancies. M. Ebert, who was also elected as a Member, has not accepted the position owing to his time being taken up with so many other things.

After a few remarks made by Messrs. Angot and Bigelow on the establishment of observatories at Tortosa and Pilar, the Report was considered.

As a mark of respect to the deceased, the Members rose from their seats.

2. **Observatory in Italy.**—M. Palazzo then read an exhaustive Report on the result of endeavours to establish a Central Magnetic Observatory in Italy (Appendix III., p. 115). Messrs.

Hellmann, Schmidt, Liznar, and Carlheim-Gyllensköld joined in a discussion in reference to this, and, at the suggestion of the President, adopted the following resolution:—

"The Commission thanks M. Palazzo for the trouble he has taken to obtain the erection of a Central Magnetic Observatory in Italy, and expresses a desire that this Observatory may, if possible, be erected either in the South of Italy or in Tripoli, in order that it may be of the greatest use from an international point of view."

3. **Comparisons of Standard Instruments.**—For the next item on the programme II., 1: Comparison of standard instruments at the principal observatories, M. Dubinsky reported on the comparisons carried out in 1907 and 1908 by M. Sawinow and himself between Pavlovsk and Karsani, Ekaterinburg, Irkutsk, Upsala, Rude Skov, Kew and Potsdam (Appendix IV., p. 117. M. Schmidt reported on those by M. Venske between Potsdam and Wilhelmshaven, and M. Kühl between Potsdam and De Bilt, Val Joyeux, and Pavlovsk, which have all been carried out during this year, and the results of which will most likely be published in the next Annual Report of the Meteorological Institute. M. Schmidt read a Report sent by Dr. L. A. Bauer on the principal results of measurements of comparison carried out since 1906 by the observers of the Department of Terrestrial Magnetism, which now extend to the observatories at Kew, Potsdam, Pola, Tiflis, Zi-ka-wei, Helwan, Dehra Dun, Christchurch, Toronto and Cheltenham (Appendix V., p. 118).

During the discussion M. Liznar indicated various sources of error in absolute measurements and laid stress on the striking fact that even measurements of declination often show comparatively large differences. He called to mind his old proposal to calculate the moment of inertia of the deflecting magnet direct from its own dimensions and substance, instead of going back to that of other less homogeneous bodies (*i.e.*, brass cylinders).

In more detailed reference to a remark already made in his Report, M. Dubinsky asked the Commission to draw the attention of observatories to Watson's valuable proposal to determine relatively all moments of inertia by comparison with his standard bar. He mentioned that the method suggested by Liznar has been adopted at Pavlovsk; homogeneous matter, such as quartz, is to be recommended for use as standard inertia masses.

Dr. Chree explained how the change in standard values of the magnetometer at Kew, mentioned in M. Dubinsky's Report, had originated. Earlier values were based on a single deflection constant which was obtained from observations at two distances, whereas for the two constants now accepted as a standard, deflections from a third distance have been also taken into consideration.

M. Hellmann referred to the difficulties, and to the mistakes which easily arise from these, connected with measurements of comparison made by means of observations at a strange place, under unusual and not seldom unfavourable conditions. Comparisons, therefore, do not render superfluous the carrying out of independent absolute fundamental measurements at isolated observatories. He said that such measurements would be taken

in hand shortly at Potsdam Observatory, according to several essentially different methods, for which preparations had been made for some time past.

M. Schmidt agreed and emphasised the necessity of utilizing absolute and in a lesser or higher degree relative measurements, according to the purpose for which they are needed. In the strict sense of the word the former are possible and necessary only at the principal observatories; in the same way as with measurements of gravity, absolute results do not possess the same accuracy as relative. Systematic, adequately repeated comparisons are therefore indispensable in obtaining a co-operative representation of the earth's magnetism. In connexion with remarks made by Messrs. Liznar and Dubinsky, the speaker discussed several sources of errors in absolute measurements, and for the latter strongly recommended Dr. Watson's proposal, which had already been adopted at Potsdam. At the same time he showed a method whereby fundamental determinations of moments of inertia can be rendered independent of the influence of the aeolotropy of the matter. For the determination of deflection constants he recommended observations for various directions of the deflecting bar, instead of those from several distances.

M. van Everdingen stated that a fundamental new determination of horizontal intensity, according to Kohlrausch's Bifilar method, is in operation at De Bilt, carried out by M. van Dijk.

After a few further remarks by Messrs. Liznar and Schmidt, M. Rykatcheff, on behalf of those present, expressed the satisfaction of the Commission with regard to the results under discussion, and their thanks to all those who had co-operated in the work. He wished to propose that it was desirable to continue such comparisons and to communicate results to the Executive Committee.

The proposal was adopted on condition that the wording of the resolution to be communicated to the Meteorological Committee be determined by the Chairman and the Secretary. The resolution worded by them is as follows:—

"Directors of Magnetic Institutes are requested to compare their standard instruments whenever possible with those belonging to other countries, and to communicate the results to the Executive Officers."

The Meeting adjourned at 12h. 30m. p.m.

Second Meeting, Friday, September 23rd, 1910.

(In connexion with the Committee of the Association of Academies for the Magnetic Survey of a parallel of latitude.)

The meeting commenced at 3h. 15m. p.m. The same gentlemen were present as in the morning, and in addition Messrs. Kühl and Nippoldt as visitors.

1. **New Members.**—The President, M. Rykatcheff, stated that on the proposal of the officers, to which all Members of the Commission present had individually agreed, Messrs. Bigelow and

van Everdingen had been received into the Commission and M. van Everdingen had also been elected a Member of the Executive. Both gentlemen consented to serve and thanked the Commission for the honour conferred upon them.

2. **International Association of Academies.**—The President reported briefly on the Meeting of the Committee of the Association of Academies held on September 21st, and referred to M. Angot's Report on new magnetic observations in the Sudan (Appendix VI., p. 121).

3. **Measurements in East Africa.**—M. Palazzo read a Report on magnetic measurements in Equatorial East Africa (Appendix VII., p. 123).

4. **Magnetic Survey of Finland.**—M. Melander reported on the proposed magnetic survey of Finland, which is to be carried out in the course of about ten years. For base station an observatory is to be established at Sodankylä. The mean distance between the stations would only amount to about 20 km.; about 50 well distributed points of observation, which at the same time belong to the réseau of the trigonometrical survey, are to serve as secular stations (Appendix VIII., p. 124).

5. **Results of the Carnegie Expedition.**—M. Rykatcheff illustrated, by means of charts, an extract from the detailed Reports of Dr. Bauer on the results of the first surveying expeditions of the ship "Carnegie," 1909-1910. The Reports appeared in the June and September numbers of the journal *Terrestrial Magnetism*.

6. **Results of Observations in Russia and Siberia.**—M. Rykatcheff submitted a Report of M. Smirnow on magnetic elements on the line between Warsaw and Vladivostok, from observations taken in 1901, 1904 and 1909. (Bull. de l'Acad. Imp. des Sc. de St. Pétersbourg, 1910.) He also gave information regarding a proposed magnetic survey of the Russian Empire. For obtaining the necessary material for reduction, European Russia is to be surveyed very thoroughly by the establishment of a number of observing stations (with a mean distance between the stations of about 20 km.), while in Siberia observations are to be confined to the neighbourhood of important transport routes. It had already proved possible earlier in the year, through means provided by the Academy of Sciences, to complete a survey of the District Government of St. Petersburg (Appendix IX., p. 127).

M. Hellmann asked for information as to the calculation of values of the secular variation which were utilized in reducing the measurements compiled by Smirnow, and as to the trustworthiness to be attributed to them.

M. Rykatcheff, in reply, referred to data contained in the above-mentioned publication.

The Meeting adjourned at 5h. p.m.

Third Meeting, Saturday, September 24th, 1910.

The Meeting commenced at 10h. 15m. a.m.

Present: Messrs. Rykatcheff, *President*; Schmidt, *Secretary*; Angot, Arendt, Bigelow, Brückmann, Carlheim-Gyllensköld, Chree, Dubinsky, van Everdingen, Hellmann, von Kesslitz, Kühl, Lecointe, Liznar, Lüdeling, Luyken, Melander, Messerschmitt, Mohn, Nippoldt, Palazzo, Schering, Shaw, Stupart.

1. **Determination of Magnetic Character of the day.**—For item II., 2 of the programme: Publication of the magnetic character of separate days, Dr. Chree expressed a wish that regulations might be made for the classification of curves in order to obtain greater uniformity.

M. Schmidt opposed this. It would not only be exceedingly difficult to come to an agreement as to such regulations, but, even if this were successful, perhaps more real harm than good would be done because it would lead to excessive emphasis on a few characteristics. Further, every endeavour to arrive at greater accuracy as regards the character figure would necessitate considerably more work, especially as the number of grades must necessarily become far greater. On account of the large number of observatories taking part, the present very simple method provides all that is necessary, and all that can be generally attained with a not accurately definable element such as the disturbance character.

M. van Everdingen thought it desirable that at least those observatories, at which estimates deviate excessively from the mean at other stations, should endeavour to facilitate comparison by altering their system.

M. Dubinsky pointed out that differences in estimation may be partly explained by the different ways of regarding the object which the values should serve.

M. Hellmann proposed to regard the length of the registered curve in relation to the length of the base line as a measure for the amount of disturbance.

M. Carlheim-Gyllensköld recommened instead the calculation of the mean square of deviations from the average and thereby the definition of the type.

M. Bigelow called to mind Sabine's method of determining deviations from the normal curve, and of regarding all which exceeded them as disturbances. The normal curve should not, however, as mostly happens, be reckoned only for the means of each month and then be used for the whole month, but should be applied with due regard to its gradual change.

M. Schmidt agreed with M. van Everdingen and drew attention to the fact that the Potsdam publications contain such comparisons. The discussion with its numerous suggestions had only strengthened him in his fundamental idea. He called to mind the principal difficulties which confront an evaluation of curve lengths as, for example, in the endeavour to establish an exact definition of the idea of coast-line measurement. He would consider the mean square of the deviations far more suitable, a quantity taken into consideration by himself while engaged on

other work, for the easy determination of which he had designed an instrument. But even with the help of that apparatus, the calculation of this quantity during the current work of an observatory would necessitate a considerable amount of labour, out of all proportion to the profit derived therefrom.

To give a proof of the utility of the characterization of the daily type obtained by methods applied hitherto, the speaker showed several diagrams of a few preliminary results of investigations which he had begun to carry out by the aid of these figures; the representation of the diurnal range of magnetic elements in dependence on the disturbance type, and the determination of a clear periodicity of nearly 30 days in the course of the character numbers. As work related to the first named he mentioned the calculation of the mean diurnal range on quiet days, which would then, but of course only then, be very valuable if all observatories used the same days, preferably those given in the publication of the tables of character numbers.

In connexion with M. van Everdingen's remarks, M. Angot suggested that the observatories which have specially great deviations might, in order to obtain greater uniformity, be requested to alter their methods and perhaps adhere to the principles adopted at Potsdam. (Veröffentlichungen d. Kgl. Met. Inst. No. 211, p. 30.)

M. van Everdingen declared himself willing to bring forward these suggestions, but at the same time thought it advisable to point out other methods. He also suggested that investigations for the comparison of results obtained by different methods be instituted.

M. Rykatcheff seconded this suggestion and proposed the following resolution:—

"That a sub-committee, consisting of Messrs. Chree, van Everdingen, Schmidt, be formed for the study of the question as to which are the best principles for ascribing a magnetic character to separate days.

"At the same time the Commission begs to thank M. van Everdingen and the Dutch Meteorological Institute for the preparation and publication of the lists of disturbance numbers of separate days."

These resolutions were adopted.

2. Exchange of Curves for Disturbed Days.—At the discussion of Item II., 3: Exchange of the curves of very disturbed days, M. Dubinsky complained of the disconcerting diversity of scales in the reproduction of the curves of various observatories. He wished that the Commission would see to the introduction of greater uniformity.

M. Schmidt seconded this wish and referred to a similar resolution already adopted by the Polar Commission and repeated at the Directors' Conference at Munich. Uniformity, at least in the time scale, is absolutely necessary. Besides it is requisite for convenient and trustworthy comparison that the hour lines should always stand for the same absolute epoch of time.

At his suggestion the Commission adopted the following resolution:—

"It is desirable that in the reproduction of the curves of very disturbed days, one should make use of the standard of 15 mm. to the hour previously agreed upon internationally (comp. Met. Codex p. 57*), and that those Institutes which have not issued such reproductions hitherto should do so in future. Further, it is highly desirable that hour-lines should be marked on all the sheets for even hours according to Greenwich time."

3. Dr. Bauer's Proposals.—For Item II., 4: Relations with the Department of Terrestrial Magnetism, Carnegie Institution, the following resolution was adopted, without discussion, at the suggestion of M. Rykatcheff:—

"After the Commission had been informed of the correspondence between their President and the Director of the Department of Terrestrial Magnetism, they expressed a wish that such work should be soon undertaken in those countries where magnetic measurements have not been carried out at all or only very long ago."

4. List of Magnetic Observatories.—Likewise for Item II., 5: List of the Terrestrial Magnetic Observatories existing at present, the following resolution, proposed by M. Rykatcheff, was adopted without discussion:—

"The Commission thanks M. Lecointe and his Government, as well as Messrs. Merlin and Somville, for the compilation and publication of the list of Magnetic Observatories."

5. New Observatory at Sodankylä.—For Item II., 6 on the programme: Extension of the net-work of magnetic observatories, M. Melander reported on the observatory which he is about to establish at Sodankylä.

6. Observatory in Northern Norway.—M. Rykatcheff stated, on behalf of M. Mohn, that it had been decided to establish an observatory in Northern Norway, and also gave information as to the net-work of observatories to be erected in connexion with the plan for the magnetic survey of the Russian Empire.

7. Observatories in Central Africa.—M. Angot laid stress on the value to be derived from continuous registrations in Central Africa.

8. Electric Tramways in Munich.—M. Messerschmitt reported on the growth of difficulties in Munich, due to the extension of the electric tramway system, which is already rendering magnetic observations almost impossible.

9. Mountain Observatories.—M. Bigelow urged the establishment of mountain observatories for the observation of magnetic phenomena in connexion with solar occurrences.

In reference to this M. Liznar remarked that the preparation for the establishment and temporary support of a pair of stations at the summit and foot of the Obir had in so far been successful as to permit one to hope for a speedy realisation of the plan.

10. Observations in very Disturbed Regions.—M. Hellmann referred to the interest attaching to the observation of variations in very disturbed regions, and remarked that when the opportunity occurred he intended to arrange for records for a considerable period in the East Prussian region of disturbance.

In this connexion M. Carlheim-Gyllensköld reported on a very exhaustive series of measurements which he had carried out in

* English edition.

the Kiirunavaara region of disturbance, and expressed the hope that it would be possible to establish a registering station in a neighbourhood so suitable for the purpose.

