

MET/2/1/3/111

M.O. 237.

FOR OFFICIAL USE.

INTERNATIONAL METEOROLOGICAL COMMITTEE.

(Appointed by the International Conference at Innsbruck, 1905.)

MINUTES

OF A

MEETING OF MEMBERS

HELD AT THE

METEOROLOGICAL OFFICE, LONDON,

ON

JULY 3rd to 9th, 1919,

BY INVITATION OF THE

DIRECTOR OF THE METEOROLOGICAL OFFICE,

PRESIDENT OF THE COMMITTEE.

Issued by the Authority of the Meteorological Committee.



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LIST OF INTERNATIONAL METEOROLOGICAL MEETINGS.

- Congresses of Official Delegates.** Vienna 1874, Rome 1879.
- Conferences.** Leipzig 1872, Munich 1891, Paris 1896, Innsbruck 1905.
- Permanent Meteorological Committee.** Utrecht 1874, London 1876, Utrecht 1878.
- International Meteorological Committee.** Berne 1880, Copenhagen 1882, Paris 1885, Zürich 1888, Upsala 1894, St. Petersburg 1899, [Paris 1900], Southport 1903, Paris 1907, Berlin 1910, Rome 1913.
- Commissions.**
- Terrestrial Magnetism and Atmospheric Electricity.** *Appointed* 1891. Munich 1891, Paris 1896, Bristol 1898, Paris 1900, Innsbruck 1905, Berlin 1910.
- Scientific Aeronautics.** *Appointed* 1896. Paris 1900, Berlin 1902, St. Petersburg 1904, Milan 1906, Monaco 1909, Vienna 1912.
- Radiation.** *Appointed* 1896, *reconstituted* 1910. Rapperswyl 1912.
- Solar.** *Appointed* 1903. Cambridge 1904, Innsbruck 1905, London 1909.
- Weather Telegraphy.** *Appointed* 1907. London 1909 and 1912.
- Maritime Meteorology and Storm Warnings.** *Appointed* 1907. London 1909 and 1912.
- Réseau Mondial.** *Appointed* 1907. Monaco 1909.
- Meteorology and Agriculture.** *Appointed* 1913. Has not met.

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MEETING OF MEMBERS OF THE INTERNATIONAL METEOROLOGICAL COMMITTEE (1905)

AT THE

Meteorological Office, on July 3rd to 9th, 1919.

LETTER OF INVITATION ADDRESSED TO

M. Angot, Paris.
Colonel Chaves, Azores.
Professor van Everdingen, Utrecht.
Professor Hildebrandsson, Upsala.
Professor Maurer, Zürich.
Signor Palazzo, Rome.
Captain Ryder, Copenhagen.
Sir Frederick Stupart, Toronto.
Dr. Walker (Swanage), Simla.
Director, Meteorological Service, Christiania.
Professor C. F. Marvin, Washington.

10, Moreton Gardens, London, S.W.5,

MY DEAR COLLEAGUE,

June 3rd, 1919.

THE state of war in the whole world which is now reaching its closing scenes has very gravely affected the international arrangements for co-operation in meteorology which originated with the Congresses of Vienna in 1873 and of Rome in 1879, and developed into the periodical conferences of Directors of Meteorological Institutes and Observatories, and the triennial meetings of the International Meteorological Committee appointed by the successive conferences. It will be remembered that a Conference was to have been held in 1915.

In ordinary circumstances it would have been natural after the long break in international relations to arrange for a meeting of the Committee with a view to preparing for a Conference, but that is not now possible, and no one can at present foresee when an international conference of the most general kind will become possible.

Before the conclusion of the war had been reached negotiations had already been initiated independently of the Meteorological Committee for co-operation among the allied nations, between the Academies on the one hand in respect of geophysical and geodynamical subjects, and between the representatives of various independent meteorological services in respect of the exchange of daily reports on the other hand. I am not at present in a

position to anticipate what the ultimate development of these negotiations may be.

The circumstances of the exchange of meteorological messages are now very complicated. The necessity for the extension of the application of meteorological information in various directions during the war has resulted in the creation of a number of separate services in this country, in France, Italy and the United States, and the relations of these separate services to the services which have been accustomed to act in co-operation during the last 45 years are not at present defined. Independent schemes of co-operation between air services have been initiated in which to some extent meteorology is involved. In place of the customary map for a single hour, or two hours a day, maps are prepared for four epochs of each day. Information, which is given by a single figure in the international code, is now asked for in greater detail. In fact, the old international telegraphic message of six groups of five figures each, giving the weather of yesterday evening and this morning, with additional information for the whole day, does not satisfy the requirements of aerial navigation. The use of summer-time adds a further complication.

The newer developments of radio-telegraphy are another feature of change in which the maritime nations are particularly interested; but the inland countries are also concerned, because it seems probable that radio-telegraphy may be used instead of telegraph cables, and land wires for the daily exchange of the customary meteorological messages.

All these matters require careful organisation, in which the experience of those who have formed the International Meteorological Committee is of the first importance; though after five years of separation it may not now be fully informed as to all the conditions which have to be satisfied.

The organisation of an effective meteorological exchange is fundamentally a question of geography, and before any conference can usefully deal with the technical and economic details, such as the selection of centres of distribution and the means of defraying the costs of transmission, it is necessary to know what information is available in different geographical regions, and what facilities are available for transmitting and receiving information in exchange.

The Meteorological Codex which represents the international agreements arrived at before the war is therefore, in many particulars, no longer sufficient. It will have to be revised and some new sections added to it to meet new requirements, particularly as regards aviation. It is, however, desirable that continuity should be preserved. The present position, as it affects the services which were associated, should be reviewed. It would be very useful if those of us who are available could exchange views as to the items of the codex which need revision, and as discussion by correspondence would be very tedious and prolonged, the personal exchange of views is desirable.

I therefore take this opportunity of inquiring of certain members of the old Meteorological Committee who are not far distant, namely, Professor Palazzo, M. Angot, Professor Maurer, Sir Frederick Stupart, Professor van Everdingen, Captain Ryder, Colonel Chaves, Dr. G. T. Walker (who is in England at present), with Professor Hildebrandsson, and a representative of the Norwegian Service in place of Professor Mohn, and of the United States Service in place of the Professor Willis Moore, whether they or some of them could and would come to London for an informal meeting on or about 3rd July to consider the codex, with a view to noting those items which, so far as the older services are concerned, require reconsideration. The reconsideration, under favourable circumstances, might come before a conference which will probably take place in the first week of October.

Will you be good enough to let me know if this suggestion meets with your approval?

I am, my dear colleague,

Yours very faithfully,

(Signed) NAPIER SHAW.

The following Directors of Meteorological Services accepted the invitation:—

M. Angot, Paris.

Professor van Everdingen, Utrecht.

Professor Palazzo, Rome.

Captain Ryder, Copenhagen.

Director Hesselberg, Christiania.

Dr. G. T. Walker, Simla.

Professor Hildebrandsson arranged for the attendance of Dr. A. N. Wallén, Director of the Swedish Meteorological Service.

Letters were received from Colonel Chaves, Professor C. F. Marvin and Dr. Maurer which are printed in Appendix I.

By arrangement with the Scientific Attaché of the United States Embassy, Dr. Bauer, Director of the Department of Terrestrial Magnetism of the Carnegie Institution, was deputed by Professor Marvin of the United States Weather Bureau to attend and report on the proceedings at the meetings.

The Superintendent of the Meteorological Service of the Admiralty, Lieutenant H. D. Grant, R.N.R., was also invited.

Lieutenant-Colonel Gold, D.S.O., F.R.S., of the Meteorological Office, acted as Secretary.

MINUTES OF MEETINGS.

First Meeting, Thursday, July 3rd, 1919.

The Meeting commenced at 11.30 a.m.

Members present:—Messrs. Angot, van Everdingen, Palazzo, Ryder, Shaw and Walker.

There were also present by invitation:—Dr. Hesselberg (Norway), Dr. Wallén (Sweden), Lt.-Col. Gold, of the Meteorological Office, and Lieut. Grant, of the Naval Meteorological Service of the British Admiralty.

The President, Sir Napier Shaw, read letters from Dr. Maurer and Colonel Chaves (Appendix I), who were unable to be present, and reported that Professor Mendenhall, at the request of Professor Marvin, Chief of the United States Weather Bureau, had asked that Dr. L. Bauer might attend the meetings and report the proceedings.

The President then made the following introductory statement:—

“The last appointment of the International Meteorological Committee dates from the Conference at Innsbruck in 1905. The Conferences and Committee were subject only to traditional regulations until a formal règlement embodying the tradition then existing was drawn up in 1907. It is printed in the Report of the Paris Meeting of the Committee, and was to have been submitted for the approval of a Conference arranged to meet at Utrecht in 1915, which did not take place. Since 1905 the Committee has met at Paris, 1907, Berlin, 1910, Rome, 1913; for each meeting a Report has been printed and issued.

“The great war has destroyed the organisation, and the règlement which was to have been offered for confirmation at Utrecht in 1915 should be offered as a record of past experience to a conference which the French Government, on the initiative of the Comité d'Action des Services Météorologiques Français, intends to summon for the last day of September in this year. As embodying the experience of international co-operation during the forty years from 1874 to 1914 it should be of great value in the re-organisation of the co-operation, and it is therefore desirable to formulate it for presentation, together with a complete edition of the Codex of Resolutions of International Meteorological Conferences and Committees.”

"In the course of the war the conditions which must be satisfied by an efficient international organisation have changed in some important details, though the underlying principles are necessarily the same. The importance of short period forecasts of detailed accuracy needs to be emphasised, and for most purposes the old system of one or two reports daily is inadequate. The applications of meteorology, particularly of the telegraphic reports, have become more numerous, and the great development of aviation has introduced new requirements in respect of information concerning the upper air obtained by pilot-balloons or in other ways. New Services employing the information have been brought into being and with them new meteorological organisations for supplying the information.