11. **Observatory at Spitzbergen.**—M. Hergesell remarked that at present external conditions are favourable for the establishment of a temporary observatory on Spitzbergen, and it is therefore desirable to bear this in mind.

12. **Observations in the Free Atmosphere.**—He also drew attention to the importance of magnetic measurements by means of balloons, and he expressed the willingness to support strongly any efforts to carry these out.

M. Dubinsky welcomed this suggestion with satisfaction; he pointed out that in regions of very strong disturbance the disturbing influence will very probably decrease with height, and thus the normal distribution of elements will be obtained with greater accuracy by means of measurements taken at a height.

M. Schmidt recognised the great interest of magnetic determinations in the free atmosphere at great heights. But he wished to draw attention to the fact that a most difficult task was involved, for only strictly accurate observations, and, as a matter of fact, practically only observations of variation, would be of value. He thought the temporary maintenance of an observatory at Spitzbergen highly desirable.

13. **New Stations in Canada.**—Mr. Stupart stated that most probably he would be able to establish several registering stations in North-East Canada in the neighbourhood of Hudson's Bay.

14. **Observatory for East Greenland.**—M. Carlheim - Gyllensköld drew attention to East Greenland as a suitable spot for an observatory, and pointed out that it is of more importance to have places of observation in as widely different magnetic latitudes as possible, than to have them in approximately similar latitudes.

15. In consequence of various proposals to which the Commission agrees in principle, and the final drawing up of which will be left to the officers, the following resolution was adopted:—

"The Commission received the communications made by Messrs. Melander, Rykatcheff (in his own and in M. Mohn's name), Stupart, Angot, Liznar, Messerschmitt, Bigelow, Hellmann and Carlheim-Gyllensköld with satisfaction and considers it highly desirable that magnetic observatories should be established in the North of Finland, in Norway, in the Northern, Eastern and South Western portions of Russian Asia, in the North of Canada and in Central Africa near the Equator, also in neighbourhoods subject to disturbances, as for example, in the region of Kiirunavaara, which has just been investigated so thoroughly, and finally on the summits of high mountains with the control of suitable base stations.

The Commission also expressed the wish that in those places where the development of the electric tramway system has resulted in the suspension of magnetic observations, or threatens to do so, central stations may once more be established in districts which are free from these disturbing influences."

The Meeting adjourned about 12h. 45m. p.m.

Fourth Meeting, Saturday, 24th September, 1910.

The Meeting commenced at 3h. 15m. p.m.

With the exception of Messrs. Kühl and Luyken, the same gentlemen were present as at the morning Meeting, with the addition of M. Venske.

1. **Uniformity in Publications.**—The Chairman called upon M. Schmidt to confirm his proposals regarding Item III. of the programme: Suggestions for the establishment of greater uniformity in the publication of magnetic observatories (Appendix X., p. 130). At the conclusion of his report, M. Schmidt requested that the discussion might, in the first place, be confined to the demand which he put forward for a minimum which shall be obligatory on all observatories; he wished to treat the other points he had touched on more thoroughly later on. For the present he suggested the following resolution:—

2. **Minimum and Obligatory Conditions.**—The Commission desires that in the publications of all observatories at least the following data should be given:—

(1.) The mean values of the observed elements for every day.

(2.) The mean diurnal variation of all elements or at least of the components for each month expressed as departures from the monthly mean, local time being used.

In the discussion M. Bigelow repeated and supplemented the views he had explained at the previous Meeting. He wished that the departures from the normal mean values of the day in question, obtained in a definite way, should be published for individual hours (Appendix X., p. 134).

M. Liznar desired the publication of hourly values for all days according to local time.

M. von Kesslitz suggested for consideration whether it would not be desirable to appoint for each day two or three observations taken strictly simultaneously. He also reported on his calculation of the trigonometrical series for the daily variation of the elements in Pola for the whole period of observation up to the present time, which he had almost completed. He was in favour of a further improvement of the method adopted hitherto, and suggested the annual change of the daily variation by its resolution into several components of various periods according to the method of harmonic analysis in the theory of the tides. His endeavours in this direction, which are not yet quite concluded have, nevertheless, already given good results.

M. Carlheim-Gyllensköld was on principle in favour of the universal application of simultaneity.

M. Rykatcheff wished to see the communication of the daily absolute extremes included in the required minimum.

M. Hellmann opposed this suggestion. He also emphasised the view, in opposition to the wishes expressed, that usually the publication of an observatory should contain only the immediate results of observation, though of course, these should be put in

the most easily available form. The deduction of everything else which is obtained from these should be left to those who want it. For instance, he thought the information relating to co-efficients of trigonometrical series far too extensive, at least in their customary detailed form.

Similarly M. Schmidt did not attach much importance to the communication of absolute extremes for each day. He found absolute values more suitable for hourly data of single days than their deviation from any normal or average value, since they are always suitable for application to special objects. He would gladly withdraw the suggestion that monthly means of the diurnal range be given according to local time if simultaneous epochs meet with greater approval.

Dr. Chree mentioned several difficulties which arise in connexion with the adoption of local time, as well as the fact that for the various observatories daily means thus determined are thereby rendered not comparable. The calculation of the diurnal variation from the observations of all days lacks a clear physical signification. He proposed to form, for each month, three means each from five days, viz., five of the quietest days, five of average disturbance, and five of maximum disturbance.*

M. Hellmann was under the impression that the question had not had sufficient light thrown on it and that the best course would be to appoint a sub-committee empowered to conduct a systematic investigation of the contents of contemporary publications and on this basis to lay definite proposals regarding the form of publication before the next Conference.

Dr. Shaw agreed with this.

M. Schmidt remarked, that he himself had originally wished to adopt this course, but while compiling such a summary he had come to the conclusion that a discussion based thereon admitted of too many side issues. He had, therefore, thought it best, especially as a fundamental solution was rendered impossible for the present by the reference back of the question of hourly means, to endeavour first of all to come to an agreement as regards the *minimum* required. As a matter of fact, as already shown, almost unanimous agreement prevailed as to the authorisation of these requirements. Dr. Chree, alone, differed essentially in his opinions. Further, contrary to the wishes expressed by him, the discussion had dealt almost entirely with requirements which went beyond this minimum, and showed, it must be admitted, the existence of great differences of opinion on the matter. This minimum could thus very well be decided on at once and only its extension be postponed and referred to a Commission for preparatory investigation. Moreover, the election of a special Commission might perhaps be superfluous; the investigation might be left to the executive.

* *Note.*—July 14, 1911. Dr. Chree informs me that the text does not exactly represent his proposal which was that three distinct sets of diurnal inequalities should be respectively computed from (*a*) five selected quiet days ; (*b*) five selected as the most disturbed days ; (*c*) all the remaining days of the month.—W. N. S.

M. Rykatcheff proposed the following resolution:—

"The Executive Officers are requested to summarise the contents and form of existing magnetic publications and to lay before the Commission, at their next Meeting, suggestions for the further development and uniformity of publications."

This proposal was adopted without further discussion.

2. Items IV. and V. of the programme were declared to be disposed of by the proceedings at the second meeting. As regards the latter, M. Rykatcheff submitted the following proposal which was also adopted unanimously:—

"The Commission thanks M. Bauer for his valuable Reports and begs to express its admiration for the fine work carried out by the Department of Terrestrial Magnetism of the Carnegie Institution for the purpose of that magnificent undertaking, a magnetic survey of the globe."*

3. At the suggestion of the President, the Secretary in conjunction with himself was empowered to publish the final form of those resolutions of which the wording had not been definitely fixed.

4. The President expressed the thanks of the Meeting to the reporters and to all those connected with the success of the proceedings, primarily M. Hellmann, for the loan of the rooms of his institute and other efficient preparations.

On behalf of the Commission M. Messerschmitt thanked the President for his forethought and the tactful way in which he conducted the proceedings. The latter in turn thanked the Secretary for his support, and declared the Meeting of the Commission to be at an end.

The Meeting adjourned at 5h. 30m. p.m.

(Signed) M. Rykatcheff,
Ad. Schmidt.

APPENDICES.

APPENDIX I.

St. Petersburg and Potsdam,
August, 1910.†

Dear Colleague,

In accordance with our preliminary communication of May 5th, we have the honour to invite you to the Meeting of the International Magnetic Commission to be held in Berlin on the 23rd and 24th of September, 1910, in the apartments of the Meteorological Institute (W. 56, Schinkelplatz 6), which has been kindly placed at our disposal for those days.

* This resolution was adopted by the Meteorological Committee with the following alteration—that the words "for the purpose of" should be changed to "for the promotion of" (*see* p. 15).

† A previous invitation, containing the request to send in suggestions and proposals for discussion before the end of July, had been despatched in May.

The first Meeting will be held on Friday, 23rd September, at 10 a.m.

The provisional programme is as follows:—

I. Report of the Executive Officers on the realisation of the resolutions of the Innsbruck Conference.

II. Discussion on the work that still remains to be done for the attainment of this object:—

(1.) Comparison of standard instruments at the principal observatories.

(2.) Publication of data on the magnetic character of each day.

(3.) Exchange of curves for disturbed days.

(4.) Relations with the Department of Terrestrial Magnetism, Carnegie Institution.

(5.) List of the present magnetic observatories.

(6.) Extension of the Réseau of magnetic observatories.

III. Scheme for obtaining uniformity of contents and form of the publications of magnetic observations (after the style of meteorological publications).

IV. Report on the resolutions of the Committee of the International Association of Academies regarding the magnetic survey along a parallel of latitude. (This Committee will meet on the 21st September.)

V. Report on the undertaking of the Department of Terrestrial Magnetism, Carnegie Institution, to make a magnetic survey of the globe.

Discussion as to the best means whereby magnetic institutions may be able to co-operate with the Department of Terrestrial Magnetism for the purpose of carrying out the two undertakings (IV. and V.).

Resolutions have either been contemplated or proposed by the following:—

For II. 1, from Messrs. Dubinsky and Schmidt.
,, II. 2, from Mr. Chree.
,, II. 5, from M. Lecointe.
,, III. from Messrs. Chree and Schmidt,
,, V. from Dr. Bauer.

If there is time to spare after the business questions are disposed of we have in mind several scientific communications for the later meetings; we hope to receive more of these. For the discussion of questions IV. and V. it is especially desirable to have, from all the members of the Commission, reports on work, either in view or accomplished, for the magnetic survey of their country, or for other countries also if they possess special information regarding them.

If necessary there will be meetings also on Monday and Tuesday, the 26th and 27th September, at times when the apartments of the Meteorological Institute are not occupied by the International Meteorological Committee.

On Sunday, September 25th, there will be an excursion to Potsdam and Seddin; a special invitation to this excursion together with a detailed programme will be sent to the members by M. Hellman, Director of the Meteorological Institute.

On September 21st, at 10 a.m., a meeting of the Committee appointed by the International Association of Academies, for the magnetic survey along a parallel of latitude, will also be held in Berlin at the Meteorological Institute. Members of the Magnetic Commission are requested to be present also at this Committee; the invitation together with the provisional programme are enclosed.

Hoping to see you at our meetings in Berlin,

We are, dear Colleague,
Your obedient servants,

M. Rykatcheff,
President.

Ad. Schmidt,
Secretary.

APPENDIX II.

Report of the President of the Magnetic Commission of the International Meteorological Committee.

Gentlemen,

Our Magnetic Commission, appointed by the International Meteorological Committee in 1896, has since met in France (in 1896 and 1900), in England (in 1898), and in Austria (in 1905).

To-day we meet for the first time in Germany, the country to which we owe the first Magnetic Association, as well as the theory of Terrestrial Magnetism and the methods of observing, which, for three quarters of a century, have served as a basis for all subsequent investigations in this science.

I wish to express my thanks to M. Hellmann who has rendered it possible for us to meet here.

When the Meteorological Conference, held in Innsbruck in 1905, had completed the Magnetic Commission by nominating new members, the Commission consisted of the following members:—

Bauer.	Messerschmitt.
von Bezold.	Moureaux.
Brunhes.	Palazzo.
Carlheim-Gyllensköld.	Paulsen.
Chree.	Rücker.
Dubinsky.	Rykatcheff (President).
von Kesslitz.	Ad. Schmidt (Secretary).
Liznar.	Schuster.
Mascart.	Snellen.
Mendenhall.	Stupart.

Those members of the Commission present at Innsbruck held a meeting there for the purpose of electing executive officers, in accordance with the resolution of the Conference. Messrs. Chree, Carlheim-Gyllensköld, Moureaux, Rykatcheff (President), and Schmidt (Secretary) were appointed an Executive Bureau. The Commission has the right to co-opt new members.

Since the Commission was appointed by the Meteorological Conference at Innsbruck we have had the misfortune to lose Messrs. von Bezold, Mascart, Paulsen, Snellen, and quite recently M. Brunhes. I propose that we rise from our seats as a mark

of respect to their memory. In addition, M. Moureaux has, to our great regret, resigned, owing to his retirement from his service and for reasons of health.

In order to complete the number of its members, the Commission elected Messrs. Angot, Faris, Ebert, and Tanakadate. M. Angot was pleased to accept his election; M. Ebert, while expressing thanks for his election, desired to be excused from taking part in our work, being already overburdened with other duties.

At the present time our Commission thus consists of the following members:—

Angot.	Messerschmitt.
Bauer.	Palazzo.
Carlheim-Gyllensköld.	Rücker.
Chree.	Rykatcheff (President).
Dubinsky.	Schmidt (Secretary).
Faris.	Schuster.
von Kesslitz.	Stupart.
Liznar.	Tanakadate.
Mendenhall.	

The Executive Bureau has not been completed.

Of this list there are present:—

Angot.	Messerschmitt.
Carlheim-Gyllensköld.	Palazzo.
Chree.	Rykatcheff.
Dubinsky.	Schmidt.
von Kesslitz.	Stupart.
Liznar.	

In addition we are pleased to have among our number several members of the International Meteorological Committee and of the Royal Prussian Meteorological Institute, the members of the Committee for a magnetic survey along a parallel of latitude, Messrs. van Everdingen and Lecointe who, though not members of the Commission, have carried out important work for the Executive Bureau; Messrs. Melander and Schering.

After having established a rule regarding correspondence which should be carried on in the name of the Executive Bureau, our first care was to take steps to carry out the following proposals of the Magnetic Commission adopted by the Meteorological Conference at Innsbruck, 1905.

Proposals of the Magnetic Commission Adopted by the Conference at Innsbruck, 1905.

1. The Magnetic Commission considers it essential that the instruments used at the different magnetic observatories be compared with one another, regularly and as frequently as possible. It expresses also the desire that the directors of the chief meteorological services should make arrangements to ensure such comparisons.

2. Magnetic observatories are requested to prepare, from January 1st, 1906, tables showing the magnetic character of each day on the scale 0 to 2. The Commission refers the question of the manner of publication of these tables to the executive officers.

3. Magnetic observatories should exchange promptly copies of their traces for all very disturbed days (type 2 on the scale mentioned in par. 2 above), and for other days of special interest. In this connexion it would be useful if a list of magnetic observatories were published without delay.

4. The Commission requests the Meteorological Conference to consider the question whether magnetic observatories which possess autographic instruments should not publish hourly mean values (Greenwich time) deduced from their curves in place of the instantaneous values at the hour. It should be understood that monthly means (local time) be published as in the past, in addition to the means determined in this way. (Referred to the Committee.)

5. The Commission is unanimously of opinion that local circumstances differ so greatly at different observatories that it is undesirable to prescribe uniform rules of procedure, and that it should be left to the discretion of individual directors to fix the number of absolute measurements for their observatories.

6. The Magnetic Commission will elect from among its own members a permanent bureau consisting of from three to five members. It shall be the duty of the bureau to carry out the resolutions of the Magnetic Commission and to prepare the business for the next Conference. The bureau is also instructed to communicate with the Department for Terrestrial Magnetism of the Carnegie Institution, and to work out a plan for the co-operation of the larger existing institutes with the department. This plan for co-operation shall be submitted at the next Conference of directors.

7. It is desirable to make more complete the network of magnetic observatories. For theoretical as well as for practical reasons it is desirable in the first instance to aim at the establishment of a number of temporary stations near a line joining the poles of the magnetic axis and cutting Africa meridionally. These stations should be equipped with autographic variation instruments, and, if possible, they should be maintained in operation for a complete sunspot cycle.

8. The Commission is of opinion that autographic thunderstorm recorders are still in the experimental stage, and consequently it cannot recommend the general adoption of these instruments at observatories.

9. The Commission is of opinion that investigations on atmospheric electricity have not progressed beyond the stage of study, and that definite methods of reduction cannot be recommended as yet.

I will keep to this order instead of following the chronological order of our proceedings.

With regard to question 1. "Comparison of Instruments," we can, in the first place, quote a large number of comparisons made by the Magnetic Department of the Carnegie Institution at Washington.

According to a letter of October 17th, 1907, which I received from Dr. Bauer,* the instruments of this Department were com-

* Letter from Dr. Bauer of October 17th, 1907, published in the Report of the Committee of the International Association of Academies. Rome, 1909.

pared with those of the following Magnetic Observatories:—In the United States: Cheltenham (Maryland), Baldwin (Kansas), Porto Rico, Sitka (Alaska), Honolulu (Hawaii). In Canada: Toronto (Agincourt). In other countries: Tokio, Zi-ka-wei, Hong Kong, Samoa, Christchurch, Sydney, Melbourne, Mexico City and Havana.

In addition, the instruments of the Department have been compared with standard instruments of the Coast and Geodetic Survey of the United States.

In 1908 the instruments of the Expedition of the Department sent to Asia Minor and to Persia were compared by Mr. J. C. Pearson with instruments of the Observatories at Kew, Helwan (Egypt) and Tiflis. At the beginning of 1908 they were compared with those at Christchurch Observatory (New Zealand) by the "Galilee" Expedition. The results of these observations are published by Messrs. John Fleming and J. C. Pearson in *Terrestrial Magnetism and Atmospheric Electricity*, March, 1909. Finally in the Report sent by Mr. Bauer to be read at the General Meeting of our two Magnetic Commissions, he gives the programme of the voyage round the World of the "Carnegie" during the years 1910-1913, indicating quite a series of magnetic observatories which will be visited by the yacht during this voyage, and where the instruments on the yacht will be compared with those of the Observatories.

There is thus ample proof that all the numerous magnetic observations made by the Carnegie Magnetic Department will be comparable, not only with each other, but also with the observations of other countries.

In the second part of his Report, Mr. Bauer gives the results of the series of observations made in 1909 and 1910 at Gardiner Bay, Long Island, on board the yacht "Carnegie." The mean results for each of the years have attained such a degree of accuracy that the secular variation of the magnetic elements deduced from the data of these two epochs is practically the same as that obtained from observations made at the Magnetic Observatory at the place. The combination of these observations made at Gardiner Bay, Long Island, with the comparison of instruments of the yacht "Carnegie" with instruments at Falmouth Observatory, made in October, 1909, after the voyage of the yacht across the Atlantic, gives a fundamental basis for the connexion of observations made in the Old and New World.

The results of the "Carnegie" at Falmouth are in perfect agreement with the excellent magnetic survey of Rücker and Thorpe.*

With regard to European observations, we have agreed to suggest to the Directors of observatories that they make comparisons each in turn with some observatory willing to take part in this work; each observatory will have two consecutive years at its disposal; notice will be given beforehand concerning the choice of observatories to be visited; efforts will be made to arrange matters so that each series of comparisons will be in

* The complete Magnetic Results of the first cruise of the "Carnegie," 1909–1910. By L. A. Bauer and W. J. Peters. Terrestrial Magnetism and Atmospheric Electricity. June, 1910.

connexion with the following series at least at one point which will be common to both. In order not to lose time we agreed that the Constantine Observatory at Pavlovsk should make the comparisons in 1907 and 1908, whereas the Observatory at Potsdam should make those for 1909 and 1910.

This plan has succeeded; in 1907 and 1908 M. Savinov compared the standard instruments at Pavlovsk with those of the Observatories at Tiflis, Ekaterinburg and Irkutsk. In 1908, M. Dubinsky compared our instruments with those of the Observatories at Upsala, Copenhagen, Kew, Potsdam and Krakau.

Thanks to the assistance rendered by the Directors and officials at all these Observatories, Messrs. Dubinsky and Savinov have succeeded in accomplishing their task.

Printed copies of the provisional results which they obtained will be laid before the Commission.

I take this opportunity of thanking those Institutions, which they have visited, for their help and courtesy.

In 1910, Dr. Kühl, of Potsdam Observatory, compared the standard instruments at Potsdam with those at De Bilt, Val Joyeux and Pavlovsk.

It is for the Committee to decide as to who shall make comparisons in future and the order in which they are to be made.

2. Regarding the publication of a statement containing the magnetic characteristics for each day, we entered into communication with M. Snellen, who, in accordance with the wish expressed by the Magnetic Commission, published for several years the statement of quiet days of terrestrial magnetism according to data contributed by various observatories.

We requested him to collect and publish more complete data concerning the magnetic character of days according to regulations adopted by the Magnetic Commission at its meetings held in Innsbruck.

In his reply of December 7th, 1905, M. Snellen informed us that he would willingly undertake this task entrusted to him by the Commission. The new form of the publication has been elaborated according to the views expressed by the Magnetic Commission at its meetings in Innsbruck in 1905.

The Executive Bureau, with the consent of M. Snellen, sent the appended circular of January, 1906 (Appendix A), to magnetic observatories.

In this circular letter the Bureau communicated the views of the Innsbruck Conference to the observatories, and drew special attention to the desiderata which could be executed without delay; these are items 2 and 3 regarding the publication of the magnetic character of the day and the exchange of magnetic traces for very disturbed days.

The Executive Bureau requested Directors to co-operate in this work, and in accordance with the discussions at Innsbruck, gave an explanatory note regarding data to be sent to M. Snellen. A supplementary circular (Appendix B) was sent to the same observatories with the request to reckon days from midnight to midnight, Greenwich mean time.

Before our circular was despatched, Mr. Tittmann, the Chief of the Coast and Geodetic Survey of the United States, was kind

enough to send us a draft of the circular which he intended sending to observatories within his province asking them to note after January, 1906, the data necessary for the publication mentioned.

The majority of magnetic observatories provided with magnetographs willingly consented to send the necessary data to M. Snellen every three months. The publication of the magnetic character of each day was begun in 1906.

M. Snellen died in October, 1907. M. van Everdingen, Director of the Meteorological Institute at De Bilt, was kind enough to suggest that the issue of this publication should be entrusted to his Institute. We were, of course, only too glad to agree to this proposal, and since then the publication has appeared regularly, edited by M. van Everdingen. The publication is entitled: "Commission Internationale de Magnétisme Terrestre. Caractère magnétique de chaque jour des mois .... 19..... publié par l'Institut Météorologique Royal des Pays-Bas."

For 1909 the Bulletin contained 42 stations distributed in different parts of the world. At the close of each year M. van Everdingen gives also the magnetic character of the year with illustrations and drawings.

The second request of the Magnetic Commission, recommended by the Meteorological Conference at Innsbruck, has thus also been carried out.

I beg to suggest that the Commission express our thanks to M. van Everdingen and to the Government of the Netherlands for this most useful international publication.

For carrying out the third request—exchange of copies of magnetic traces for very disturbed days—the same steps were taken by the Executive Bureau, but with less success.

In the circular of January, 1906 (Appendix A), mentioned above, we drew the attention of Directors of observatories to this request, and we invited them to reproduce the traces for exchange in the form most convenient to themselves. To our regret, several observatories, which had begun to publish these traces, left off doing so after a time. At present, as far as I can judge from material which we receive at Pavlovsk, only the following twelve observatories reproduce and distribute copies of traces to magnetic observatories:—

Apia, Isle of Samoa.
Cheltenham, Maryland, U.S.A.
Ekaterinburg, Russia.
Kew, England.
Honolulu, Hawaian Islands.
Pavlovsk, Russia.
Potsdam-Seddin, Germany.
Sitka, Alaska, U.S.A.
Tokio, Japan.
Uccle, Belgium.
Val-Joyeux, France.
Zi-ka-wei, China.

Four of these observatories exchange copies:—Apia, Ekaterinburg, Pavlovsk and Potsdam, whereas the other eight give the

traces in their publications. It is very desirable that those observatories equipped with magnetographs, not mentioned here, should complete the material of the traces for very disturbed days.

We are more fortunate as regards the request, mentioned in the same paragraph, to publish a complete list of magnetic observatories.

A preliminary list drawn up according to data available at the observatories of Potsdam and St. Petersburg had been completed by members of the Executive Bureau. In accordance with this list the circular, mentioned above, was sent to the Directors of observatories with the request to supply the Bureau with details regarding their observatories. Quite independently of this circular, and almost at the same time, two Institutes were engaged on the same question.

Mr. Bauer, Director of the Magnetic Department of the Carnegie Institution, addressed a circular to the observatories inviting them to supply him with the necessary information for the publication of a list, similar to the one we had in view, in Terrestrial Magnetism.

As soon as he received our circular, however, he withdrew his proposal.

In 1906 we received from 15 to 20 replies to our circular. Up to 1908 the number of replies had not greatly increased. We were still waiting for material to publish as complete a list as possible, when in September, 1908, M. Lecointe informed us that the Institute at Uccle was preparing the publication of a list of magnetic observatories and seismological observatories; two members of the staff of the Royal Observatory of Belgium were engaged on this work. Taking advantage of this opportunity, our Bureau, to avoid duplication of work, sent all the material which we had to M. Lecointe.

We have pleasure in announcing that this work, entrusted to the Commission, has been carried out by the Royal Observatory of Belgium. M. Lecointe has just sent us the publication entitled: "Observatoire Royal de Belgique, Service Astronomique, Liste des Observatoires Magnétiques et des Observatoires Séismologiques, by E. Merlin and O. Somville. Brussels, 1910." I take this opportunity of requesting the Commission to express our thanks to M. Lecointe, his Government, and Messrs. Merlin and Somville.

Question 4, regarding the publication of mean hourly values from magnetic curves, has been sent by the Conference to the Meteorological Committee.

Questions 5, 8 and 9 have been decided by the Conference itself, and do not require any action on the part of the Magnetic Commission.

With regard to question 6, the Commission is organised and has nominated Executive Officers as desired by the Conference; as to its relations with the Carnegie Magnetic Department, it appeared from the correspondence of the President of the Commission with Mr. Bauer and the documents sent to the Commission

by Mr. Bauer, that the best way of assisting this Department would be to co-operate in making magnetic surveys in those countries where there are none as yet.

In this way we may co-operate in the great enterprise of the Carnegie Institution, the making of a magnetic survey of the globe. Mr. Bauer appended to his report a map of the world, on which was shown the magnetic survey carried out by the yachts "Galilee" and "Carnegie," and the places where magnetic measurements were made by Expeditions of the Carnegie Institution. On the map before you there are shown, by the side of these data, the countries where magnetic surveys have already been carried out.

With regard to Russia, I have had marked on the map those places where magnetic observations for all three elements were made during the period 1900 to 1910.

Magnetic surveys of other countries are given according to the publications which we have at the Constantine Magnetic Observatory at Pavlovsk.

I will endeavour to complete this map by means of information from our Colleagues assembled here.

We have pleasure in being able to state that the work towards a magnetic survey of the globe has progressed enormously during the period of five years since our last meeting at Innsbruck. I remember the enthusiasm with which Mr. Bauer's telegram, announcing the commencement of a magnetic survey of the Pacific Ocean, was welcomed at that time by our Commission and the Meteorological Conference. For our meeting here, Mr. Bauer has sent this map, from which you will see that the survey of the Pacific Ocean and a large portion of the North Atlantic Ocean has been carried out, and, moreover, that numerous expeditions of the Carnegie Magnetic Department have worked in all parts of the world in various countries hitherto unexplored.

Let us bear in mind that during this short period the two magnetic poles were explored, the North Pole by Roald Amundsen during his expedition on board the "Gjöa" in 1903-1907, and the South Pole by the expedition under the command of Lieut. Shackleton, which succeeded in making observations in the neighbourhood of this point.

We must also mention the publication of the work of the English Expedition, "National Antarctic Expedition," on board the "Discovery" (1901-1904).

The probable position of the magnetic pole, as determined from the magnetic observations of this expedition was, according to these observations, determined in about the same place as Shackleton's expedition discovered it. Results of the German Antarctic Expedition under the command of M. Drygalski (1901-1903), have also been published, and we wish to mention specially the two portions of the magnetic publication by M. Bidlingmaier, of which one appeared in 1905 and the other in 1909. This work is especially remarkable by reason of the author's fine researches on the observation of horizontal intensity on board ship. He also gives a series of magnetic observations

for all three elements on land and sea. Results of the exploration of Franz Josef Land by the Ziegler Expedition have also been published since 1905.

During the same period, 1905-1910, magnetic surveys of the United States, India, South Africa and Brazil have been carried out. In these vast countries the réseaux of observing stations are very dense and sufficient for the construction of magnetic charts; the work, however, is being continued for the study of secular change and anomalies.

The survey of the Dutch East Indies has also been accomplished; the results of magnetic surveys in North Germany and the Kingdom of Saxony in 1908 and 1910 have been issued; the results of the survey in Roumania have been published together with magnetic charts. M. von Kesslitz has published the magnetic survey of the coasts of the Austrian Empire.