"These new organisations have developed new requirements so that the international code for the exchange of information requires revision.

"It is upon the members of the International Meteorological Committee that we must rely in order to preserve the continuity which is necessary for the continued success of the international system.

"Of the 17 members of the International Committee at the time of the meeting in Rome in 1913, six have, for various reasons, vacated their places, and many of those who remain have had no opportunity of exchanging views upon the alterations which have developed in the international situation. Any endeavours to exchange views by correspondence would be quite inadequate and would take too long a time.

"I have, therefore, after consultation with the French Authorities, thought it desirable to invite those members of the old Committee, who were within reach, to meet together so that they may be made aware of the various questions that have arisen and obtain the knowledge of the details which will require careful study by the several authorities if a satisfactory conclusion is to be reached at the Conference in Paris.

"The business of this meeting will be, therefore, mainly the information of the representatives of the several countries upon the points to which the attention of the co-operating services must be directed."

The President also distributed the following papers:—

1. Codex of Resolutions, &c., M.O. 200, with additions to 1913.
2. Report of the meeting of the International Meteorological Committee at Paris, 1907, containing the *Règlement* for international co-operation in Meteorology.
3. Copies of the Daily Weather Report of the Meteorological Office (British Section, Upper Air Section and International Section).
4. Code for reports from individual stations to a Central Office.

5. Letter from Hydrographer concerning the Scale of Visibility.

6. Letter from Hydrographer concerning the Scale of Sea-Disturbance.

7. Despatch from the Norwegian Minister with reference to Amundsen's Arctic Expedition.

The meeting adjourned at 12.40 p.m., to visit the Kew Observatory, Richmond.

(Signed) NAPIER SHAW.

July 5th, 1919.

Second Meeting, Friday, July 4th, 1919.

The meeting commenced at 9.30 a.m.

Present: Messrs. Angot, van Everdingen, Palazzo, Ryder, Shaw, Walker.

Dr. Bauer, Lt.-Col. Gold, Lieut. Grant, Dr. Hesselberg, Dr. Wallén.

1. International Organisation.—The question of International Organisation having been discussed, the following resolutions were passed:—

- i. "We, the undersigned members of the International Meteorological Committee, beg leave to present to the Conference of Meteorologists in Paris, a copy of the *Règlement des Conférences et du Comité Météorologique International* which was formulated at Paris in 1907.

"The *Règlement* represents the system of international co-operation which had gradually evolved itself in practice from the period of the International Congresses of 1874 in Vienna, and 1879 in Rome.

"In presenting this copy of the *Règlement* the undersigned members of the Meteorological Committee with their Colleagues of Sweden and Norway, whose representatives, Hildebrandsson and Mohn, took a prominent part in the international deliberations, wish to place on record their sense of the excellence of the international system of Conferences, Committee and Commissions and its peculiar suitability to the many conditions which must be satisfied by international co-operation in meteorology.

"[They are aware that the extent and detail of international co-operation must be much greater in the future than in the past, but the problems are essentially of the same nature as those which have confronted meteorologists since 1872.]"

- ii. "In Section I. of the '*Règlement*' (functions of Conferences of Directors) by the word '*concrete*' is understood '*administrative or executive.*'"

- iii. "The meeting has considered the formation of an International Executive Committee by the selection of countries to be represented, but finds the existing system of appointment by a General Conference preferable; on the understanding that as a general rule such Conferences should be held at intervals of nine years."

(Signed) NAPIER SHAW.
L. PALAZZO.
E. VAN EVERDINGEN.
CARL RYDER.
GILBERT T. WALKER.
A. ANGOT.
TH. HESSELBERG.
A. N. WALLÉN.

2. M. Angot undertook to have copies of the *Règlement* and the resolutions relating to it taken at this meeting printed for circulation to representatives attending the General Conference at Paris in September.

3. **Codex of Resolutions.**—Copies of the English Edition of the Codex of Resolutions of International Meteorological Meetings (1872-1907) interleaved with the resolutions of the later meetings at Berlin (1910) and Rome (1913) were examined, and it was decided to send copies of this Codex to the President of the Comité d'Action des Services Météorologiques Français for the information of delegates attending the Conference at Paris in September, 1919.

4. **Codes for Telegraphic Reports** (Appendix VII.).—Preliminary consideration was given to the code of reports from individual stations to a Central Office and to the representation of the information in the Daily Weather Report. It was noted that copies of a code for reporting observations of upper winds and temperatures would be circulated to complete the scheme of transmitting the information required for detailed forecasts for the purpose of aviation.

The code for reporting sea-disturbance was discussed. The necessity for the differentiation between ripples, waves, and swell having been emphasised, further consideration of this question and of the proposed new weather code was postponed.

5. The meeting adjourned at 12.30 p.m.

(Signed) NAPIER SHAW.

5th July, 1919.

Third Meeting, Saturday, July 5th, 1919.

The meeting commenced at 9.30 a.m.

Present: Messrs. Angot, van Everdingen, Palazzo, Ryder, Shaw, Walker.

Lt.-Col. Gold, Lieut. Grant, Dr. Hesselberg, Dr. Wallén.

1. The minutes of the meeting of July 3rd were read and confirmed. The minutes of the meeting of July 4th were read. The following addition was made to Section I, sub-section (i):—

"They are aware that the extent and detail of International co-operation must be much greater in the future than in the past, but the problems are essentially of the same nature as those which have confronted meteorologists since 1872."

With this addition the minutes of the meeting of July 4th were confirmed.

2. **Maritime Meteorology** (observations in selected squares).—Professor van Everdingen wished to emphasise Resolution 8 of the Commission on Maritime Meteorology (Rome, pp. 19, 57), and agreed to draft a resolution.

3. **Code for Observations of the Upper Air.**—In accordance with Minute 4 of meeting of July 4th, a code for reporting upper winds and temperatures was presented, and a discussion took place on the specification of heights and wind direction; opinions differed, and no definite conclusion was reached.

4. **Code for Characteristic of Barometric Tendency.**—Dr. Hesselberg presented a memorandum on the characteristic of barometric tendency, and Professor van Everdingen wished to have the tendency itself expressed in tenths of millimetres or millibars. These questions were referred to a Sub-Committee (Professor van Everdingen, Captain Ryder, Dr. Hesselberg, Lieut.-Colonel Gold).

5. **Daily Synoptic Charts of the Atlantic Ocean.**—Captain Ryder explained that there was material available for the completion of the series of charts published jointly by the Danish Meteorological Institute and the German Naval Observatory up to the end of 1913, but for the years 1914 and onwards the material would have to be supplied by the co-operation of the States which had observations on ships.

It was agreed that it was desirable to continue the series of charts, but with maps for evening as well as morning until adequate daily maps of the Atlantic Ocean are issued based upon the observations received in the various countries by radio-telegraphy, and with this object in view it was agreed that the representatives of the several institutes present should endeavour to secure from their respective Governments—

- (1) the transmission of a copy of all available observations to Copenhagen for compilation there of two maps for each day;
- (2) the contribution of a sum of money necessary to enable the charts to be produced and issued by the Danish Meteorological Institute.

With regard to ten-day means it was decided that the need for these had now disappeared as the wireless reports already available for the North Atlantic provided a representation equally good and more up-to-date.

6. **Proposal of the Norwegian Government for co-operation in Polar Research.**—Dr. Hesselberg explained the plans formed for co-

operation with Amundsen's Polar Expedition; he showed a chart of the stations proposed and emphasised the importance of combined magnetic and meteorological observations. Further discussion of the proposals was deferred.

7. The meeting adjourned at 12.10 p.m.

(Signed) NAPIER SHAW.

7th July, 1919.

Fourth Meeting, Monday, July 7th, 1919.

The meeting commenced at 9.30 a.m. and was adjourned from noon till 2.30 p.m.

Present:—Messrs. Angot, van Everdingen, Palazzo, Ryder, Shaw, Walker.

Lt.-Col. Gold, Lieut. Grant, Dr. Hesselberg, Dr. Wallén.

1. The minutes of the meeting of July 5th were read and confirmed.

2. **Daily International Exchange of Observations.**—A statement summarising the position reached in regard to the daily international exchange of observations was read and agreed to in principle. The discussion of details is given below, paragraph 9.

3. **Reports from Iceland.**—Captain Ryder explained at length the existing arrangements for the reports by cable and telegram of the observations from Iceland. The resolutions on this and on reports from Greenland are given below—paragraphs 7 and 8 of "Daily International Exchange of Observations."

4. **Maritime Meteorology (Observations in Selected Squares).** Minute 2 of Third Meeting.—The following resolution was adopted:—

"Owing to the intervention of the War the programme contemplated in Resolution 8 of the Commission on Maritime Meteorology (Rome, p. 57) has been interrupted and the meeting, therefore, takes the opportunity of directing attention to this resolution and of asking Meteorological Institutes to send extracts from meteorological logs for the selected squares to the Director of the Netherlands Institute with a view to publication of a resumé as a contribution to the meteorology of the Globe (Kon. Ned. Met. Inst. No. 107a). If possible, extracts should be sent from logs for 1915 onwards."

5. **Magnetic Character of the Day.**—Professor van Everdingen made a report on magnetic character (Appendix II.) and the following resolution was adopted:—

"In receiving the Report on 'Magnetic Character' by Dr. van Everdingen, the meeting expresses its thanks and appreciation for the successful manner in which Dr. van Everdingen, as President of the Sub-Committee, carried out the work during the war."

6. **Characteristic of Barometric Tendency.** Minute 4 of Third Meeting.—The report of the Sub-Committee on barometric

tendency (Appendix III.) was discussed and the meeting agreed "that the report should be circulated to the Meteorological Institutes and the considered opinions of the different Services taken after consideration of the various codes available, before a decision is made at Paris."