M. Palazzo has published the magnetic survey of Sardinia. Finally, M. Angot informs us that the Tilho mission has carried out magnetic determinations in Africa between the Meridians of 2° and 17° E. Greenwich, and between the parallels of 11° and 17° N., for the most part between the Niger and Lake Tchad and also to the N.E. of this lake.

Besides the work of the Carnegie Institution, magnetic surveys have been undertaken in New Zealand, the Argentine Republic, Canada, Mexico, Mozambique, and German East Africa.

To complete the data in our possession and in accordance with the wish indicated by Mr. Bauer in his letter of July 8th, 1910, I expressed a desire in my circular letter of August, 1910 (Appendix I., p. 99), to have reports, from all the members of our Commission, on the work, whether contemplated or executed, for the magnetic survey of their countries. This circular letter was also enclosed with the letter of invitation sent to the members of the Committee for observations along a parallel of latitude, and to my colleagues of the Meteorological Committee. I hope, Gentlemen, that you will help me to complete this chart, which should give a complete idea of the present state of magnetic work carried out on the surface of the globe.

There remains for us to report on what has been done with regard to request No. 7, to complete the network of magnetic observatories, especially on the line of the magnetic meridian crossing Africa. In order to carry out this request the Executive Officers were primarily engaged in taking steps to connect the European network with observatories in Italy and in its African Colony. With this end in view, a letter was sent in September, 1907, to M. Palazzo, Director of the Ufficio Centrale di Meteorologia e Geodinamica, in which we drew attention to the important effect that the establishment of magnetic observatories equipped with self-recording instruments, in Italy and further South in the North of Africa, would have on the theory and also on the practice of terrestrial magnetism. The Officers requested M. Palazzo to make a corresponding suggestion to his Government, should he be of our opinion.

We have received a favourable reply. M. Palazzo submitted the requests of the International Commission to his Government,

and petitioned for a National Magnetic Observatory to be established in Italy. The Government has not yet come to any decision; but M. Palazzo hopes that matters are well on the way towards fulfilment. He finds many reasons for establishing a National Magnetic Observatory at Sestola in Central Italy, near Mount Cimone (Appenines); the locality is far removed from large centres, and electric lines will never reach there. There is already a geophysical observatory at Sestola belonging to the Ufficio Centrale; the magnetic observatory will be incorporated with the present observatory, which has premises suitable for the installation of magnetic instruments. The scheme for this observatory is receiving attention, it will be established at the expense of the Ministry of Agriculture, on which the Bureau Central is dependent. As for the observatory in South Italy, the geophysical observatory of Messina University took the initiative in establishing a magnetic station here also. Local Institutions have already awarded grants necessary for adapting premises for the magnetic station. The Government has been requested to assign a sum requisite for acquiring the necessary instruments.

M. Palazzo also agrees with the point of view of the Bureau regarding the advantage of having a magnetic observatory at Tripoli, but he considers that the question is still rather premature. I hope that M. Palazzo will be able to give us fresh information on the present state of affairs regarding the proposed observatories at Sestola and Messina.

I have still to mention several observatories which have started operations or begun to publish results since 1905.

The Ebro Observatory in Spain published results first for 1905.

Helwan Observatory (near Cairo) is equipped with magnetographs, and published results first for 1908[1].

For the first time, very complete publications of hourly magnetic observations taken from the records of magnetographs of the four magnetic observatories belonging to the Coast and Geodetic Survey, U.S.A., have appeared. They include observations from Cheltenham Observatory, Maryland, for the years 1901-1904 and 1905 and 1906, published in 1909[2], observations from the Sitka Observatory, Alaska (1902-1906)[3], from Porto Rico (1903-1904)[4], from Baldwin Observatory, Kansas (1901-1904)[5], and from Honolulu Observatory, Hawaii (1902-1904)[6].

[1] Ministry of Finance, Egypt, Survey Department. Magnetic observations made during 1908 at Helwan Observatory. Cairo. 1909.

[2] Department of Commerce and Labour, Coast and Geodetic Survey, O. Tittmann, Superintendent.
Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, 1901–1904. Washington, 1909. Idem 1905 and 1906. Washington, 1909.

[3] Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Sitka, Alaska, 1902–1904. Washington, 1909. Idem 1905 and 1906. Washington, 1909.

[4] Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Vieques, Porto Rico, 1903–1904. Washington, 1909.

[5] Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory, at Baldwin, Kansas, 1901–1904. Washington, 1909.

[6] Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, 1902–1904. Washington, 1909.

Since our last Meeting several magnetic observatories of the first order have had to discontinue their observations or remove them to a different neighbourhood on account of electric tramways. Potsdam Observatory, which was already a good way away from the capital, was obliged to convey a part of its observations to Seddin; even Kew Observatory, which has for so long past undertaken the verification of a large number of instruments distributed throughout the World, is also threatened, and has had to establish a new magnetic observatory at Eskdalemuir. The magnetic observatory at Copenhagen has been obliged to remove to Rude Skov; Zi-ka-wei to Lukiapiang. At home, in Russia, we also experience the same inconvenience. Several years ago we had to transfer our magnetic observatory from Tiflis to Karsani, where the magnetographs have been placed temporarily in very small and damp cellars. But this year the Government has made a sufficient grant for the construction of a magnetic observatory at Karsani. The magnetic buildings are under construction. The observatory at Irkutsk is also threatened, and M. Wosnessensky has submitted a proposal to transfer magnetic observations to the village of Sukhaya.

In concluding my Report, I beg leave to say a few words on magnetic work in Russia.

In accordance with my suggestion, the Imperial Academy of Sciences at St. Petersburg appointed a special Commission to elaborate a scheme for the magnetic survey of Russia. We propose to make a detailed survey of Russia in Europe, whereas in Siberia we will have to be satisfied with a survey along the roads which will form no dense réseau. Universities and other high schools, scientific societies and other institutions will co-operate in this undertaking if the Government is in a position to grant us the sum necessary. Finland, which is also taking part in this enterprise, has outstripped us: the observatory at Helsingfors has already obtained the necessary sums for ten years during which time the survey will be finished; there are many hundreds of stations where observations will be made, and a sufficient number of fixed stations will serve to repeat observations for the purpose of determining secular variations. A magnetic observatory will be established in the north of Finland. This observatory, if it remains permanent, will also satisfy a wish of the International Solar Commission, namely, to have an observatory in Europe at a very high latitude.

For Russia in Europe we have magnetic charts by Tillo, constructed according to observations made at many hundreds of places, mostly during the Nineteenth Century, reduced to the epoch 1880. Since 1900 we have observations made by the Hydrographic Department on the shores of the Polar Sea, Baltic Sea, and Pacific Ocean, and this summer in the Black Sea. The Nicholas Central Physical Observatory has commissioned one of its staff to take observations at various places in Russia in Europe for determining secular variations to enable the data of Tillo's charts to be brought up to date, but these data can only serve as a first approximation.

M. Wosnessensky, Director of the observatory at Irkutsk, has also, during the last few years, made magnetic observations in Eastern Siberia and especially along the Amur.

In 1909, as you know, our physicist M. Smirnow carried out the magnetic survey along the railway line from Warsaw to Vladivostok; this line can also serve as one of the routes of the réseau planned for Siberia. Finally, this summer we obtained a small sum for making a magnetic survey of the St. Petersburg district. Three observers of the Constantine Observatory by turns have observed at 20 to 30 stations each according to a previously arranged plan. It is the beginning of the great magnetic survey which will be carried out if the necessary money is allotted.

Magnetic surveys and observing stations are marked on the chart.

I trust, Gentlemen, you will forgive me for having made my report a little long; but I thought it of advantage to remind you of what had been done so that you should have a clearer idea of what is still to be accomplished.

M. Rykatcheff.

APPENDIX A.

Circular to Magnetic Observatories.

Executive Bureau of the International Commission
for Terrestrial Magnetism.
St. Petersburg and Potsdam,
January, 1906.

Sir,

In the name of the Executive Officers of the International Commission for Terrestrial Magnetism, appointed at the Conference of Directors held at Innsbruck, the undersigned have the honour to inform you of the following decisions of the Commission, and trust that you will be able to carry out the requests mentioned therein.

We beg leave to call your attention to points No. 2 and 3 in particular, and to request you to carry out the propositions contained therein from the beginning of the current year.

For the purpose of making the meaning of the decisions clearer we beg to add the following remarks based on the discussions of the Commission.

(2.) A number of magnetic observatories have, for several years, sent to M. Snellen a list of "quiet days" made every three months. M. Snellen collated them and then distributed them amongst all the observatories.

A new decision has been arrived at for the purpose of extending this arrangement somewhat. In future a list of *all* days with indication in figures of the character of the disturbance should be sent to the Central Institute. To simplify matters as far as possible a scale of three degrees should be used for this purpose:—

Quiet days	=	0.
Days with moderate disturbances	=	1.
Days with violent disturbances	=	2.

The Commission thought it unnecessary, for the present, to give a precise definition of these degrees: it was of opinion that these definitions would not be obtained until after the various

methods proposed had been tested by having been put into practice, and this will be the subject of the next discussion of the Commission.

For the present it is left to the care of each observatory to establish its own rules for the classification of days. We only desire to express a wish that these rules may be formulated as precisely as possible, and that they may be communicated to the bureau, where they will be combined in order that basis of an accurate definition may be deduced from them.

[Certain observatories in their publications determine the character of the day (in most cases for each element separately) according to the Eschenhagen scale. It is by no means the wish of the Commission that this method should be replaced by the new one; its sole aim is to obtain a rapid survey of the magnetic state of the Earth for each day. Moreover, to reduce the work, the new method might be combined with the old one by identifying for instance, 0 with 1 according to Eschenhagen, 1 with 2 and 3, and 2 with 4 and 5. All the same this is not in any way the proposal of the Commission; it is a remark to dispel doubts should they arise].

At the request of the Commission, M. Snellen agreed to continue the collection and publication of the lists. We would, therefore, ask you to address your lists, assuming that you are willing to send them, to

M. Maurits Snellen,
Apeldoorn,
Netherlands.

every three months, if possible.

(3.) About two years ago, the majority of observatories began to exchange curves of disturbances. The Commission recommends an extension of this exchange, but it is of opinion that the formation of rules based thereon would be premature. In particular the choice of the scale and of the manner of reproducing the curves (whether by drawing, lithography, photography, etc.) should be left to each observatory, because a uniform rule would, for the present, meet with enormous practical difficulties.

Hoping that you will take part in this exchange, we would ask you, Sir, kindly to send copies direct to all the other observatories.

The Commission entrusted the bureau with the drawing up of a list of magnetic observatories. To fulfil this task as conscientiously as possible, we think it would be advantageous to apply to the observatories themselves with the request to be furnished with authentic information.

We would therefore beg you to send us information on the following points:—

(1.) Name and locality of your observatory.
(2.) Geographical co-ordinates (latitude, longitude, altitude).
(3.) Director and other scientific assistants.
(4.) Constitution (maintained by the State, privately, or by some corporation; is it an independent institute or is it part of another institute, astronomical observatory, university, etc.; in this case the name of the director).

(5.) Description and extent of observations, in particular are automatic records obtained regularly for some or all elements by means of the magnetograph, or are hourly readings taken.

(6.) Title and contents of publications, in particular are the hourly values published for each day, are the curves published.

(7.) Period of establishment of station, historical development and other special circumstances of general interest.

Kindly send your communication to the undersigned secretary (Potsdam, Telegraphenberg).

Thanking you in anticipation for the trouble you will take,

We remain, Sir,
Your obedient servants,

M. Rykatcheff,
President.

Ad Schmidt,
Secretary.

APPENDIX B.

Executive Bureau of the International Commission
for Terrestrial Magnetism.

St. Petersburg and Potsdam,
March, 1906.

Sir,

M. Snellen wishes to point out an omission in the circular letter of January last, which might be the cause of some confusion. It is that the second resolution of the Innsbruck Conference does not define clearly the times of day. According to the sense of the resolution itself and the explanations which have taken place, these times should be identical for all observatories, so that the figures of observation may characterise the simultaneous state of the entire globe. Mean Greenwich time has been adopted generally for all simultaneous magnetic observations recently undertaken, the result of which naturally is that the same system should be adopted in the present case. In the subsequent statement (Resolution 4) this method is mentioned definitely.

It might perhaps be of advantage to show that this rule will not be the cause of any inconvenience. It is true that the curve characteristic of a certain period of time will always consist of two parts to be found on different sheets; but, on the other hand, the same thing will occur if local time be used, for the sheet will certainly not be changed at midnight except at a few observatories.

We therefore request you to add the following to the second page of the circular:—

"Each day characterised in some way by the figures 0, 1, 2 should be counted according to Greenwich Mean Time, that is to say, from midnight at Greenwich until the following midnight at Greenwich."

M. Rykatcheff,
President.

Ad. Schmidt,
Secretary.

To Magnetic Observatories.

APPENDIX III.

The Present State of the Question Regarding a National Magnetic Observatory in Italy.

I think it is expedient that I should explain to my colleagues the reason why, in consideration of a succession of unfavourable circumstances, Italy is still unprovided with a magnetic observatory; it is unnecessary to tell of the grief and disappointment felt by all those who put their whole heart into improving geophysical studies in Italy.

Since the Central Meteorological Bureau was established at Rome (*i.e.*, in 1879) it assumed, as one of its principal duties, the magnetic survey of the whole of Italy for the construction of magnetic charts. The idea, therefore, naturally arose to present the nation with a complete and suitable magnetic observatory, which at first was to be erected at Rome. The Director at that time, the late M. Tacchini, who earned our gratitude by the organisation of our meteorological and geodynamical service, of which he was at the head for more than 20 years, had already formed in 1881 a suitable project which, after a long delay, was presented to Parliament as a Bill in 1884. By this Bill a grant was proposed for establishing at Rome, in the neighbourhood of Mount Aventine, a magnetic observatory in connection with the Central Meteorological Office. The proposed Bill was examined by the Parliamentary Commission which came to a favourable conclusion, but other urgent Parliamentary work did not permit of this project being discussed by the Chamber before the end of the session. The scheme was then taken up again and presented by the Minister, M. Grimaldi, in the following legislature; but, once again, the bill did not pass, that is to say, for reasons extraneous to the true value of the scheme, it was not approved by the Legislative Chamber. This is why Italy remains destitute of an important institution so long desired by scientists. In reality the idea of the observatory was never abandoned; but later on there commenced to develop, not only in Rome, but also in the various Italian towns and even in the country, networks of electric tramways, town and suburban, the neighbourhood of which is absolutely irreconcilable with a magnetic observatory. Consequently, the problem of finding a situation suitable in every respect for a magnetic observatory became more and more complicated and difficult of solution. Henceforth one can only think of establishing a magnetic observatory either at the summit of an uninhabited mountain, or on some small isolated island in the middle of the sea. For a short time it seemed as if a favourable place had been found at Sestola, in the Modena Appenines, a neighbourhood far removed from all electric lines at present, and where these are not to be anticipated in the future, and where one of our meteorological observatories has been established in an old castle for some time past. With a few additions and a minimum of expense, it was thought possible to establish the National Magnetic Observatory up there, and for this purpose the Italian Physical Society,

at a meeting of the Congress of the Society for the Progress of Science, held at Parma in 1907, expressed a special desire which received much consideration from the Minister of Agriculture.

While our thoughts were directed to Sestola for establishing there a permanent station for terrestrial magnetism, and our hopes were raised by the probable imminent realisation of our old wish, I was solicited by our esteemed President, General Rykatcheff, to promote the establishment of a magnetic observatory in Southern Italy, and the idea was put forward of establishing a magnetic station of Messina, in connection with the observatory and Geophysical Institute of the University of that town. The site occupied by the observatory appeared to be suitable, and, indeed, it was so at this time (1906) when there were not as yet any electric tramways in Messina; however, the electric tramways could not be hindered from one day invading the town. We consequently decided to establish, on the site of the Messina Observatory, a temporary magnetic building of wood, easily taken to pieces and transportable elsewhere without difficulty when the necessity for doing so should make itself felt.

Meanwhile, at Messina, one would have had the advantage of being able to entrust the management of the magnetic station to a competent staff in every respect suitable for this end—namely, the staff attached to the observatory of the University. We were already in communication with Professor Rizzo, Director of this Observatory, when in the terrible seismical disaster of December 28th, 1908, the observatory building was destroyed, together with unhappy Messina. Thus we had to give up all schemes for the establishment of a magnetic observatory in that neighbourhood.

Then once more we turned our thoughts to the establishment of an observatory at Sestola. But before making any definite plan of the observatory to be erected, it seemed advisable to investigate first the distribution of magnetism round Sestola in order to make sure of the non-existence of local disturbing influences, although such influences seemed *à priori* improbable since Mount Sestola is composed entirely of calcareous matter. I entrusted this preliminary work of magnetic investigation to Dr. Pacini, assistant at my institute. Dr. Pacini carried out researches during the summer of 1908, determining, by means of a Kohlrausch variometer with four deflecting magnets, the direction of isodynamic lines round Sestola. Unfortunately, the result was entirely different from what had been expected, as the neighbourhood is extremely disturbed on account of sporadic masses of serpentine which effloresce from the limestone, a few kilometres away from Sestola—masses which give a very extraordinary course to isomagnetic lines in this region, as shown on the chart appended to Dr. Pacini's Report. Under these conditions it is no longer possible to think of establishing a magnetic observatory at Sestola. In this connection I recall an investigation made by Professor M. N. Piltschikoff, which showed that in disturbed regions not only are the absolute values of the components of the earth's field changed, by reason of the anomaly, but also the variations of the declinometer and bifilar are generally greatly

modified; it is only the variometer of vertical intensity which retains its variations unchanged whatever the anomaly.

In conclusion, since even Sestola has had to be excluded as a favourable locality for the establishment of a magnetic observatory, the question of a National Magnetic Observatory in Italy still remains open—that is to say, not determined. It will, therefore, be necessary to look for another locality, where on the one hand geological conditions, and on the other economical and social conditions, appear favourable for the establishment of a magnetic observatory, which will allow us to compete with other civilised nations in this branch of research.

L. Palazzo.

APPENDIX IV.

Differences between the Standard Magnetic Instruments of the Constantine Observatory at Pavlovsk and the Standard Instruments of Observatories at Karsani (Tiflis), Ekaterinbourg, Irkutsk, Upsala, Rude Skov (Copenhagen), Kew and Potsdam, according to comparisons made by S. Savinov and W. Dubinsky during the years 1907-1908 by means of the Wild-Freiberg Control Theodolite and the Wild-Edelmann Induction Inclinometer.

Horizontal Intensity.

Pavlovsk (Standard Instrument Wild-Freiberg I).

Pavlovsk minus.		Time of Comparisons.	Observer at the theodolite.
Karsani (Wild-Edelmann Theodolite) to 1st December.	− 14·6γ	XI 1907	Savinov
Karsani (Wild-Edelmann Theodolite) after 1st December.	0·0	XII 1907	,,
Ekaterinbourg (Wild Freiberg Theodolite).	− 0·4	VI 1908	,,
Irkutsk (Wild Freiberg Theodolite)	− 1·7	VI–VII 1908	,,
Upsala (Lamont's large Theodolite)...	− 9·0	IX 1908	Dubinsky
Rude Skov (Bamberg Theodolite, 1973).	+ 9·3	IX 1908	,,
Kew (Unifilar Magnetometer) ...	− 8·6	X 1908	,,
Potsdam (Wanschaff Theodolite) ...	− 6·7	XI 1908	,,

Inclination.

Pavlovsk (Standard Induction Inclinometer).

Karsani (Induc. Inclin. Wild-Edelmann).	+ 0·4′	XI–XII 1907	Savinov
Katharinenburg (Induc. Inclin. Wild-Edelmann).	+ 0·5′	VI 1908	,,
Irkutsk (Induc. Inclin. Wild-Edelmann).	− 1·0′	VI–VII 1908	,,
Upsala (Needle Inclin. Dover 60, Needles 3 and 4).	− 0·2′	IX 1908	Dubinsky
Rude Skov (Induc. Inclin. Wild-Edelmann).	− 0·5′	IX 1908	,,
Kew (Needle Inclin. Barrow 33, Needles 1 and 2).	− 0·9′	X 1908	,,
Potsdam (Induc. Inclin. Schulze 1)	+ 0·7′	XI 1908	,,

Declination.

Western Declination reckoned as positive.

Pavlovsk (Standard Declinometer).

Rude Skov (Bamberg Theodolite, 1973).	— 0·2′	IX	1908	Dubinsky
Kew (Unifilar Magnetometer) ...	— 0·7′	X	1908	,,
Potsdam (Wanschaff Theodolite) ...	— 0·2′	XI	1908	,,

Corrections of the Instruments used in making Comparisons.

Wild-Freiberg Theodolite II. Horizontal Intensity.

X	1907	— 0·8γ
II–V	1908	— 2·2
VII–VIII	1908	— 2·0
IV–V	1909	— 2·1

Inclinometer A (used by Savinov).

X–XI	1907	+ 0·40′
II	1908	+ 0·25′
VII	1908	+ 0·35′

Wild-Freiberg Theodolite II. Declination.

IX	1908	— 0·9′
III–IV	1909	— 1·2′

Inclinometer B (used by Dubinsky).

VIII–IX	1908	— 1·0′
VII	1909	— 0·5′

W. Dubinsky.

APPENDIX V.

Chief Results of the Intercomparison of Magnetic Instruments obtained by the Carnegie Institution of Washington.

By L. A. Bauer and J. A. Fleming.

(Abstract.)

The following Table gives a provisional summary of the chief results regarding the differences between magnetic standards obtained by the Department of Research in Terrestrial Magnetism of the Carnegie Institution of Washington in the regular course of its world-wide magnetic operations. It is not possible now to give all the results nor in every instance the final results, either because the required data have not yet been received from certain institutions, or because of there being some question about those received which will require further correspondence. For these reasons the publication of a complete article on the subject, intended for the September, 1910, issue of the Journal "Terrestrial Magnetism," must be deferred until all questions at issue have been settled. Reference must be made to that article for all details regarding the comparisons—suffice it to say that the attempt has been made to eliminate every source of extraneous error, in order to make sure that the differences found were solely due to instrumental causes.

Although the presentation of the final and complete results must be deferred, enough of sufficient interest and value can be given now. The signs of the tabular quantities are the algebraic differences found by subtracting the values with the observatory standards from those observed with the magnetic instruments of the Carnegie

Institution of Washington referred to its adopted standards as stated below; east declination, inclination of north end of needle below horizon, and horizontal intensity are regarded as positive. In order to give some idea of the relative accuracy of the determination of the differences, the probable errors ε as computed from Bessel's well-known formula, are added.

The standards provisionally adopted by the Carnegie Institution of Washington are :—

C. I. W. Magnetometer No. 3, for declination and horizontal intensity, this instrument having a correction of −0·0030 H applied so as to make it conform with the provisional International Magnetic Horizontal Intensity Standard adopted by us in 1907 (*see* Terr. Mag., vol. 12, 1907, pp. 161–165); Eschenhagen-Schulze Earth Inductor No. 48 for inclination diminished by −0′·5. These standards are designated in the Table as "C. I. W."

Ten magnetometers, differing in construction and make and belonging partly to the Institution and partly to the United States Coast and Geodetic Survey, have been compared with these standards at various times in Washington, each one of these ten instruments having had all constants involved determined independently—that is, they were all absolute instruments. In declination, the correction varied from + 1′·6 to − 0′·4, the average correction being + 0′·36 ; for horizontal intensity, the correction ranged from − 0·0011 H to + 0·0011 H, and the average correction being + 0·00028 H. Hence our D and H standard is in agreement with the mean of ten absolute magnetometers at Washington by quantities well within the absolute errors of field magnetic results.

The same satisfactory result is shown by the ten observatory comparisons below. Thus taking the mean of all, the average correction on the C. I. W. standard would be for declination, + 0′·30, and for horizontal intensity + 0·00019 H—quantities in excellent agreement with the extensive Washington comparisons. In other words, it would appear conclusively proven that the C. I. W. provisional international magnetic standard will require a correction in declination not exceeding − 0′·4, and in horizontal intensity not exceeding −0·0002 H, and possibly not over −0·0001 H —thus serving every possible practical requirement.

The standard C. I. W. instrument for inclination (Earth Inductor 48) agrees with the various earth inductors at Potsdam, Pola, Dehra Dun, and Cheltenham within quantities not exceeding 0′·2 (the difference of the Tiflis earth inductor of −1′·6 is receiving further investigation, additional comparisons having been made in 1909). At the other five observatories where dip circles are used, the differences reach the amount of −1′·7 at Kew, where, however, a large number of comparisons of various kinds have shown that the Kew dip circle gives too large inclinations on the order of 1′ ; it should also be recalled that the medium of intercomparisons was not an earth inductor but a dip circle. Taking the indiscriminate mean of all results (five earth inductors and five dip circles), the average difference is found to be −0′·49. We may safely conclude, apparently, that our inclination standard is absolutely correct within 0′·5—most probably within 0′·3.

It is now possible to refer the results obtained by the Carnegie Institution of Washington over the whole globe to the same standards within an absolute accuracy exceeding that generally possible in field work, thus more than complying with all practical requirements.

Results of some Comparisons of Magnetic Observatory Standards by the Carnegie Institution of Washington.

(Differences : C. I. W.—Observatory value.)

Observatory.	Date of Comparisons.	Declination.		Inclination.		Horizontal Intensity.	
		ΔD	ε	ΔI	ε	ΔH	ε
Kew, England ...	Mar., 1908, and Mar., 1910.	+0′·7	±0′·1	−1′·7	±0′·2	+0·0001 H	±0 00003 H
Potsdam, Germany	Feb., 1910 ...	+0·3	±0·0	−0·2[2]	±0·1	+ 4	7
Pola, Austria ...	Feb., 1910 ...	−0·3	±0·1	+0·1[2]	±0·1	+ 5	3
Tiflis, Russia[1] ...	June, 1908 ...	+0·7	—	−1·6[2]	±0·1	+ 4	4
Zi-ka-wei, China...	May and Sept., 1907.	−1·0	±0·1	−1·1	±0·3	+ 6	3
Helwan, Egypt ...	April, 1908 ...	+0·5	±0·1	+0·2	±0·1	+ 3	6
Dehra Dun, India	Oct., 1909 ...	+0·4	±0·1	−0·1[2]	±0·3	—[3]	—
Christchurch, New Zealand.	July, 1906, Dec., 1907, Jan., 1908.	+1·3	±0·0	−1·4	±0·1	+ 8	5
Toronto, Canada...	Sept. and Oct., 1906.	+0·1	±0·1	+0·8	±0·1	− 6	7
Cheltenham, Maryland.	Feb., 1908, and April, 1910.	+0·3	±0·0	+0·1[2]	±0·1	− 9	3
Mean of all ...		+0·30		−0·49		+0·00018 H	

[1] Additional comparisons were made in June and July, 1909, but the final observatory data have not yet been received.

[2] At these observatories there are earth inductors in use whereas at the remainder there are dip circles.

[3] The result of the H comparison is at present omitted pending settlement of value of constants of observatory magnetometer.

The experience has also shown that if magnetic instruments are carefully made and tested they will yield results with sufficient accuracy for the proper correlation of magnetic survey work. In our opinion a magnetometer should preferably be an absolute one so as to admit of the determination of its constants independently of another instrument—this of course will not prevent its being used as a relative instrument if so desired. Only in exceptional cases is the use of a purely relative instrument justifiable.

Every institution, furthermore, engaged in magnetic work should have the scientific force and the facilities for determining and controlling its own instrumental constants. At some of the places where the observers of the Institution have made comparisons, differences were found considerably larger than those shown in the Table, due in general either to poor instruments or to defective instrumental constants.

It is with much pleasure that we may record and acknowledge here, in behalf of our observers, the very cordial and valuable assistance rendered them at the various observatories and by those in charge.

APPENDIX VI.

Magnetic Observations in the Sudan.

In the course of the Tilho Mission for settling the boundaries of the Franco-British frontier between the Niger and Lake Tchad, magnetic observations were made by Naval Lieutenant M. Audoin, a Member of the Mission. They are published in detail in Volume I. (pages 355-404) of Scientific Documents of the Tilho Mission (Paris, National Printing Office, 1910). We give here only a résumé.

These observations refer to the region between 11° and 17° Latitude North and 0° and 15° Longitude East of Paris. They were made by means of travelling instruments lent by the Bureau Central Météorologique, which were carefully compared at Val Joyeux before leaving and on their return. The comparisons showed that the instruments did not change during the journey. Observations of declination and intensity are quite trustworthy; those of inclination are more doubtful, the dip circle presenting quite peculiar difficulties of observation in a region so close to the Magnetic Equator.

The observations have been reduced to the epoch, January 1st, 1908, by deducing the mean annual values of the secular variation from comparisons with results obtained in 1895 by M. Schwerer at Cotonou, and in 1899-1900 by M. Foureau at Zinder and Adeber. As all the observations of M. Audoin were made between November 23rd, 1906, and November 22nd, 1908, this reduction introduces very little uncertainty.

The observations have not been corrected for diurnal variation although several series of hourly observations of declination were made from 6 h to 18 h. We, therefore, give below the declination and inclination only to the nearest minute and the horizontal component to four decimal places.

Observations of declination and of the horizontal component have been made at 38 different stations, at nine of which inclination has also been observed.

Magnetic observations will also be made shortly in other parts of French Africa.