7. **Summer-Time.**—The question of Summer-Time was discussed and attention drawn to the difficulty of securing sufficiently early distribution of reports if the meteorological reports continued to be made according to G.M.T. It was, however, hoped that the plan for four reports daily at intervals of six hours, would go far towards meeting this difficulty. It was noted that in Norway, Sweden and Denmark, the use of Summer-Time has been discontinued after one year's trial owing to its adverse influence on agriculture and its general unpopularity.

8. **Reports of Observations of Clouds.**—With reference to the great importance of cloudiness for the study of radiation, and since the radiation from the sun and from the earth is affected differently by the lower and upper clouds, it was agreed that it is desirable that the lower and upper clouds be observed, and communicated separately.

9. **Sea-Disturbance.**—The discussion of the details of the general statement was resumed. The proposal to specify the heights of the waves corresponding with the different numbers of the scale of sea-disturbances (Appendix IV.) was subjected to much criticism based mainly on the ground that the sea-disturbance is a function of other variables in addition to the wave-height. The following resolution was adopted:—

"The meeting is not prepared to express an opinion upon the scale of equivalents of heights of waves until further observations have been obtained, but considers that sea-disturbance in the open sea should be estimated by the height of waves. The meeting invites the services to obtain from light-ships, &c., comparisons of estimates of sea-disturbance with measurements of heights and lengths of waves."

10. **Visibility.**—The proposal to change the scale of visibility (Appendix V.), was discussed the existing scale having been designed for use with fixed objects at definite distances from the observation station was regarded as meeting the requirements of land stations, but for use at sea the principle of specification by limits was adopted; the exact limits to be chosen to avoid disagreement between the two methods of specification.

11. A proposal relating to the desirability of wireless operators receiving instruction in meteorology was adopted (*see* "Daily International Exchange of Observations" para. 9). The general statement finally agreed to was as follows:—

DAILY INTERNATIONAL EXCHANGE OF OBSERVATIONS.

1. **Extension of the Service and Multiplication of Hours of Observation.**—The meeting of members of the International Meteorological Committee in association with the Directors of the Meteorological Services of Sweden and Norway have had before

them the enlarged form of the Daily Weather Report of the Meteorological Office, London, which now comprises:—

- (1) A British Section of four pages, including full data for the British Isles as observed at 1h., 7h., 13h., 18h., G.M.T., charts of pressure, wind, upper cloud, lower cloud, visibility, temperature, weather and sea.
- (2) An Upper Air Supplement of two pages for the presentation of data concerning upper winds from observations of pilot balloons or otherwise, and the temperature of the upper air by aeroplane, and
- (3) An International Section of four pages, containing charts of north-western Europe, shewing pressure, wind, temperature and weather at 1h., 7h., 13h. and 18h., G.M.T.

They have had before them the formulæ and the codes for the transmission of "Reports from Individual Stations to a Central Office," in much greater detail than the International Code agreed upon in 1913, and also the codes for the transmission of information concerning the upper air which have been in use between Great Britain and France since the beginning of the current year.

They had also before them the Bulletin of the Italian Air Service, giving charts of the results of pilot-balloon observations, &c.

They recognise that an efficient meteorological service for aircraft will require more detailed observations of weather than heretofore, and also observations of the upper air to be exchanged between the countries which co-operate in that service in addition to the observations necessary for the construction of the customary maps of pressure, wind, temperature, weather and sea.

2. Services invited to consider the number of Contributing Stations and the Hours of Observation.—It would appear that the number of stations in the several countries which would supply the more detailed information, and of those which would supply the information concerning the upper air by way of international exchange as well as the codes to be employed, should be ultimately settled by agreement at a meeting of representatives of the co-operating services. The meeting, therefore, invites the services represented to consider the facilities which they could offer for the development of an international scheme of that character.

It would also appear that the detailed information referred to would be required for certain specified air-routes rather than for an unlimited area; that the transmission of information by telegraph or wireless would be arranged between the respective services, and that the publication by any service of the details for its own area would discharge any international obligation in that respect.

The question of the hours of observation for Europe is one of some difficulty. The selection of 1h., 7h., 13h., and 18h., has been gradually developed from the results of previous international agreements. It has been suggested that if the service were to be commenced *de novo*, the hours 3h., 9h., 15h., 21h.,

G.M.T., would be more generally convenient, provided that the newspapers found one or other of these hours acceptable.

Summer-Time.—The majority of the meeting was of opinion that, when the selection of hours is made, the same time should be adhered to throughout the year in spite of the adoption of summer-time for other civil purposes.

3. The Codes for the Transmission of the Observations.—It is understood that one set of codes only would be used for all stations whether they send a message of full detail or only the customary information. They find it desirable that the codes from the different countries, as well as the remarks which the different services wish to make about the English code, should be sent to the President of the Committee for presentation to the Conference at Paris.

They have not thought it opportune to enter into all the details of the various messages and codes. They have, however, noted the following points:—

Weather.—The several items of the code for weather in two figures are not mutually exclusive, and are to that extent not suitable for special localities, *e.g.*, 39 (lunar halo) is not incompatible with 71 (snow lying).

Sea Disturbance.—The sea disturbance in the open sea should be estimated by the height of waves. The meeting is not prepared to express an opinion upon the scale of equivalents of waves and estimates until further observations have been obtained.

Visibility and Fog.—The meeting raises no objection to the principle of the scale proposed by the Hydrographer for observations at sea (Appendix V).

4. Exchange of Observations by Radiotelegraphy.—By a communication from Dr. Maurer the attention of the meeting was called to the great delay existing at present in the transmission of messages to Zurich by telegraph, and supporting the suggestion that the distribution of collective meteorological messages should be by radiotelegraphy. It was also urged that the acceleration of messages from Great Britain to Norway and other countries was very desirable.

It was pointed out, that for such a scheme an understanding would have to be arrived at as to:—

- (1) The fixed times at which the collective messages should be sent, *e.g.*, 3h., 9h., 15h., 21h., or 5h., 11h., 17h., 23h.
- (2) The transmission of reports which arrive at the collecting station too late for inclusion in the collective message.
- (3) The order in which the collective messages of the several countries (twelve or more) should commence their transmission, and what time should be reserved for them.

The President was requested to communicate with the radiotelegraphic authorities with a view to placing a definite scheme before the proposed Conference in Paris.

5. **Reports by Radiotelegraphy from Atlantic Liners.**—The meeting noted with pleasure that the scheme of obtaining reports by radiotelegraphy from ships in the Atlantic had been resumed, and that the observations are included in the British Section of the Daily Weather Report.

They further agreed that consideration be given to the question of a suitable International Wireless Telegraphic Code for the reporting of observations from ships at sea, keeping in view the desirability of such a code being, as far as possible, identical with the International Code for reports from shore stations.

They expressed the opinion that arrangements should be made for the telegrams received in this manner to be added to the collective messages of the countries in which the receiving shore stations are situated, dividing them, in case of messages that reach two stations, according to latitude.

6. **Finance.**—The meeting expressed the opinion that if a system of distribution by radiotelegraphy were established, it would be convenient and sufficient if each country discharged the expenses of the transmission of its own collective messages, including the cost of telegraphing the belated messages.

7. **Telegrams from Iceland.**—It was suggested that the present arrangement with the Great Northern Telegraph Company should cease, and that the messages should be sent to Great Britain and distributed thence by wireless or by cable, the expense being shared by the associated countries.

It was further agreed that a request should be put forward for an official representation to be sent to the Icelandic Government of the importance for the meteorological services of Europe of the maintenance of the meteorological stations in Iceland, and of a satisfactory arrangement for the transmission of the messages to Europe.

It was also agreed that a representation be made to the British Wireless Board that the Icelandic reports be sent by radiotelegraphy at selected hours daily to a British wireless station for retransmission thence for general meteorological purposes.

8. **Telegrams from Greenland.**—The attention of the meeting was called to the importance of information from Greenland, and Captain Ryder indicated the probability of provision being made by the Danish Government at an early date. It was agreed to represent in the proper quarter the desirability of an official message being sent to the Danish Government setting out the importance to the meteorology of the Atlantic of the observations in Greenland.

9. **Instruction in Meteorology for Wireless Operators at Sea.**—The meeting expressed the opinion that the time is opportune to give attention to the possibility of instructing senior wireless operators on board ship in meteorology, observing the increasing importance that attaches to the correct transmission of meteorological observations by wireless telegraphy. For this purpose it is recommended, that in future schemes for the grading of wireless operators, some elementary knowledge of meteorology should be considered as part of the general course of instruction.

10. **Letter from Professor C. F. Marvin.**—The President reported the receipt of a letter from Professor C. F. Marvin, Chief of the United States Weather Bureau, which is printed in Appendix I.

(Signed) NAPIER SHAW.

July 9th, 1919.

Fifth Meeting, Tuesday, July 8th, 1919.

The meeting commenced at 9.30 a.m.

Present: Messrs. Angot, van Everdingen, Palazzo, Ryder, Shaw, Walker.

Dr. Bauer, Lt.-Col. Gold, Lieut. Grant, Dr. Hesselberg, Dr. Wallén.

1. **Reports of Wind Force in Terms of Velocity.**—The proposal to report surface wind in velocity instead of by the numbers of the Beaufort Scale was discussed, and emphasis was laid on the difficulties (a) of securing a standard exposure at inland stations, (b) of securing instrumental measurements on ships at sea, (c) of securing continuity in the records. The following resolution was passed:—

“The meeting is of opinion that if the wind is reported by the velocity, the velocity should be given to an accuracy of one unit of the scale employed (miles per hour, metres per second or kilometres per hour), and if abbreviations to one figure are used the Beaufort Scale should be employed. The question of the unit for international reports and of the exposure of the anemometer should be raised at the Paris meeting.”

2. **North Polar Investigation in Co-operation with Amundsen's Expedition.**—The question of co-operation with Amundsen's North Polar Expedition was again discussed, and in particular the proposal for the establishment of a station in the island of Jan Mayen.

The full programme for such a station includes meteorology, aerology, terrestrial magnetism and atmospheric electricity, including observations and photographs of aurora.