Lieutenant Villatte is soon leaving on a topographical mission to the Ivory Coast. He has magnetic instruments at his disposal which have been used before by the Foureau Commission, and he is at present at Val Joyeux practising these special observations. The route he intends taking extends from the coast of the Gulf of Guinea to the upper course of the Niger.

M. Roussilhe, hydrographic engineer of the Navy, in charge of a hydrographic mission on the Gaboon, the Congo, and the Oubanghi, likewise intends determining magnetic elements all along his route. His observations will probably not begin until some time in 1911.

A. Angot.

Stations.	Latitude N.	Longitude E. of Paris.	Magnetic Elements on 1st January, 1908.		
			Western Declination.	Horizontal Component.	Inclination.
	° ′ ″	° ′ ″	° ′		° ′
Dahomey.					
Cotonou	6 21 30	0 06 13	14 23	0·3153	—
,, ...	6 21 30	0 05 59	14 26	—	—
Parakou	9 21 00	0 17 00	13 38	0·3228 0·3236	—
Kandi	11 07 30	0 33 36	13 08	0·3288	—
Karimama	12 04 05	0 48 30	12 48	0·3256	—
,, ...	12 04 05	0 48 30	12 49	0·3259	—
From the Niger to Zinder.					
Niamey	13 30 15	0 13 45	12 52	0·3278	11 07
Gaya	11 52 49	1 02 00	12 54	0·3259	—
Dioundiou	12 37 21	1 09 26	12 32	0·3252	—
Jélou...	12 15 35	1 12 00	12 38	0·3262	—
Bengou	11 59 45	1 12 15	12 39	0·3246	—
Tounouga	11 48 03	1 13 00	12 43	0·3258	—
Bébeye	12 53 19	1 32 00	12 21	0·3258	—
Tagouan	13 42 00	1 36 00	11 58	0·3263	12 29°
Birni n'Konni	13 47 08	2 55 26	11 38	0·3277	12 52
Arzarori	14 08 15	3 32 15	11 21	0·3277	—
Sabo n'Birni	13 34 18	3 58 16	10 55	0·3237	—
Tibiri	13 34 12	4 40 27	10 59	0·3278	10 18
Aguié	13 30 45	5 25 35	10 42	0·3285	—
Zinder	13 48 00	6 37 45	10 27	0·3314	10 02
From Zinder to Lake Tchad.					
Dungass	13 03 57	6 58 12	10 28	0·3307	—
Komi...	13 21 12	7 45 59	10 01	0·3302	—
Gouré	13 59 13	7 54 47	9 55	0·3290	9 55
Zoumba	13 25 30	8 52 52	9 39	0·3307	—
Adebour	13 18 29	9 29 43	9 35	0·3317	—
Kabi	13 17 23	10 04 25	9 24	0·3297	—
Lake Tchad and the Country East of Lake Tchad.					
N'Guigmi	14 15 31	10 44 22	9 01	0·3322	9 50
Bosso	13 41 49	10 56 10	8 59	0·3300	—
Kouloa	14 14 35	11 31 00	8 49	0·3314	9 35
Bol	13 27 24	12 17 21	8 40	0·3328	—
Fort-Lamy	12 06 36	12 42 00	8 46	0·3337	—
Mao	14 07 39	12 56 24	8 19	0·3329	8 45
Hangara	16 08 13	13 04 23	8 06	0·3318	—
Zigueï	14 43 07	13 22 44	8 06	0·3320	—
Hacha	15 41 00	14 01 17	7 51	0·3347	—
Am Raya	14 08 05	14 06 26	8 03	0·3355	—
Aourak	14 52 45	14 09 36	7 57	0·3319	—
Torodoum	16 30 28	14 10 43	7 46	0·3329	—
Korou (Koro Kidinga) ...	16 58 25	14 31 47	7 42	0·3346	—
Gouradi	16 23 49	14 45 19	7 41	0·3339	—

* Observation made at Dogondoutchi, near Tagouan.

APPENDIX VII.

On some Magnetic Observations in Eastern Equatorial Africa.

I have pleasure in informing my colleagues of the Magnetic Commission, that during the last two years 1908 and 1909, I also carried out some surveys of terrestrial magnetism on the occasion of two journeys which I undertook in East Africa.

Magnetic observations were not exactly the object of my journeys; I went to Africa for the purpose of investigating the upper atmosphere over the Indian Ocean; nevertheless I have always made a practice, on similar journeys, of carrying with me, as part of my luggage, my magnetic instruments, so as not to miss any occasion for taking observations whenever a favourable opportunity offers itself. As the Italian Central Meteorological Bureau takes part regularly in the work of the investigation of the upper atmosphere, according to the programme drawn up by the International Commission for Scientific Aeronautics, so Italy wished to make a contribution to the great series of balloon and kite ascents arranged for the last week of July, 1908, by means of a naval expedition to Zanzibar for the purpose of investigating atmospheric phenomena in connexion with the summer monsoon, which prevails over the Indian Ocean at that period of the year.

The Italian Warship "Caprera" was at Zanzibar; and, having completed my preparations for the expedition, I travelled by German steam-packet to Zanzibar to organise balloon ascents on board the Ship "Caprera," which had been placed at my disposal for these investigations by the Naval Minister.

Having accomplished my ærological work and left Zanzibar, I stayed for several days at Mombasa, in British Africa, and there I made a first magnetic station. The idea of making these surveys at Mombasa had already been decided on when I prepared to leave Europe. In fact, I had undertaken the work of reducing the magnetic measurements made by Commander Cagni when he accompanied H.R.H. the Duke of Abruzzi on his splendid voyage to Ruwenzori, during the summer of 1906; observations had been made at seven stations on the route followed by the Duke. But Cagni's observations, not being taken with suitable instruments, rendered the circumstances, under which the magnetometer had been used, doubtful; and to clear up these doubts the most sure way was to repeat the same measurements with the instruments of the Duke of Abruzzi's expedition together with other control instruments at at least one of the stations where observations had been made by Commander Cagni; and Mombasa was just such a station. For the purpose of obtaining a better and further check besides the station at Mombasa, I thought it expedient to repeat the measurements at the station of Entebbe on the banks of the great Lake Victoria, for Entebbe was also one of Cagni's stations; moreover, the journey from Mombasa to Entebbe is comfortable and very easy, thanks to the splendid Uganda Railway, which in two days takes one from the coast washed by the Indian Ocean to the very heart of the dark continent. Comfortable steamers carry the traveller from the East

shore of the Lake to the opposite side, where, on a hill, there rises Entebbe, the principal, semi-European, town of the Kingdom of Uganda. I stayed a whole week at Entebbe, and thus I had sufficient time to make all the measurements of comparison and checking that I desired for the reduction of Cagni's magnetic determinations.

I obtained the following results:—

—	Latitude.	Longitude E. of Greenwich.	Declination.	Inclination.	Horizontal Intensity.
	° ′ ″	° ′ ″	° ′	° ′	
Mombasa ...	4 3 18 S.	39 41 18	5 48·8 W.	31 50·8 S.	0·30112
Entebbe ...	0 3 52 N.	32 28 12	6 58·2 W.	22 57·4 S.	0·31475

In the following year, 1909, on the occasion of the great International Aerological week in December, I undertook another naval aerological expedition to the Indian Ocean, on the Royal Ship "Volturno" along the coast of Italian Somaliland. I even penetrated inland for a short distance, in the region of the Goscia, by going up the River Juba in a steam launch as far as was possible, that is to say, to the native village of Margherita, not being able to proceed further on account of the shallowness of the river. Also on this second journey to Equatorial Africa I made several magnetic stations:—Margherita, just below the Equator, Jumbo, near the mouth of the Juba, Brava, and Mereg on the coast called Benadir and finally in the sultanate of Obbia, beyond the Northern boundary of the Benadir. Already during the two preceding years, 1907 and 1908, the Royal Italian Warship "Staffetta" had made magnetic surveys along the East Coast of Africa; my measurements served to complete the above, for having myself made observations at places on the coast, where I had had occasion to stop during my journey, I had the good fortune to make observations just at those ports where the "Staffetta" had not yet had an opportunity of surveying.

A detailed report of my observations will be given in the Annals of the Meteorological Bureau of Rome, and a résumé of them will also be published in the Journal of Terrestrial Magnetism.

We may now say that the magnetic chart of the globe has been enriched by the survey of the entire Benadir coast as far as the Equator by the Italian Ship "Staffetta" and myself.

L. Palazzo.

APPENDIX VIII.

Magnetic Survey of Finland.

There is little to say about magnetic measurements in Finland. The old observations are practically worthless, and we have very few of recent date.

The first magnetic observations in Finland date as far back as 1780. At that time the University at Åbo was occupied with

declination phenomena. The meteorological observations of this time give also declination data taken two or three times a day. It is difficult, however, to judge of the accuracy of these measurements. Probably the shipwrecks which occur so frequently in our Archipelago gave rise to these measurements.

At the beginning of the last century many strangers travelled through Finland to make magnetic measurements. The results of these measurements by Hansteen, Lenz, and Kämtz are given in the works of Sabine (Phil. Trans., 1862) and of Tillo (*Repertorium für Meteorologie*), Vol. VIII. and IX.).

The native professors of physics, Hällström and Nervander, were both interested in magnetic research, but they did little for the magnetic survey of the country. Nervander, however, founded the magnetic observatory at Helsingfors in 1840 and fitted it up with the best instruments of his day. His premature death is the reason perhaps that absolute magnetic measurements were not carried out at that time. Isolated magnetic observations were taken later, in 1865 by General Järnefelt, and in 1871-2 by Professor Lemström, but their travels were undertaken for totally different purposes, and they never published the results of their measurements.

The magnetic observations taken by the Polar Expedition in the years 1882-4 at Sodankylä, Kultala, and at a few other places are to be found in the 2nd volume of the report of that expedition. Director Biese has also taken a few absolute magnetic measurements in Helsingfors since 1886, which are published in the "Oefversigt" of the Finnish Scientific Society, vols. XXIX., XXX., and XXXI. In 1893 M. Geitlin visited twenty-two districts in Finland in order to take magnetic observations. The results of this journey, which was made at the instigation of the Helsingfors Geographical Society, have never been made known on account of M. Geitlin's illness, and now it seems to be impossible to discover the original observations. In 1901 the Geographical Society of Finland again intended to make a magnetic survey of the country. People were then busy with the organisation of an expedition for pendulum observations, and for this purpose it was necessary to construct solid pillars and to take time and azimuth observations at every point.

It was easy, therefore, to carry out simultaneously the survey of magnetic elements. So it was arranged that M. Alenius should take magnetic measurements at every point of observation. He was supplied with an old theodolite of the Wild-Edelmann pattern, a dip-circle by Dover, etc.

The observations taken by Alenius are to be found in the publication Fennia, vol. 24, No. 2. Alenius has visited the ten following places:—Helsingfors, Kilpimäki (trigonometrical point, which was made use of for the measurement of degrees 1816-1855), Murtomäki (also a trigonometrical point), Tornea, Uleaborg, Wasa, Tammerfors, Viborg, Sortavala and Åbo.

In 1908, M. P. Stelling of Tiflis repeated the observations taken by Alenius. The results of these researches are not yet published.

In 1908 the Imperial Academy of Sciences at St. Petersburg appointed a Magnetic Commission which was to prepare a mag-

netic survey of Russia. When I was invited to join this Commission I suggested setting up a magnetic observatory in Lapland. In fact the Finnish Scientific Academy has already received a sum of money for the purpose of erecting an astronomical and magnetic observatory in Lapland. But this sum is far too little for both purposes; I have, therefore, proposed to set up first a magnetic, and later, if there are sufficient funds, an astronomical observatory. The fitting up of even the magnetic observatory presents difficulties. It is true we have already had given us a large plot of land for the purpose, and even the wood necessary for the building is promised us, but the cost of building in Lapland is much greater than we thought, therefore our means do not yet suffice. I am, however, empowered to order the recording apparatus for this observatory. First, however, we should like to investigate the magnetic anomalies of this district. They certainly cannot be very marked, as nothing was noticed in the years 1882-4. The question of the magnetic land survey rests on a much better footing with us. We have this summer obtained the necessary funds for the purpose, and the work is already partly carried out.

M. A. Hintikka has visited the following fourteen points this summer:—Viborg, Sortavala, Kilpimäki, Murtomäki, Uleåborg, Ii, Kuivaniemi, Kemi, Torneå, Brahestad, Oulainen, Wasa, Tammerfors, and Åbo. He had with him a newer Wild theodolite which is described in the Festschrift der Naturforschenden Gesellschaft in Zürich 1896. At first he tried to use a dip-circle as well as an earth inductor, but it proved that he managed much better with the earth inductor alone.

Through the kindness of M. Rykatcheff and of M. Dubinsky, director of the observatory at Pavlovsk, all our field instruments were tested and compared at Pavlovsk.

The observations made by M. Hintikka represent only a preliminary control of the older survey. The results of his observations have not yet been calculated. His journey lasted from August 13 until September 17.

Next summer we shall start on a systematic land survey. The work will be conducted on the plan proposed by the Magnetic Commission of the Imperial Academy of Sciences at St. Petersburg. Certain principal points will be visited as often as possible, but the other stations as a rule only once, unless they happen to lie on the route taken by the observer on his return journey. The distance between the stations is to be about 20 km., or one station to every 400 sq. km. The principal stations will be about 100 km. distant from one another, or one principal station to every 10,000 sq. km.

As the area of Finland is about 370,000 sq. km. we should really like to have 925 observation points. But in Lapland it will be impossible to visit so many stations, and I have, therefore, calculated that we shall need only about 800 ordinary stations. As principal stations we should prefer to use places where topographic and magnetic measurements have already been made. We must have 38 principal points, but I have not been successful in finding everywhere places where astronomical determinations

of position have been made. Topographical surveys have already been made at 34 of the proposed stations, but at only 16 have magnetic observations been formerly taken. The work will probably take about ten years.

We should like to reduce our observations with the aid of the Pavlovsk records. When the observatory in Lapland is ready, its records must, of course, be handled with special regard to the reduction of observations taken in the most northerly regions.

G. Melander.

APPENDIX IX.

Scheme for the Magnetic Survey of the Russian Empire and the Survey of the St. Petersburg District.

The Commission for the magnetic survey of the Russian Empire, appointed by the Imperial Academy of Science of St. Petersburg in co-operation with representatives of higher schools, institutions, and scientific societies, elaborated the following scheme for the survey:—

The magnetic survey of Russia in Europe should give the true and detailed distribution of magnetic elements at the earth's surface, the material should be capable of use in the solution of contemporary problems both practical and theoretical. In Siberia, Central Asia, and the northern and south-eastern provinces of Russia in Europe, where the population is scattered, and where the network of communication lines is not at all dense we propose to limit ourselves to making magnetic observations along some of the principal routes, as far as possible, with a distance of 100 versts (107 kilometres) between each station. To reduce, as far as possible, the special grant which will have to be requested for the survey, institutes and departments, willing to take part in the enterprise, will co-operate in the work, and existing resources such as apparatus, observatories, and observers, will be turned to account.

The Detailed Survey of Russia in Europe.

To solve questions such as the relations between magnetic distribution and the geological structure of the terrestrial crust or vertical electric currents, the network should be as dense as possible; these conditions exist especially within the radii of anomalies, and our aim will be to have a network of stations sufficiently dense not to allow perceptible anomalies to pass unnoticed; the same condition is necessary for practical requirements, for example concerning the magnetic declination which should be known when using a compass for geodetical or land-surveying work. Now, detailed surveys abroad and in several parts of Russia prove that quite considerable anomalies occasionally extend for very short distances. Taking into consideration these reasons on one hand and the necessity to carry out the scheme in a short period of time, for instance, in not more than 10 or 15 years at the most, with moderate funds, the Commission

has decided to have a station for every 400 square versts. Thus the distance between the stations will be about 20 versts. That will give 7,000 stations for Russia in Europe.

It is not necessary to require the greatest possible precision at the points of observations. It is more important to be able to start a large number of stations as mentioned; errors in the observations will always be smaller than possible variations of magnetic elements between two neighbouring stations. It is important that the equipment be portable and easy to instal, and that the correction of the constants be invariable. It is absolutely necessary that the results be trustworthy; the time of observations must be economized by making only one complete series of observations. But this series should include control checking so that there may be no great error in the result.

For instance, if an astronomical theodolite is not taken, one must have a vertical circle to the magnetic theodolite to determine the time as well as the azimuth; in that case the rate of the chronometer, taking into consideration the difference of longitudes, acts as a check.

For the same reason in determining the declination it is necessary that the needle be turned each time round its axis, and that observations be made in each position. The inclination can be determined from the observations of a single needle, but a complete series of observations should be made each time before and after the change of magnetism; in any case the observer should have a second needle and make observations with two needles as often as this is possible without hindering the progress of the work according to the programme to be followed; observations with two needles provide a good check.

Horizontal intensity should be determined from observations of angles of deflection and observations of oscillations before and after observations of the angles of deflection. The degree of accuracy required for each result is $\pm$ 2′ for inclination and declination, and $\pm$ 10 γ for horizontal intensity.

Any type of instruments may be used provided that they satisfy the conditions mentioned. It will be necessary to make the majority of the observations in summer, on very bad roads, in a carriage without springs. Before and after each expedition the field instruments should be compared with the instruments at the nearest observatory. Moreover, during the period of survey it is desirable to verify the field instruments with those at an observatory in the North and another in the South of Europe.

Besides magnetic work in the field, we have in contemplation from 70 to 100 stations, where more numerous observations will be made and with greater accuracy at the beginning and end of the survey to determine secular variation. At a few of these stations a series of observations will again be made at about the middle of the survey work.

To reduce observations to the given epoch a magnetic observatory ought to be established at least at Archangel; it is possible that the Hydrographic Department will supply this want; another observatory North of Finland will probably be erected by the Society of Sciences of Finland; finally, it is hoped that in the

South-West of Russia in Europe we shall have portable variation instruments which can be installed within the radius where survey work is being carried out.

Siberia and Central Asia.

The work in Siberia and Central Asia will be carried out on the principal routes and along rivers under the direction of the observatories at Ekaterinburg, Irkutsk and Tashkent; they should have at their disposal sets of variation instruments together with the necessary staff.

Finland.

As I mentioned in my report on opening the meeting of the Magnetic Commission, Finland has left us behind. She has already got the necessary funds, and has begun work. M. Melander will give you some details regarding the matter.

Magnetic Survey of the St. Petersburg District.

This summer, as I mentioned this morning, the observers of the Constantine Observatory made a magnetic survey of the St. Petersburg district. They used Moureaux's pattern of instruments, a chronometer, and a tent, which is sometimes replaced by a large umbrella; they naturally followed the plan of observations according to the principles mentioned above. To have stations at a distance of 20 versts (21½ kilometres) one from the other, we could not be content with the network of railways; to make observations we were obliged to buy a horse and a " tarantasse " (a light and simple cart, without springs, resembling a waggon). An attendant at the observatory accompanied us as driver; he helped to set up the tent, &c. In view of the extremely bad roads and the necessity of observing for about three hours at each station, it was mostly impossible to work more than one station a day; in cases where the sky was overcast it was necessary sometimes to wait at the station for more than a day. In the end 62 stations were done by carriage during a journey lasting 71 days. This network was completed by several stations which were accessible by railway; the total number of stations where observations were made in the St. Petersburg district is 80.

The work of the Hydrographic Department and Universities.

Other institutions, and especially the Hydrographic Department, and several universities also made observations in 1910 which would form part of the survey of the Empire. Up to the present I have received particulars of observations made on the shores of the Polar Sea, Baltic Sea, and Black Sea, and a certain number of stations by the Universities of Odessa, Tomsk and Warsaw.

Superintendence of the work of the Magnetic Survey.

The work of the magnetic survey of Russia, the reduction and publication of results, will be carried out under the direction of

the Magnetic Commission, which consists of members nominated by the Imperial Academy of Sciences and of representatives of institutions and societies taking part in the work. The Commission has elected an Executive Bureau which will manage affairs.

The scheme of the Commission has been presented to the Academy, and everything is in readiness to start work as soon as the necessary funds are assigned.

M. Rykatcheff.

APPENDIX X.

Suggestions for the Establishment of greater Uniformity with regard to the Publications of Magnetic Observatories.

A.

The investigation of terrestrial magnetic occurrences is interfered with principally by the comparatively small number of magnetic observatories and their unfavourable distribution. It is still more regrettable that full use cannot be made even of the data collected by them, because these are generally published as very scanty extracts, and, moreover, the varying form of publication renders their use exceedingly laborious.

A certain unity in the contents and form of the publications would thus be of great advantage, as proved by the kindred Department of Meteorology. Moreover, with terrestrial magnetism no great essential difficulties arise, at least theoretically, to prevent such an agreement, because there can hardly be any serious differences of opinion as regards the minimum amount to be published by each station. Apart from observations (such as observations of earth current) which have hitherto been put in the programme of work only incidentally or at a few points, the question to be solved is clearly defined and comparatively simple—the determination of the time changes of the earth's magnetic field. When these changes are large and apparently irregular oscillations—namely, at times of so-called disturbances—they can only be reproduced graphically; for the rest it is sufficient to characterise the changes by a number of values relating to times separated by equal intervals. The current custom of choosing intervals of an hour seems suitable in every respect.

So far as these are concerned the work to be published by an observatory can now be definitely determined. First and foremost, it should contain the essential direct results of observations; and, secondly, those further data derived from them which are universally employed under the scientific conditions of the present day. Strictly speaking, the first would be sufficient, as it gives everyone an opportunity of deducing these further data for themselves as occasion arises. It would, however, naturally be uneconomical to proceed in this manner, especially with regard to work taking up much time which would thus have to be

done over and over again instead of being disposed of once for all. Results thus derived accompany all statements of a statistical character, especially certain mean values, which not only facilitate the general survey, but offer besides the most suitable basis for many investigations. This applies also with regard to terrestrial magnetic phenomena. According to the above explanation there are two kinds of mean values of special importance which must therefore be contained in the publications—the daily means as well as the monthly and annual means of absolute values derived therefrom, and, on the other hand, the monthly means of the diurnal variation. Indeed, one might even venture to say that these mean values are sufficient for most purposes. The course of the hourly values for each single day has hitherto been so little used, and the more extended manipulation of them (possibly for the purpose of deducing lunar influence) already offers such comprehensive work, even for a single station, that for the present it is quite sufficient for a few of the principal observatories to publish hourly values for each day. Of course, all isolated stations which supply the sole data for a large portion of the earth's surface should be included amongst these.

There results, in consequence, the conclusion that all Observatories should publish the above mentioned mean values and reproductions of curves for disturbed days, the principal Observatories to give also the hourly values for each day.

Nothing further need be said here with regard to the reproduction of curves, as this question has already been treated separately by the Commission and disposed of by a resolution (p. 94).

Also as regards hourly values a discussion must, for the present, be withheld, although two important matters come into question—namely, the time to be used (Greenwich or local time), and whether instantaneous values at the hour or hourly mean values should be determined. These questions were, however, referred to the Meteorological Committee at the Innsbruck Conference, and, therefore, unfortunately withdrawn until further notice from consideration by the Magnetic Commission.

In this connexion the following question can thus also be put on one side, namely, as to whether in hourly values it would not be better for the astronomically determined components X, Y, Z, to take the place of the practically universally adopted elements D, H, Z. On the other hand I shall always be of opinion that hourly values should be published according to their absolute amounts and not as deviations from daily means or any other standard values; this method indeed preponderates. The absolute values represent direct observations *equally* available for *every* purpose, the deviations are actually results of a certain calculation which serves some particular purpose or fits in with some theoretical point of view. They may be convenient for that particular purpose but are necessarily unsuitable for other problems and theoretically have the drawback of favouring one point of view to the exclusion of others perhaps equally legitimate.

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It must be admitted that all these questions also come into consideration with regard to the mean values; but here they are mostly of less importance, partly free from doubt. And so far as a doubt is possible the comparatively small range of the material to be communicated allows of the various aspects receiving simultaneous consideration. In particular one will have to give the monthly means of the diurnal range for *all* elements including the components. It seems comparatively unimportant whether instantaneous values or hourly means are published, for in the smoothed curve, as shown by the monthly average, both are equally suitable for the representation of time change. Similarly the employment of simultaneous time (at present of course only Greenwich time can come into consideration) or local time are equally permissible, because the smoothed curve allows an adequately reliable interpolation and thereby a simple transition from one form of representation to another. The best thing would be to give both; should this not occur, then, according to a resolution of the Paris Conference in 1896 (Meteorological Codex p. 58), data according to local time would be preferable. Indeed this has a real significance so long as the variation is only regarded as a function of geographical latitude and local time, thus ignoring its difference at sundry points of the same parallel of latitude. At the same time, logically, true instead of mean time should be employed.

The formation of the monthly average for each single hour is an operation which concerns exclusively the mean daily variation. This, however, would be most clearly expressed by the deviation of single hourly values from their average, the mean of the daily means. In contrast with what was previously decided in connexion with the hourly values of single days, the values of these deviations are to be desired in this connexion. The publication of absolute values would be less suitable; the same holds good for the representation by deviation from the annual mean to be found in some publications. Moreover, this requirement also corresponds to a resolution of the above-mentioned Conference (Meteorological Codex p. 59) which only consented to restriction to the months of January and July under certain circumstances.

The representation of the diurnal variation for each month by means of trigonometrical series may be noted as being desirable; nevertheless, in fixing a minimum this must be put aside. In any case the limitation to the components X, Y, Z, is sufficient because the series comes into consideration exclusively for theoretical purposes.

The deduction and publication of the mean diurnal range on quiet days in addition to that on all days hitherto spoken of, seems to me also desirable, but nevertheless exceeds the minimum to be unconditionally exacted. The days most suitable for selection as quiet days are the five calmest and most equable days of each month, which are noted as such in the publication of the International character numbers. Moreover, the limits of these days should be chosen according to Greenwich time, as in a publication, the mean variation derived from special selected days has of course a clearly defined meaning only when it refers to really

simultaneous values for all observatories. Apart from copies of the most important storm curves, the following data would thus be the minimum of what each observatory should publish regularly: —

1. Mean values for each day of elements observed (together with the monthly and daily means of all elements dependent thereon).

2. The mean diurnal variation of all elements, or at least of the components for each month in deviations from the monthly mean according to local time.

These requirements only slightly exceed those already adopted in 1891 at the Conference in Munich (Meteorological Codex p. 58). Nevertheless, it is advisable first of all to aim at their accomplishment before extending them. If these requirements were carried out by all observatories considerable progress would already be achieved, and, on the other hand, they can be attained with so little work, if an evaluation of the registered curves is generally practised, that this cannot prove a serious impediment. An observatory, however, hardly deserves the name if it does not measure its curves at least according to scale values (which is sufficient in this case, as the further reduction to mean values can follow).

In the foregoing the results of observations of variation have been discussed exclusively, nevertheless, on the understanding, long acknowledged as obvious, that these will be reduced to absolute values according to standard base values. As a matter of fact the absolute measurements as well as the determinations of scale values and temperature co-efficients are only subsidiary observations which serve the purpose of determining the reduction constants of the variometer. If a few stations still publish only mean values obtained from absolute measurements as annual means (which occurs principally in the case of inclination) this no longer answers the purpose in the present state of investigation. It appears from what has been said that there is no necessity for a uniform regulation for absolute measurements. In fact, in view of the variety of instrumental equipments and working facilities at various observatories, it could not but work badly. On the contrary, one can only lay stress on the request that each institute should carry out these measurements and the other secondary observations in such a manner and with such frequency that their results should render a reliable determination of reduction constants of the variometer possible. It is desirable, however, and as far as the principal observatories are concerned absolutely essential, that these measurements and the reduction of observations of variation should be published so exhaustively that every scientist can thereby judge of the trustworthiness of the final results.

AD. SCHMIDT.

APPENDIX X.

B.

Terrestrial magnetism has three branches:

(1.) The instrumental equipment and observations.
(2.) The distribution and secular variations of H, D, V.
(3.) The hourly (dH, dD, dV) and daily slow variations (ΔH, ΔD, ΔV).

In order to study the variations generally and effectively, it is recommended that the following scheme be followed in the publications :—

Let H (observed hourly) = H_0 (daily mean) + dH (hourly variations).
D = D_0 + dD
V = V_0 + dV

Month.	Hourly variations dH.						Daily mean H_0.	Distributed secular mean H_s.	Daily amplitude $\Delta H = H_0 - H_s$.
	Mid	1	2	3	. . . . .	11 p.m.			
Day 1	dH	dH	dH		. . . . .				
2	dH	dH	dH						
3					. . . . .				
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Monthly means.	(dH)	(dH)	(dH)				Secular mean (H).		
Eliminated mean.	(ΔH)	Storms eliminated							

$$(H)_2 - (H)_1{}^1 = \Delta(H) \qquad \text{Daily change} = \frac{\Delta(H)}{30}$$

$$\text{Distributed secular means} = (H)_1 + \frac{\Delta(H)}{30}.n \quad \text{15th to 30th}$$

$$\text{and} \qquad (H)_2 - \frac{\Delta(H)}{30}.n \quad \text{1st to 15th}$$

n = number of days from 15th of month.

[1] $(H)_1$ and $(H)_2$ denote the means for two consecutive months.

Further Tables should include—

ΔH	ΔD	ΔV	To Magnetic meridians
ΔX	ΔY	ΔZ	To Geographical meridians
σ vector length	a vertical angle	β azimuth angle	Polar co-ordinates of the disturbing vectors.