The station would require to be maintained from the early summer of 1920 to the autumn of 1922; the first year of this period would be most important.

For a full programme at a single station there would be required—

- 3 meteorologists (qualified by a University Education in science and post-graduate training at a meteorological institute).
- 3 technical assistants.
- 1 mechanic.
- 1 handyman.
- 1 cook.

Professor van Everdingen hoped to be able to lend a self-registering theodolite for pilot balloon measurements at such a

station if application for the instrument were made to him at De Bilt.

It was agreed that the members present would do their best to secure favourable consideration of the co-operation of their respective institutes on the lines laid down in the proposal circulated by the Norwegian Government. (Appendix VI.)

Director Hesselberg undertook to forward to the President papers by Dr. Krogness, Professor Störmer and himself relating to the programme of work of the Expedition.

The meeting was adjourned at 11.30 a.m. to visit the Upper Air Observatory at Benson in charge of Mr. W. H. Dines.

(Signed) NAPIER SHAW.

July 9th, 1919.

Sixth Meeting, Wednesday, July 9th, 1919.

A sixth meeting was held on July 9th at 2.30 p.m.

Present: Messrs. van Everdingen, Palazzo, Ryder, Shaw.

Dr. Bauer, Lt.-Col. Gold, Lieut. Grant, Dr. Hesselberg, Dr. Wallén.

The minutes of the previous meetings were revised, completed and signed.

(Signed) NAPIER SHAW.

July 9th, 1919.

APPENDICES.

APPENDIX I.

Zürich,

le 23 juin 1919.

TRÈS HONORÉ MONSIEUR ET CHER COLLÈGUE,

PERMETTEZ moi de vous remercier vivement par ces quelques lignes de votre très aimable lettre ainsi que de l'invitation cordiale.

Je suis tout à fait d'accord avec vous qu'il faut chercher à reprendre sous peu toutes les relations perdues, surtout au point de vue de la transmission des observations météorologiques. Nous souffrons beaucoup sous le grand retard des dépêches de l'Angleterre, de la France et de l'Italie, qui nous parviennent régulièrement seulement dans l'après-midi. Le seul moyen de recevoir les dates à temps serait, comme vous le dites vous mêmes cher Monsieur le Collègue, la Télégraphie sans fil, si l'on fixerait pour la transmission des heures bien matinales. Il y a quelque temps que j'ai écrit dans ce sens à Londres, Paris et Rome.

J'espère vivement qu'il résultera un bon succès à ce sujet à la conférence, et j'ai grand regret de ne pas pouvoir être présent aussi moi, mais pour le commencement du mois de juillet j'ai à préparer pour l'assemblée de notre commission météorologique Suisse tous détails, ce que me donne encore beaucoup à faire. Mais soyez assuré que j'assisterai en pensée à votre conférence et je ne m'en doute pas que sous votre bonne direction nos vœux puissent se réaliser!

Agréez, très honoré Monsieur et cher Collègue, ainsi que tous autres Messieurs, l'assurance de ma plus haute considération et mes salutations les plus sincères,

Votre tout dévoué,

J. MAURER.

Serviço Meteorológico dos Açores,
Ponta Delgada,

17th June, 1919.

MON CHER COLLÈGUE,

Au mois de janvier dernier j'ai reçu une lettre officielle du "Président du Comité d'Action des Services Météorologiques Français" en me demandant mon opinion au sujet d'une modification du Code télégraphique, combiné dans la notre Réunion à Rome, en 1913. Je lui ai répondu étant d'accord dans cette modification, vu les progrès de l'aviation et la possibilité de profiter la télégraphie sans fil dans des communications météorologiques; mais manifestant aussi mon opinion (comme je l'ai communiqué au Prof. Angot) de que la seule autorité pour autoriser ou proposer ses altérations était le Comité Météorologique International.

Au mois de mai dernier j'ai reçu une invitation pour être présent à une Réunion provoquée par le susdit "Comité d'Action" qui devait avoir lieu à Paris du 16 au 25 juin courant. Dans l'impossibilité d'y aller j'ai écrit au notre Collègue Angot en lui priant de me représenter dans cette Réunion. Peu de jours après nouvelle communication de que la Réunion de Paris ne s'effectuerait pas mais que le Comité Météorologique International se réunirait à Londres. Par le votre télégramme du 12 dernier je vois que la Réunion s'effectuera du 3 juillet en avant. Les Transports d'ici pour le continent sont à présent très incertains et dans ces conditions je ne peux pas me risquer à perdre bien des jours en dehors des Açores. Je suis parfaitement d'accord dans toutes les modifications que le Comité pense nécessaires pour le Code télégraphique comme j'ai déjà manifesté à M. Angot, qui certainement ira à la Conférence. Vous êtes aussi autorisé à approuver en mon nom tout ce que vous jugerez utile pour le progrès de la Météorologie. J'attends toujours votre réponse au sujet

des communications par la Station T.S.F. de l'Amirauté Anglaise. Je pense que le Capitaine Garrigan vous aura déjà parlé, et présenté ma lettre du 10 dernier.

Toujours votre bien dévoué et reconnaissant,

F. A. CHAVES.

Office of the Chief, United States Department of Agriculture
Weather Bureau, Washington,

June 25th, 1919.

Sir Napier Shaw,
London, England.

MY DEAR COLLEAGUE,

YOUR letter of June 6th and memorandum of June 3rd, following your cablegrams of June 13th and 15th, relative to informal meeting of meteorologists of the International Meteorological Committee, have just reached me and I hasten to reply.

On June 14th I cabled you as follows:—

"Impracticable to attend meeting International Meteorological Committee in London July third."

About the same time our National Research Council requested Dr. Mendenhall to get further information as to the import of the meeting of July 3rd, nations to be represented, and relation of the meeting to meteorology at Brussels.

With your letter and memorandum before me, I have arranged that Dr. L. A. Bauer, now in London, be requested to attend the meetings you wish to hold and act in my behalf as far as practicable.

Your difficulties in deciding upon the proper course with reference to the resumption of international relationships in meteorology are fully appreciated. Personally, I feel that I do not know the essence and complexity of the problem so far as North-western Europe is concerned, and I hold an open mind concerning many important details, especially with reference to the exchange of daily observations and the like.

We on this side of the Atlantic are less dependent for our day-to-day work on such exchanges, but we earnestly look forward to the time when extensive exchanges of reports permit the resumption of a daily weather map of the Northern Hemisphere, if not of the Globe.

I have wondered how far it would be possible to go to perpetuate, or seem to perpetuate, the old international organisations. You, doubtless, know that in the United States the National Research Council has already gone very far to systematically and comprehensively organise and federate all scientific interests and agencies of the nation. The international interests and relations are fully recognised and provided for, and the machinery is expected to function through the so-called International Research Council, which is now fully launched and will, as you know, hold its real organisation meeting at Brussels, July 18th.

With us in this country a provisional Geophysical Association or Union will federate and comprise activities in geodesy, meteorology, seismology, and terrestrial magnetism and electricity. It has been contemplated that somehow the duly accredited international section of this new organisation should perpetuate the work and objects of the pre-war associations, committees or conventions occupying similar fields of scientific interests or activities. The difficulties of terminating, continuing, or transferring to a new international group the activities of the old organisations are fully recognised, but we have expected this would be one of the very important questions to be acted upon at the Brussels meeting. I take it for granted that your present intention to hold an informal meeting of meteorologists is, possibly, with the object of effecting co-operation or union with the International Geophysical Union which it is expected will be organised at Brussels.

All the foregoing has to do with questions of international organisation, not alone of meteorology but of other branches of science, and seems to call

for first consideration and disposition. Only then can the real problems of adjustment to the new conditions, as well as the new questions which arise, be grappled with.

I feel it is premature for me to attempt to say much with respect to the new questions left by the war. While directly and indirectly the Weather Bureau contributed very greatly to the application of meteorology in military operations, the service in this country has not been seriously split up or disorganised as yet. It seems fairly generally conceded that meteorology in the Army and Navy under a peace-time basis would be limited to strictly military needs and uses, while the functions of the civil organisation would continue as heretofore and doubtless expand to greater activity in free air observations, investigations and forecasts in the interests of civil and military aeronautics.

As you mention in your memorandum, the revision and adjustment of the Meteorological Codex to the new state of things claims early and careful attention. The war practically suspended, if it did not largely terminate, our scheme of marine meteorology, and we are now bending renewed effort to the rehabilitation of this work, made more important than ever by trans-oceanic flying. The time is rapidly approaching when marine reports by radiotelegraphy should make the daily synoptic map of the principal ocean lanes a practical realisation for the purposes of forecasting.

You mention in complication of summer-time. This legislative falsification of clocks is an abomination in meteorology and chronology, and during two summers of its operation in the United States it has added many extra hours of labour to our corps of observers, because we could not permit ourselves to break the continuity of our long series of observations; on the other hand we had to fall in line with the civic procession of diurnal events, which required double sets of observations one hour apart.

Fortunately our Congress has voted the repeal of this law, effective in October of this year, and we are not likely to be troubled on this account hereafter.

Addressing myself more specifically to your desire for an informal conference of "certain members of the old Meteorological Committee who are not far distant . . . on or about July 3," you already know my attendance is impracticable. As to "the items of the Codex which need revision," I can say at this time only that I must study the question more carefully than I have, because the need of changes therein has not as yet forced itself upon our attention, and in our minds such questions have been deferred in the interest of promptly settling more urgent questions of the appropriate perpetuation (may I say purging and purification?) of the old organisation, unless the results to be thus accomplished may not be attained better by the creation of entirely new agencies and affiliations.

I hope the foregoing will indicate to you how the questions presented in your memorandum of June 3 impress me at the present time, and I shall be indeed glad to learn from you later the outcome of your efforts. I wish to assure you of my hope that international meteorology may soon be much more powerfully and effectively organised than ever before, also that I may aid you in these matters as fully as possible.

Very respectfully,

C. F. MARVIN,

Chief of Bureau.

APPENDIX II.

REPORT OF SUB-COMMITTEE ON "MAGNETIC CHARACTER."

(Report of Sixth Meeting of International Commission for Terrestrial Magnetism and Atmospheric Electricity. Berlin, 1910, p. 24.)

The Sub-Committee on Magnetic Character asked M. van Everdingen to act as President.

As a first step towards uniformity in assigning magnetic character numbers, a circular was sent out to ask observatories using a very extreme scale to substitute for this a scale resembling that in use at Kew, De Bilt or Potsdam. A distinct approach to uniformity has been obtained in consequence.

Dr. Chree prepared a list of the five most disturbed days in each month since 1906. Further investigations by Dr. Chree on this subject afterwards led to the addition to the annual review of a list of the five most disturbed days in each month.

The observatories have been asked to propose days suitable for reproduction, and the quarterly lists of character numbers give days proposed for general reproduction and others for facultative reproduction.

The late Professor Bidlingmaier's proposal to determine the "magnetic activity" for every hour instead of a character number for the whole day has been tested in various ways. Potsdam and De Bilt undertook to calculate the activity for the whole year 1915, other observatories promising to do the same, and Dr. Chree calculated activity for all the term days associated with Scott's Antarctic Expedition.

The members of the Sub-Committee have come to the conclusion that the very large amount of work involved in the calculation of the activity does not lead to quite satisfactory results and cannot be recommended for general use. Various investigations, however, point to the conclusion that a satisfactory substitute for activity and character numbers both might be obtained by using squared hourly and daily ranges or something similar.

APPENDIX III.

REPORT OF SUB-COMMITTEE ON BAROMETRIC CHARACTERISTIC AND TENDENCY.

1. Dr. Hesselberg's proposal (*see below*) makes for simplicity in dividing the changes into two general types, and permits the tendency to be given in all cases without the addition of 50; as the negative value is indicated by the characteristic.

2. The proposal has, however, the disadvantage of not providing the double check, usually given by the old system through the characteristic and the addition of 50 for negative values.

3. It is undesirable to make any change in a well-established code unless there is a decided advantage which cannot be obtained by the existing code.

4. The Sub-Committee could not come to a unanimous decision; and recommends that this proposal should be circulated to Meteorological Institutes, and the considered opinions of the different services taken before a decision is made at Paris.

5. Tendencies smaller than 1mm. or 1 mb. in 3 hours should be given with greater accuracy than the nearest millimetre or half-millibar provides, wherever the instruments permit of such greater accuracy. As tendencies greater than 40 practically never occur, it is recommended:—

- (a) That tendencies should normally be given in half-millibars.
- (b) That tendencies of 0.1, 0.2 millibars should be reported as 41, 42, 43, for positive tendencies and as 91, 92, 93, for negative tendencies.
- (c) If a tendency greater than 40 occur on an exceptional occasion it should be reported as observed and a note "tendency in half-millibars" added at the end of the message.

Proposal of Dr. Hesselberg.

It is suggested that the existing instructions for determining the appropriate characteristic number of the telegraphic code (0 - 9) should be replaced by actual standard types of trace as illustrated below. The numbers 4 and 8 correspond with traces of both the types illustrated.

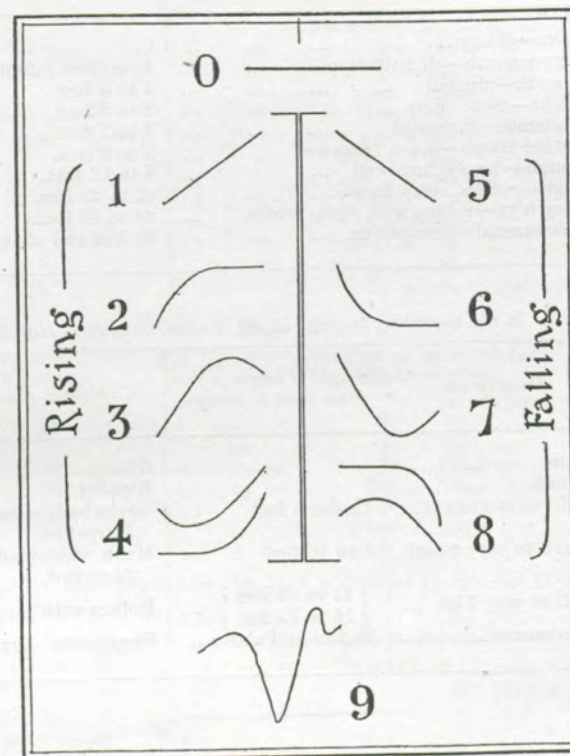


FIG. 1.

If this proposal were adopted, it would be unnecessary to add 5 or 50 to denote negative tendencies, as the sign of the tendency would be given by the characteristic (1 to 4 mean "plus" tendency, 5 - 8 mean "minus" tendency).

APPENDIX IV.

OBSERVATION OF SEA DISTURBANCE.

New Scale Proposed.

Scale.	Description.	Height of waves in feet from crest to trough.
0	Calm—glassy... ..	0.
1	Very smooth—slightly rippled	Less than 1 foot.
2	Smooth—rippled	1 to 2 feet.
3	Slight—rocks buoy	2 to 3 feet.
4	Moderate—furrowed	3 to 5 feet.
5	Rather rough—much furrowed	5 to 8 feet.
6	Rough—deeply furrowed	8 to 12 feet.
7	High—rollers, steep fronts	12 to 20 feet.
8	Very high—rollers with steep fronts	20 to 40 feet.
9	Phenomenal—precipitous	40 feet and above.

Scale now in use according to page 51 of *Marine Observer's Handbook*.

Scale.	Description.	Height of waves in feet from crest to trough.	Condition of surface.
0	Calm	—	Glassy.
1-2	Smooth	—	Rippled.
3-4	Slight to moderate	Under 5 feet ...	Rocks buoy or small boat. Furrowed.
5-6	Rough to very rough	5 to 10 feet ...	Much disturbed, deeply furrowed.
7-8	High to very high	{ 11 to 15 feet } { 16 to 35 feet } ...	Rollers with steep fronts.
9-10	Phenomenal	36 feet and above ...	Precipitous—towering.

APPENDIX V.

VISIBILITY SCALE.

Hydrographic Department,
Admiralty,
Whitehall, S.W.1.

25th June, 1919.

SIR,

With reference to previous communication of the 31st January last, No. 01539, enclosing copy of the Meteorological Code for the Transmission of General Weather Reports from Observing Stations to Central Office, I beg to inform you that with reference to the "Surface Visibility" and "Fog Scales" therein, it is not definitely understood in this Department whether the distances given in the code are Mean Values for the appropriate numbers on the scales or whether they are to be taken as "Limiting Values."

In the Meteorological Branch of this Department the distances given are taken as limiting values, and for any given number on the visibility or fog scale the equivalent distance is regarded as the upper limit and

the next lesser distance as the lower limit of the range within which the surface visibility or "f" number is as stated. (7f—25 metres is regarded as a somewhat unnecessary exception to this rule.)

I shall be glad of your views in the matter and to be informed what interpretation is in current use at the Meteorological Office, observing that it is considered in this Department that the "Limiting Value" scheme should be accepted generally and the scales in question re-cast to read as follows:—

Surface Visibility.

Number.	Distance of most distant object visible.
0	0—200 metres
1	200—500 "
2	500—1,000 "
3	1,000—2,000 "
4	2,000—4,000 "
5	4,000—7,000 "
6	7,000—12,000 "
7	12,000—20,000 "
8	20,000—30,000 "
9	No observations.
10	V.—Above 30,000 metres.

Fog Scale.

Number.	Distance of most distant object visible.
7f	0—25 metres
6f	25—50 "
5f	50—100 "
4f	100—200 "
3f	200—500 "
2f	500—2,000 "
1f	2,000—10,000 "
0f	10,000—30,000 "

A letter in these terms has also been addressed to the Air Ministry.

I am, Sir,

Your obedient Servant,

H. P. DOUGLAS,
for Hydrographer.

The Director,
Meteorological Office,
South Kensington, S.W.7.

NOTE ON APPENDIX V.

Surface Visibility.

To ensure agreement with the "land scale" given in Section VI of Appendix VII. the limiting distances corresponding with the different numbers of the scale should be as follows:—

Number.	Corresponding limiting distances.
0	0—490 metres
1	500—900 "
2	1,000—1,900 "
3	2,000—3,900 "
4	4,000—6,900 "
5	7,000—11,000 "
6	12,000—19,000 "
7	20,000—29,000 "
8	30,000 upwards
9	No observation.
10	above 30,000 metres clear air,

II.

Fog.

To ensure agreement with "land scale" given in Section II of Appendix II.

Number.	Distance.
8f	0- 24 metres
7f	25- 49 "
6f	50- 90 "
5f	100- 190 "
4f	200- 490 "
3f	500- 1,900 "
2f	2,000- 9,000 "
1f	10,000-20,000 "
0f	30,000 upwards.

APPENDIX VI.

AMUNDSEN'S EXPEDITION.

The Norwegian Minister presents his compliments to the Secretary of State for Foreign Affairs and, by order of his Government, has the honour to apply for Earl Curzon of Kedleston's kind assistance in the following matter:

By a Bill of the 21st March this year it was proposed to the Norwegian Storting that the necessary means should be granted to establish and run geophysical stations which should be worked in co-operation with Roald Amundsen's Expedition to the North Pole.

It is also suggested in the Bill that the Norwegian Government should approach the Governments of Great Britain, Canada, Finland, Sweden, Denmark, Iceland, United States of America, Japan, and Siberia with a view of learning whether these countries would be willing to take part in this work.

Monsieur Vogt begs leave to enclose two copies of "Geophysical Investigations in the Arctic Regions in Co-operation with Roald Amundsen's Expedition," and would feel much obliged for being informed whether the Governments of the United Kingdom and Canada would be willing to establish such co-operation, which would, no doubt, be of very great importance.