All these magnetic variations appear to depend upon the effects of ionization currents of electricity, and these upon the solar radiation prevailing.

(1.) The hourly variations represent a disturbance field closely associated with meteorological convection currents, and hence originate in the lower strata of the atmosphere.

(2.) The daily amplitudes represent a different field, distributed nearly along magnetic meridians, including the entire earth, and they are apparently connected with the very high level ionization from radiation transformations.

It is recommended that further efforts be made to perfect the instruments for measuring the ionization effects, (*a*) for the electric potential, (*b*) the electric conductivity, (*c*) and the count for the number of ions per c.c.

The functions connecting radiation energy, ionization energy, magnetic energy, and heat energy in the earth's atmosphere are not yet understood.

It is recommended that in co-ordination with magnetic and electric observations the available measures of the radiation should be made: (1) with standard pyrheliometers; (2) with standard bolometers, for integral and for spectrum measures of absorption and emission in homogeneous series, in order that these functions may be studied alongside of the local ionizations and magnetic variations.

It is also recommended that standard polarimeter observations be always made in connection with the radiation observations.

Since the solar radiation suffers many depletions in the earth's atmosphere, which are difficult to measure on account of the mixing effects of the circulation upon the aqueous vapour and dust contents, it is desirable to continue regular observations of the visible solar variations, and especially to supplement the usual sunspot and prominence observations with spectroheliograms and homogeneous relative numbers of the solar faculae over the entire disk of the sun.

On account of the expense of constructing and operating suitable solar physics-meteorological observatories, it is advisable to concentrate attention upon three pairs of observatories in each hemisphere. Each complete observatory should have a high level and a low level station for radiation and ionization observations. The six observatories should be distributed as follows :—

(1) United States (Mt. Wilson—Pasadena. / Mt. Whitney—Lone Pike.)
(2) Europe (Alpine Mountain—Tortosa.)
(3) Asia (Himalaya—India.)
(4) South America (Pilar—Tujuy).
(5) South Africa (Johannesburg—Wellington.)
(6) Australia (— —)

FRANK H. BIGELOW.

INTERNATIONAL METEOROLOGICAL COMMITTEE WITH ITS COMMISSIONS.

(November, 1910.)

International Meteorological Committee.*

(*See p. 2 for list of meetings of the Committee.*)

W. N. Shaw, 1900, Director of the Meteorological Office, London, *President.*

G. Hellmann, 1903, Geheimer Regierungsrat, Professor, Director of the Prussian Meteorological Service, *Secretary.*

H. Mohn, 1873, Professor, Director of the Norwegian Meteorological Service.

W. G. Davis, 1894, Director of the Meteorological Service of the Argentine Republic.

Willis L. Moore, 1896, Chief of the Weather Bureau, United States of North America.

M. Rykatcheff, 1896, Lieutenant-General, Director of the Russian Meteorological Service.

Luigi Palazzo, 1900, Professor, Director of the Italian Meteorological Service.

Francisco S. Chaves, 1901, Commandant, Director of the Meteorological Service of the Azores.

K. Nakamura, 1905, Director of the Meteorological Service in Japan.

A. Angot, 1907, Professor, Director of the French Meteorological Service.

H. E. Hamberg, 1907, Director of the Swedish Meteorological Service.

J. Maurer, 1907, Director of the Swiss Meteorological Service.

R. F. Stupart, 1907, Director of the Meteorological Service of Canada.

E. van Everdingen, 1910, Professor, Director of the Dutch Meteorological Institute.

C. H. Ryder, 1910, Captain, Director of the Danish Meteorological Institute.

W. Trabert, 1910, Professor, Director of the Austrian Central Institute for Meteorology and Geodyamics.

G. T. Walker, 1910, Director-General of Indian Observatories.

International Commission on Terrestrial Magnetism and Atmospheric Electricity.†

Appointed at Munich, 1891. Has met at Munich, 1891; Paris, 1896; Bristol, 1898; Paris, 1900; Innsbruck, 1905; Berlin, 1910.

Lieutenant-General M. Rykatcheff, St. Petersburg, *President.*

Prof. Ad. Schmidt, Prussian Meteorological Institute, Potsdam, Germany, *Secretary.*

Prof. A. Angot, Central Meteorological Bureau, Paris.

Prof. L. A. Bauer, Carnegie Institution, Washington, U.S.A.

* The International Meteorological Committee consists of only 17 Members, while there is no limit to the number of Members belonging to the Commissions.

† *See* p. 16.

Prof. F. H. Bigelow, Meteorological Office, Buenos Aires.

Dr. V. Carlheim-Gyllensköld, Stockholm, Sweden.

Dr. Ch. Chree, Kew Observatory, London.

W. Dubinsky, The Observatory, Pavlovsk, Russia.

Dr. E. van Everdingen, Meteorological Institute, De Bilt.

R. L. Faris, Coast and Geodetic Survey, Washington, U.S.A.

Captain W. Kesslitz, Hydrographic Office, Pola, Austria.

Prof. J. Liznar, Hochschule für Bodenkultur, Vienna.

Prof. T. C. Mendenhall, Worcester, Mass., U.S.A.

Prof. J. Messerschmitt, Magnetic Observatory, Munich, Germany.

Prof. L. Palazzo, Central Meteorological Office, Rome.

Sir A. W. Rücker, Newbury, Berkshire, England.

Dr. A. Schuster, Manchester, England.

R. F. Stupart, Meteorological Office, Toronto, Canada.

Dr. A. Tanakadate, The University, Tokio, Japan.

International Commission for Scientific Aeronautics.

Appointed at Paris, 1896. Has met at Paris, 1900; Berlin, 1902; St. Petersburg, 1904; Milan, 1906; Monaco, 1909.

H.I.H. The Grand Duke Konstantin Konstantinowitch, St. Petersburg, *Honorary Member.*

H.I.H. The Grand Duke Nicolaewitch, St. Petersburg, *Honorary Member.*

H.R.H. The Prince of Monaco, *Honorary Member.*

H.R.H. Prince Roland Bonaparte, Paris.

Prof. H. Hergesell, Director of the Meteorological Service of Alsace-Lorraine, *President.*

Dr. H. Abels, Magnetic Meteorological Observatory Katharinenburg, Russia.

P. Y. Alexander, London.

Prof. A. Angot, Paris.

Prof. R. Assmann, Aeronautical Observatory, Lindenberg, Germany.

Major Baden-Powell, London.

Prof. K. Bamler, Rellinghausen bei Essen, Germany.

Baron von Bassus, Munich.

Prof. A. Berson, Zehlendorf, near Berlin.

G. Besancon, Paris.

Prof. V. Bjerknes, Christiania University, Norway.

Commandant Borgatti, Rome.

Chef de Bataillon Bouttieaux, Paris.

L P. Cailletet, Paris.

Colonel J. E. Capper, South Farnborough, England.

C. J. P. Cave, Petersfield, England.

Le Clément de St. Marcq, Military Aeronautical Service, Antwerp.

W. H. Dines, Meteorological Office, London.

Dr. H. Ebert, Technical High School, Munich.

W. de Fonvielle, Paris.

Dr. P. Gamba, Geodynamic and Aeronautical Observatory, Pavia.

Captain Antonio Gordejuela, Military Balloon Station, Guadalajara, Spain.

Major Gross, Military Aeronautical Department, Berlin.
G. Hermite, Paris.
Prof. H. H. Hildebrandsson, Upsala.
Captain Hildebrandt, Berlin.
Captain Hinterstoisser, Military Aeronautical Department, Vienna.
H. Hlassek, Physical Observatory, Tiflis, Russia.
J. Jaubert, Montsouris Observatory, Paris.
Dr. E. Kleinschmidt, Friedrichshafen, Germany.
Hofrat Th. von Konkoly, Meteorological Office, Buda-Pesth.
Prof. W. Köppen, Deutsche Seewarte, Hamburg.
General Kowanko, Military Aeronautical Department, St. Petersburg.
W. W. Kusnetzov, The Observatory, Pavlovsk, Russia.
Dr. J. Maurer, Zürich.
Commandant Moris, Rome.
Count J. Morkov, Meteorological Observatory, Nemertchy, Russia.
Major-General Neureuther, Munich.
Dr. Emilio Oddone, Central Meteorological Office, Rome.
Prof. L. Palazzo, Rome.
Dr. P. Polis, Meteorological Observatory, Aix-la-Chapelle.
Dr. A. de Quervain, Central Meteorological Office, Zürich.
Paul Renard, Paris.
D. Rjabouchinsky, Koutchino Observatory, Moscow.
Major Francisco de P. Rojas, Guadalajara, Spain.
Prof. A. L. Rotch, Blue Hill Observatory, Hyde Park, Mass.
Captain C. H. Ryder, Meteorological Institute, Copenhagen.
Lieutenant-General Rykatcheff, St. Petersburg.
Captain Scheimpflug, Vienna.
Colonel Semkovsky, R. Technical Society, St. Petersburg.
Dr. W. N. Shaw, Meteorological Office, London.
Prof. R. Süring, Potsdam Meteorological Observatory.
L. Teisserenc de Bort, The Observatory, Trappes, France.
Prof. W. Trabert, Meteorological Institute, Vienna.
Lieutenant-Colonel F. Trollope, London.
Comte de la Vaulx, Paris.
J. Vincent, Meteorological Service, Uccle.
Colonel Pedro Vives y Vich, Ceuta, Africa.
A. V. Wosnessensky, Magnetic Meteorological Observatory, Irkutsk.
Dr. N. J. Zukovsky, The University, Moscow.

International Commission on Radiation.

Appointed at Paris, 1896. Has not met. Reconstituted at Berlin, 1910 (*see* p. 22).

Dr. J. Maurer, Zürich, *President.*
Dr. F. Åkerblom, Meteorological Observatory, Upsala.
Prof. Frank H. Bigelow, Meteorological Office, Buenos Aires.
Prof. C. Chistoni, The University, Naples.
Prof. O. D. Chwolson, The University, St. Petersburg.
Dr. L. Gorczynski, Meteorological Bureau, Warsaw.
Prof. G. E. Hale, Carnegie Institution, Pasadena, U.S.A.

A. R. Hinks, The Observatory, Cambridge, England.
R. T. A. Innes, Transvaal Meteorological Department, Johannesburg.
Prof. H. H. Kimball, Mount Weather Observatory, Va., U.S.A.
E. Marchand, Observatoire du Pic du Midi, Bagnères-de-Bigorre, France.
Dr. W. Schmidt, Vienna.
Prof. J. Violle, Paris.
George W. Walker, Eskdale Observatory, Langholm, Dumfriesshire, Scotland.

International Solar Commission.

Appointed at Southport, 1903. Has met at Cambridge, 1904; Innsbruck, 1905; London, 1909.

Sir J. Norman Lockyer, K.C.B., F.R.S., Solar Physics Observatory, London, *President.*
Dr. W. J. S. Lockyer, Solar Physics Observatory, London, *Secretary.*
Prof. A. Angot, Paris.
Prof. F. H. Bigelow, Meteorological Office, Buenos Aires.
Prof. K. Birkeland, The University, Christiania.
Padre R. Cirera, S.J., Observatorio del Ebro, Tortosa, Spain.
Walter G. Davis, Meteorological Institute, Buenos Aires.
H. Deslandres, Astronomical Physical Observatory, Meudon, France.
Prof. E. van Everdingen, De Bilt.
Prof. G. E. Hale, Solar Observatory, Carnegie Institution, Pasadena, Cal., U.S.A.
Prof. J. von Hann, Vienna.
St. C. Hepites, Bucarest.
Prof. W. H. Julius, The University, Utrecht.
Hofrat Thege von Konkoly, Meteorological Institute, Budapest.
Prof. W. Köppen, Deutsche Seewarte, Hamburg.
Captain H. G. Lyons, Roehampton, London.
E. Marchand, Observatoire du Pic du Midi, Bagnères-de-Bigorre.
Prof. H. Mohn, Meteorological Institute, Christiania.
Prof. A. Riccò, Astrophysical, Meteorological and Geodynamical Observatory, Catania.
Prof. G. B. Rizzo, The Observatory, Messina.
Prof. A. L. Rotch, Blue Hill Meteorological Observatory, Hyde Park, Mass., U.S.A.
Sir A. W. Rücker, Newbury, Berkshire, England.
Lieutenant-General M. Rykatcheff, St. Petersburg.
Prof. J. Scheiner, Astrophysical Observatory, Potsdam, Germany.
Dr. W. N. Shaw, London.
Captain A. Silvado, Rio de Janeiro.
A. Steen, Meteorological Institute, Christiania.
R. F. Stupart, Meteorological Office, Toronto, Canada.
L. Teisserenc de Bort, The Observatory, Trappes, France.
Prof. J. Violle, Paris.
Prof. A. Wojeikov, The University, St. Petersburg.
Prof. Max Wolf, Astrophysical Institute, Heidelberg.
Prof. A. Wolfer, Zürich.

International Commission for Weather Telegraphy.*

Appointed at Paris, 1907. Has met in London, 1909.

Dr. W. N. Shaw, London, *President.*
Prof. A. Angot, Paris.
Rear-Admiral Herz, Deutsche Seewarte, Hamburg.
Prof. Willis L. Moore, Washington, U.S.A.
Lieutenant-General M. Rykatcheff, St. Petersburg.

International Commission for Maritime Meteorology and Storm Warnings.†

Appointed at Paris, 1907. Has met in London, 1909.

Dr. W. N. Shaw, London, *President.*
Prof. A. Angot, Paris.
Rev. L. Froc, S.J., Zi-ka-wei, Shanghai.
Rear-Admiral Herz, Deutsche Seewarte, Hamburg.
Prof. H. Mohn, Christiania.
Prof. Willis L. Moore, Washington, U.S.A.
K. Nakamura, Tokio.

International Réseau Mondial Commission.

Appointed at Paris, 1907. Has met at Monaco, 1909.

L. Teisserenc de Bort, Paris, *President.*
Prof. H. H. Hildebrandsson, Upsala, *Secretary.*
H. Deslandres, Meudon, France.
Prof. G. Hellmann, Berlin.
Prof. H. Hergesell, Alsace-Lorraine.
Captain H. G. Lyons, Roehampton, London.
Prof. Willis L. Moore, Washington, U.S.A.
Prof. A. L. Rotch, Blue Hill Meteorological Observatory, Hyde Park, Mass., U.S.A.
Captain Ryder, Copenhagen.
Lieutenant-General Rykatcheff, St. Petersburg.
Dr. W. N. Shaw, London.
Prof. R. F. Stupart, Meteorological Office, Toronto, Canada.
Dr. G. T. Walker, Director-General of Observatories, Simla, India.

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* This Commission is to be extended ; *see* p. 20.
† This Commission is to be extended ; *see* p. 14.

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