Norwegian Legation,
London.

May 9th, 1919.

*Geophysical Investigations in the Arctic Regions in Co-operation with
Roald Amundsen's Expedition.*

As Roald Amundsen had decided to start his Arctic voyage in the year 1914, the International Aerological Polar Commission held a meeting in Copenhagen, February 28th-March 1st, 1914, at which was planned an international co-operation with the expedition.¹ They decided to promote the erection of a network of aerological stations round about the Arctic Ocean, where, as far as possible, meteorological and aerological observations should be made as long as the expedition lasted. In the meantime, the war broke out, international co-operation was impossible, and the expedition was postponed.

¹ Procès-verbaux des séances de la Commission Internationale Polaire d'aérostation scientifique, Réunion de Copenhague 28 février-1 mars, 1914. St. Petersburg, 1914.

In spite of the war, Roald Amundsen managed to start his expedition in June, 1918. He took with him a large and first-class meteorological, aerological, and oceanographical outfit and instruments for measurements of the terrestrial magnetism and investigations of the northern lights. In addition, he succeeded in engaging the meteorologist Dr. H. U. Sverdrup as leader of the scientific work of the expedition. The latter has, therefore, the best conditions to be able to make valuable geophysical investigations in the Arctic Regions. However, these investigations have much less value when they are performed isolated than when geophysical observations are also made at stations round about the Arctic Ocean. It would, therefore, be most valuable if as many geophysical stations as possible could be erected to co-operate with the expedition.

For the work of these stations, there has been, in close agreement with the determinations in Copenhagen, made out the following plan:

1. As long as Roald Amundsen's Expedition lasts, aerological observations are, as far as possible, to be made. This will be of greatest importance in the principal year, 1920, when Amundsen will be nearest to the North Pole. Later on, there shall, in any case, even at stations of limited material, be taken observations on the days given in the following table.

Table of Fixed Days.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1919	2	5-7	6	3	8	4-6	3	4-9	4	8-10	6	4
1920	7-9	5	4	8	5-7	10	5-10	5	8-10	7	4	2
1921	6	3	3	6-8	12	6-11	7	3-5	8	6	3	7-9
1922	5	2	8-10	6	8-13	8	5-7	3	7	5	1-3	7
1923	4	7-9	8	2-7	3	6-8	5	2	6	3-5	8	6
1924	2-4	7	3-8	3	7-9	5	3	7	3-5	2	6	4

By arrangement with Dr. Sverdrup, the expedition will on these days make ascents with registering balloons, kites, captive balloons or pilot balloons.

2. The following programme for observations must be considered necessary:

- (a) Meteorological observations as they are performed at a first order station.
- (b) Pilot balloon ascents, which, at least in the year 1920, are to be performed daily.
- (c) Observations made as frequently as possible on the direction and velocity of the motion of clouds.
- (d) Kite ascents, ascents of captive balloons, and, as far as possible, registering balloons at the stations intended for the purpose.

3. The stations are to perform observations at three fixed hours daily (at local time). On the fixed days given at the above table, there shall be performed at 7 a.m. (Greenwich time) direct observations of all meteorological elements and at the same time the aerological ascents are to take place.

4. As the expedition is taking with it registering apparatus for terrestrial magnetism, it will be of great importance that the stations are as far as possible also equipped with such.

5. The stations are, if possible, to be equipped with apparatus for the photographing of the northern lights.¹ It is specially required to get

¹ Concerning the photographing of northern lights refer to the following papers by C. Störmer. Sur les trajectoires des corpuscules électrisés dans l'espace 21. Archives des sciences physiques et naturelles, Genève, 1911. Terrestrial magnetism, 1913, 1915, and 1916. Astrophysical Journal, No. 1913, and April, 1916. Comptes rendus, Paris, 16 June 1913, and 13 March, 1916. Bulletin de la Soc. Astr. de France, November, 1913.

photographs on the above mentioned fixed days. The best thing would be to perform photography of the northern lights at the same time at two stations connected by telephone for the determination of the height and position of the northern lights, the stations being at a distance of about 25km. from each other. If no basis can be obtained, the northern lights should be photographed from one station. It may then be limited by only photographing coronas and quiet, regular arcs and bands for the determination of their accurate position among the stars. It is especially of importance to get photographs of the highest point of the arc and the terminal points on the horizon in speedy succession in order to get variations with the time.

The usual observations of the northern lights are also required, particularly the hour for the appearance of special forms, *e.g.*, corruscation, corona- and drapery-formations. These observations should also be made at the stations which are not equipped with apparatus for the photography of northern lights. Further, the following may be emphasised:—

6. It is essential that possible Arctic expeditions, *e.g.*, Aeroplane Expeditions, should be equipped with instruments so that they can in a scientific respect co-operate with Roald Amundsen's Arctic Expedition. It is particularly of importance to perform aerological observations on the fixed days given in the above table.

7. The observations should be published as soon as possible. A collected scientific treatment of the material will be carried out by Dr. Sverdrup.

8. Owing to the limited time it is to be foreseen that it may be impossible to establish all the stations in the year 1919. Stations which are established in the summer 1920 will also be of exceedingly great importance.

As the matter is of great importance it is hoped that the Norwegian Government will grant the necessary funds to establish kite and registering balloon stations at Spitsbergen, Tromsø, Kristiania and Bergen. In the north of Russia it is likely that there will be established two or three pilot balloon stations at the "Central Hydrometeorological Station" at Archangel. It is hoped that the countries to which the Norwegian Government will send a request to take part in the matter, will do this as far as in their power. We have here an exceedingly good opportunity of extending our knowledge and understanding of the geophysical conditions of the Arctic regions.

Communication concerning the erection of stations and their working programme should be sent to the Norwegian Meteorological Institution, Kristiania.

Kristiania,

February, 1919.

APPENDIX VII.

CODES FOR REPORTS FROM INDIVIDUAL STATIONS TO A CENTRAL OFFICE.

Symbolically the message is

BBBDD FwwTT βbbH.k hA.LA₂H SW.W.W₂W₂ (9W₃W₃W₄W₄)

ADDVH MxMxRRR (at 18h.)

MnMnRRR (at 7h.)

where BBB = Barometer in millibars and tenths

DD = wind direction in points

F = wind force Beaufort Scale (for force 10, 11, 12 omit initial 1 and add 50 to wind direction)

ww = present weather. (See Code I. attached)

TT = temperature in whole degrees

β = characteristic of tendency. (See Code III. attached)

bb = tendency in half-millibars (add 50 for fall)

where H₁ = relative humidity. (Code IV. attached)

k = visibility. (Code VI. attached)

h = height of lowest cloud. (Code V. attached)

A₁ = form of low cloud. (Code VIII. attached)

L = amount of low cloud (10 telegraphed as 0)

A₂ = form of high cloud or medium cloud. (Code VIII. attached)

H = amount of high cloud or medium cloud (10 telegraphed as 0)

S = sea disturbance. (Code IX. attached)

W₁W₂W₃W₄ = 2 pairs of past weather figures; if two pairs are not enough on any occasion add 2 more pairs as indicated by (9W₃W₃W₄W₄). (Code II. attached)

MxMx = maximum temperature in the day (whole degrees)

RRR = rainfall in day (millimetres and tenths). (Code X. attached)

MnMn = minimum temperature at night (whole degrees)

RRR = rainfall in night (millimetres and tenths). (Code X. attached)

A = form of cloud from which velocity and direction are observed by nephoscope

DD = direction of cloud. This could be conveniently to nearest 5° using numbers 1 to 72,

V = relative speed or velocity-height-ratio of cloud, *i.e.*, if z is height of cloud in 1000's of feet, zV = speed of cloud in feet per second.

H = hour of observation of upper cloud; initial 1 or 2 omitted (on 1 to 24 system). No risk of confusion except that 21h might be confused with 1h., call 1h. 25h. for this purpose

(This is so that upper cloud can be observed at any time when it appears, without depending on the chance of getting it at one of the four fundamental hours.)

If no cloud was observed the group ADDVH would be omitted.

Where additional information was required, *e.g.*, grass minimum and duration of sunshine at 7h. or solar maximum and duration of sunshine from dawn to 18h., a group could be added.

As A would never be 9 there would be no risk of confusing the cloud group with a second "past weather" group.

Rainfall and other phenomena reported only at certain of the reporting hours are appropriately provided for by special groups additional to the general regular groups. Rainfall ought always to be reported twice daily.

Visibility at night ought to be obtained for a number of stations by having lights at selected distances; all 1st order observatories ought to have this without exception.

Code I.—Present weather.

NOTE:—Numbers 00 to 49 refer to weather *without* precipitation.

72, 73. " 50 to 99 " " with precipitation, except for 71,

No.		
00	Cloudless absolutely	=b
01	Some cloud, but less than 1	=b ₁
02	Sky about 1/2 clouded	=bc
03	Sky about 3/4 clouded	=c
04	Sky overcast but small amount of blue visible	=o
05	Sky absolutely overcast	=o
06	Overcast and 1f	} Haze and mist
07	Overcast and 2f	
08	Overcast and 3f	
09	Overcast and 4f	
10	Overcast and 5f	} Sky overcast, varying degrees of haze, mist or fog.
11	Overcast and 6f	
12	Overcast and 7f	
13	Overcast and 8f	

No.		
14	Haze 1f	Varying degrees of haze or fog. Information regarding state of sky given by cloud group.
15	Haze 2f	
16	Fog 3f	
17	Fog 4f	
18	Fog 5f	
19	Fog 6f	
20	Fog 7f	Varying degrees of mist or wet fog. Information regarding state of sky given by cloud group.
21	Fog 8f	
22	Mist 1fe	
23	Mist 2fe	
24	Fog 3fe	
25	Fog 4fe	
26	Fog 5fe	Miscellaneous Phenomena
27	Fog 6fe	
28	Fog 7fe	
29	Fog 8fe	
30	e (wet air)	
31	Exceptional visibility	
32	Haze	Miscellaneous Phenomena
33	Dew	
34	Hoar Frost	
35	Rime	
36	Glazed Frost	
37	Glazed Roads	
38	Solar halo	Miscellaneous Phenomena
39	Lunar halo	
40	Sola corona	
41	Luna corona	
42	Aurora	
43	Squalls	Rain and Fog.
44	Gale	
45	Gloom	
46	Ugly, threatening	
47	Thunder	
48	Lightning	Rain and Fog.
49	Thunder and lightning	
50	Slight rain and 2f or 3f	
51	Moderate rain and 2f. or 3f	
52	Heavy rain and 2f or 3f	
53	Slight rain and 4f or 5f	Rain and Fog.
54	Moderate rain and 4f or 5f	
55	Heavy rain and 4f or 5f	
56	Slight rain and 6f to 8f	
57	Moderate rain and 6f to 8f	
58	Heavy rain and 6f to 8f	Rain and Fog.
59	Slight rain and squalls of wind	
60	Moderate rain and squalls of wind	
61	Heavy rain and squalls of wind	
62	Slight rain and hail and squalls	Squally conditions with rain, hail or snow.
63	Moderate rain and hail and squalls	
64	Heavy rain and hail and squalls	
65	Slight sleet and squalls	
66	Moderate sleet and squalls	
67	Heavy sleet and squalls	Snow lying.
68	Slight snow and squalls	
69	Moderate snow and squalls	
70	Heavy snow and squalls	
71	Snow lying covering the whole country	
72	Snow lying but patches of bare ground	
73	Snow lying and deep drifts	
74		
75		
76		

No.		
77	Slight drizzle	Drizzle.
78	Moderate drizzle	
79	Thick drizzle	
80	Slight rain	Rain without qualification
81	Moderate rain	
82	Heavy rain	
83	Slight hail	Hail.
84	Moderate hail	
85	Heavy hail	
86	Slight sleet	Sleet.
87	Moderate sleet	
88	Heavy sleet	
89	Slight snow	Snow.
90	Moderate snow	
91	Heavy snow	
92	Slight thunderstorm	without hail
93	Moderate thunderstorm	
94	Heavy thunderstorm	
95	Slight thunderstorm	with hail
96	Moderate thunderstorm	
97	Heavy thunderstorm	

Code II.—Past weather.

Notes:—Numbers 00-49 refer to past weather where there has been no precipitation.

Numbers 50-99 refer to past weather where there has been precipitation.

No.		
00	Cloudless	Without precipitation or fog
01	Mainly b and bc ; medium or high cloud	
02	Mainly b and bc ; low cloud	
03	Mainly b and bc ; mixed cloud	
04	Mainly bc and c ; medium or high cloud	
05	Mainly bc and c ; low cloud	
06	Mainly bc and c ; mixed cloud	
07	Mainly c and o ; medium or high cloud	
08	Mainly c and o ; low cloud	
09	Mainly c and o ; mixed cloud	
10	Overcast, but occasional patches of blue sky visible ; medium or high cloud.	Without precipitation or fog
11	Overcast, but occasional patches of blue sky visible ; low cloud.	
12	Overcast, but occasional patches of blue sky visible ; mixed cloud.	
13	Completely overcast, with no blue sky at all visible ; low cloud or mixed cloud.	
14	Mainly b and c ; low cloud or mixed cloud	
15	Overcast and 1f	
16	Overcast and 2f	
17	Overcast and 3f	
18	Overcast and 4f or 5f	
19	Overcast and 6f to 8f	
20	Haze 1f	Cloud above fog, so that sun or stars not visible at all.
21	Haze 2f	
22	Fog 3f	
23	Fog 4f or 5f	
24	Fog 6f or 8f	
25	Mist 1fe	
26	Mist 2fe	
27	Fog 3fe	
28	Fog 4fe or 5fe	
29	Fog 6fe to 8fe	

No.		
30	e (wet air)	
31	Exceptional visibility	
32	Haze	
33	Dew	
34	Hoar frost	
35	Rime	
36	Glazed frost	
37	Glazed roads	
38	Solar halo	Special phenomena without precipitation
39	Lunar halo	
40	Solar corona	
41	Lunar corona	
42	Aurora	
43	Squalls	
44	Gale	
45	Gloom	
46	Ugly, threatening	
47	Thunder	
48	Lightning	
49	Thunder and lightning	
50	Passing showers light	Showers.
51	Passing showers moderate	
52	Passing showers heavy	
53	Passing showers slight	
54	Passing showers moderate	
55	Passing showers heavy	
56	Passing showers slight	
57	Passing showers moderate	
58	Passing showers heavy	
59	Passing showers slight	
60	Passing showers moderate	
61	Passing showers heavy	
62	Occasional slight	Occasional precipitation.
63	Occasional moderate	
64	Occasional thick	
65	Occasional slight	
66	Occasional moderate	
67	Occasional heavy	
68	Occasional slight	
69	Occasional moderate	
70	Occasional heavy	
71	Occasional slight	
72	Occasional moderate	
73	Occasional heavy	
74	Occasional slight	
75	Occasional moderate	
76	Occasional heavy	
77	Continuous or nearly continuous slight	Drizzle
78	Continuous or nearly continuous moderate	
79	Continuous or nearly continuous heavy	
80	Continuous or nearly continuous slight	Rain
81	Continuous or nearly continuous moderate	
82	Continuous or nearly continuous heavy	
83	Continuous or nearly continuous slight	Rain and hail.
84	Continuous or nearly continuous moderate	
85	Continuous or nearly continuous heavy	
86	Continuous or nearly continuous slight	Sleet or rain and sleet.
87	Continuous or nearly continuous moderate	
88	Continuous or nearly continuous heavy	
89	Continuous or nearly continuous slight	Snow.
90	Continuous or nearly continuous moderate	
91	Continuous or nearly continuous heavy	

No.		
92	Thunderstorm slight	without hail
93	Thunderstorm moderate	
94	Thunderstorm heavy	
95	Thunderstorm slight	with hail
96	Thunderstorm moderate	
97	Thunderstorm heavy	

Thunderstorm.

Code III.—Characteristic of Barometric Tendency.

Number.		
0—steady	...	0
1—unsteady	...	U
2—rising	...	+
3—falling	...	-
4—falling, then rising	...	- +
5—steady, then rising	...	0 +
6—steady, then falling	...	0 -
7—falling, now steady	...	- 0
8—rising, now steady or falling	...	+ 0 -
9—line squall	...	LQ

Code IV.—Relative Humidity.

Number.		
0	...	95-100 per cent.
1	...	90-94 "
2	...	85-89 "
3	...	less than 40 "
4	...	40-49 "
5	...	50-59 "
6	...	60-69 "
7	...	70-79 "
8	...	80-84 "
9	...	no observation.

Code V.—Height of Lowest Cloud.

Number.		
0	...	cloud below 500 feet.
1	...	1,000-1,500 "
2	...	1,500-2,000 "
3	...	2,000-3,000 "
4	...	3,000-4,000 "
5	...	4,000-5,000 "
6	...	5,000-7,000 "
7	...	7,000-9,000 "
8	...	500-1,000 "
9	...	no observation or no low cloud.

Code VI.—Surface Visibility.

Number.		
0	...	Distance of most distant object visible.*
1	...	200 metres or less.
2	...	500 metres.
3	...	1,000 "
4	...	2,000 "
5	...	4,000 "
6	...	7,000 "
7	...	12,000 "
8	...	20,000 "
9	...	30,000 "
10	...	No observation.
	...	V—above 30,000 metres and clear air.

* The "object" is one of a definite set of objects at the distances of the table; and the heading should strictly be "distance of the most distant of the selected objects which is visible." This may be made clearer by the following method of specification which was the original method.

Number.		
0	Objects not visible at a distance of 500 metres.	
1	Objects visible at 500 metres but not at 1,000 metres.	
2	" " 1,000 " " 2,000 "	
8	" " 30,000 " " and air clear.	
10	" " 30,000 " " and air clear.	

The typical object to be selected for observation whenever possible is an object on the sky line subtending a vertical angle of 10 feet and a horizontal angle of $2\frac{1}{2}$ feet, i.e., at a distance of 10 km. a suitable object would be a tower 30 metres high and 8 metres broad.

Code VII.—Fog Scale.

Number.	Distance of most distant object visible.
Fog ... { 8f Less than 25 metres.	
7f 25 "	
6f 50 "	
5f 100 "	
4f 200 "	
3f 500 "	
Haze or mist { 2f 2,000 "	
1f 10,000 "	
0f 30,000 "	

This scale is used for night observations, the observer using his experience of daylight observations and whatever means are available locally to arrive at a fair estimate.

Approximate Relation between Visibility and Fog Scale.

Fog.	(In Daylight.)	Visibility.
8f	}	0
7f		
6f		
5f		
4f		
3f	}	1
2f		
1f		
0	}	2
	}	3
	}	4
	}	5
	}	6
	}	7
	}	8
	}	10

Code VIII.—Form of Cloud.

Number.	Form.
Low cloud:	
1	Fracto Cumulus.
2	Mammato Cumulus.
3	Low Strato Cumulus (below 4,000 feet).
4	High Strato Cumulus (above 4,000 feet).
5	Nimbus.
6	Cumulus.
7	Cumulo Nimbus.
8	Stratus.
Medium cloud:	
5	Thin Alto Stratus (Sun or Moon visible).
6	Thick Alto Stratus.
7	Alto Cumulus (low).
8	Alto Cumulus (high)
High cloud:	
1	Cirrus.
2	Cirro Stratus.
3	Cirro Cumulus.
4	False Cirrus.

{ Dividing line between low and high to be about 3 km. or 10,000 feet.

Code IX.—Sea Disturbance.

Number.	
0	calm glassy.
1	very smooth slightly rippled.
2	smooth rippled.
3	slight rocks small boat or buoy.
4	moderate furrowed.
5	rather rough much furrowed.
6	rough deeply furrowed.
7	high rollers with steep points.
8	very high rollers with steep points.
9	phenomenal towering, precipitous.

Heights from Crest to Trough of Waves.

Number.	Feet.	cm.
0	$\frac{1}{2}$ or	15
1	$\frac{1}{2}$ — $1\frac{1}{2}$ "	15—45
2	$1\frac{1}{2}$ — $2\frac{1}{2}$ "	45—75
3	$2\frac{1}{2}$ — $3\frac{1}{2}$ "	75—105
4	$3\frac{1}{2}$ — $4\frac{1}{2}$ "	105—135
5	$4\frac{1}{2}$ —6 "	135—180
6	6— $7\frac{1}{2}$ "	180—225
7	$7\frac{1}{2}$ —10 "	225—300
8	15 and upwards	450 and upwards.

Code X.—Rainfall for Collective Telegrams.

Number.	
0	Nil or trace.
1	1 mm.
2	2 mm.
3	3 mm.
4	4 mm.
5	5—7 mm.
6	8—12 mm.
7	13—25 mm.
8	Over 25 mm.
9	No report.

Revised Draft Code for Meteorological Reports of the Upper Air by Telegram.

For upper wind information areas would be taken and one station (the highest ascent) for each area would be sent. For the British Isles the existing division by districts would suffice. No ascent for less than 3,000 feet would be sent.

Code: Index Number (see below) **NNHHB** $h_1D_1D_1V_1V_1$ $h_2D_2D_2V_2V_2$ &c.

Where **NN** = station number.

HH = time to nearest hour.

B = how balloon lost (see below).

h_1 = height in 1,000's feet (1 or 2 omitted for heights above 10,000 feet).

D_1D_1 = direction to 72 points (i.e., number of degrees divided by 5, so that 256° becomes 51 and so on).

V_1V_1 = velocity in miles per hour.

Scale for B. (How Balloon Lost.)	Heights to be used. Alternative Sets.	
1—in cloud	Surface.	Surface.
2—cloud passed below	500 metres.	2,000 feet.
3—in distance or haze	1,000 "	3,000 "
4—in sun or moon	1,500 "	4,000 "
5—burst	2,000 "	6,000 "
6—accidentally lost from field	3,000 "	8,000 "
7—confused with star: last group doubtful	4,000 "	10,000 "
8—confused with star: last two groups doubtful ... {	5,000 " 6,000 "	15,000 " 20,000 "

In all cases of Pilot Balloon Winds (except for surface) the wind given should be the mean value for a layer centering at the height given and equal in thickness to the vertical distance covered by the balloon in two minutes.

Index Group.

	Index Group.
Wind from Balloon (1 theodolite)	49867
" " " (2 theodolites)	49846
" by Sound ranging	49835
" from Shell-bursts (2 mirrors)	49821
" " " (1 mirror)	49957
" " " (aeroplane observation)	49998

Standard Heights for Shell-bursts.—In the case of shell-bursts standard heights 6,000, 10,000, 15,000, 20,000 feet should be adopted as far as possible: these correspond, roughly, with 2,000, 3,000, 4,500, 6,000 metres.

Upper Air Temperatures and Humidities.—These should be sent for a selection of stations; if possible 2 in Ireland, 2 in Scotland, 1 in North England, 1 in S.W. England, 1 in Midlands, 1 in S.E. England, i.e., 8 places in all for the British Isles.

They should be sent for definite pressure of, say:—

1,000, 950, 900, 850, 800, 750, 700, 650, 600 millibars
numbered 1 2 3 4 5 6 7 8 9

but in addition the following should be sent:—

- (1) Temperature and humidity at 1,000 feet above ground level.
- (2) Pressure at any inversions and increase of temperature there.

Code: 47519 **NNHHM 1TTHH 2TTHH 3TTHH 4TTHH xTTHH**
BBBtt.

Where 1 = 1,000 millibars.

2 =	950	"
3 =	900	"
4 =	850	"
5 =	800	"
6 =	750	"
7 =	700	"
8 =	650	"
9 =	600	"

TT = temperature in degrees Fahrenheit.

HH = relative humidity computed from wet and dry bulb readings or hair hygrometer.

xTTHH = for 1,000 feet.

BBB = pressure in millibars at inversion.

tt = increase of temperature there.

NNHHM = stations number and time of ascent to nearest 10 minutes.

APPENDIX VIII.

RULES OF INTERNATIONAL METEOROLOGICAL ORGANISATION.

The International Meteorological Organisation comprises:—

1. Conferences of Directors.
2. The International Meteorological Committee.
3. Commissions.

1. *Conferences of Directors.*—The special function of Conferences of Directors is to "discuss concrete questions, to agree as to methods of observation and calculation, and to organise co-operative researches."* Purely theoretical questions cannot be included in the programmes of the Conferences.

The Conferences are to be convoked by the International Committee (see below).

The Officers of the Committee shall invite to the Conferences all Heads of Systems of Stations and the Directors of Meteorological Observatories which are official and independent of one another in each country.

Further, the Officers shall consult the Directors of official services in each country as to whether the Directors of certain private institutes, or the representatives of Meteorological Societies shall be invited to attend.

2. *The International Meteorological Committee.*—The Conferences of Directors shall nominate a Committee whose authority shall end at the following Conference. The Committee shall be composed of members chosen by the Conference. Each member must belong to a separate country, and must be the Director of an independent meteorological establishment.

The Committee is empowered to elect new members in the event of the resignation or death of any of its members. It may also co-opt, for the purpose of consultation, distinguished men of science whose advice is likely to prove of service.

The Officers, consisting of a President and a Secretary, are nominated by the Committee.

The Committee shall superintend the carrying out of the resolutions adopted at the Conferences. It shall make it its business to propose measures likely to prove helpful to the development of Science, to bring about uniformity of ideas, or to foster the maintenance of good relations between the services of different countries, and shall prepare for discussion questions to be submitted to the Conferences. Whenever necessary it shall appoint Commissions, whose duty it will be to advance the study of special questions.

3. *The Commissions.*—One of the objects of the International Meteorological Organisation is, "to organise co-operative researches." Since 1891, the International Committee has, with this end in view, appointed several Commissions. The creation of these Commissions has been of the utmost service in the development of our Science. By this agency we have been able to organise and carry out successfully, work which would have been beyond the power of individual workers. It is most desirable that all who are working at the same or similar problems should meet periodically, to allow ideas to become crystallised, and to co-ordinate isolated efforts, without in any way interfering with personal initiative.

In the cases of newly organised Commissions, the Presidents shall be nominated by the Committee.

The Commissions have power to co-opt additional numbers, and to arrange their work as they please.

The Presidents of Commissions who are not members of the Committee shall be invited to attend the meetings of the Committee, and to take part in the discussions, but with a consultative voice only. At the com-

* Munich, Rapport du Bureau, p. 2, re-adopted at Innsbruck (pp. 17, 28).

mencement of each meeting of the Committee they should present a report on the work of their Commission.

Dates of Meetings.—The Directors' Conferences are to be convoked by the International Committee when there are important questions to be submitted for discussion.

The Committee and the Commissions shall meet, as a general rule, once in three years.

The Officers of the Committee shall inform members of the Committee and the Presidents of Commissions by circular, one year in advance, of the intention to hold a meeting of Committee, and shall desire them to fix the time and place of the meeting by vote.

The date and place for a meeting of a Commission shall be fixed by the President of the Committee and the President of the Commission acting conjointly.

It is very desirable that those who wish to bring up a subject for discussion at a meeting of the Committee, or of a Commission,* should distribute a short report on it to the respective members two months before the meeting.

* Southport, 11th September, 1903, p. 18.

ANNEXE.

In accordance with paragraph 3 on page 16 in the Minutes of the Fourth Meeting of the Committee, the following Norwegian telegraph code has been received from Dr. Hesselberg.

NORWEGIAN TELEGRAM CODE.

At 7 a.m., 1 p.m., and 7 p.m. are telegrams worked out at the barometer stations after the following code:—

BBDD FWTTT HHHA β bbRRR DDVmm rreck

Meaning:—

BBB—Barometer in millibars and tenths, or millimetres of mercury and tenths.

DD—Wind direction in points (02–32).

F—Wind force, Beaufort scale (for wind forces 10, 11 and 12 write 9 and at the end of the telegram storm 10, storm 11, or storm 12).

W—Weather in scale 0–9 (the international code).

TTT—Temperature (Celsius) in degrees and tenths.

HHH—Relative humidity (at stations with hygrometer). Reading of wet thermometer (at stations with psychrometer).

A—The most widespread cloudform in scale 0–9 (Code I attached).

β —Characteristic of tendency (Code II attached).

bb—Tendency in millibars and tenths, or millimetres of mercury and tenths.

RRR—Rainfall since the last telegram in millimetres and tenths. (In the telegram at 7 a.m., rainfall 7 p.m. to 7 a.m., in the telegram at 1 p.m., rainfall from 7 a.m. to 1 p.m., and in the telegram at 7 p.m., rainfall 1 p.m. to 7 p.m.).

DD—Direction of the drift of lower clouds in points 02–32.

V—Velocity of the lower clouds in scale 0–3 (Code III attached).

mm—Minimum temperature (degrees Celsius) at night (whole degrees). In telegrams at 1 p.m. and 7 p.m. write 99.

rr—Hour of the beginning of rainfall (Code IV attached).

cc—Hour of the cessation of rainfall (Code V attached).

k—Characteristic of past weather (Code VI attached).

CODE I.

Cloud forms.

In the Norwegian text the popular names of the cloud forms are given; also descriptions and pictures of them.

0—no clouds.

1—Ci.

2—CiSt, ASt.

3—CiCu, ACu.

4—StCu, St.

5—Cu.

6—FrCu.

7—CuNi.

8—Ni.

9—darkness or fog prevents observation, or the observer cannot decide which cloud form he has before him.

CODE II.

Characteristic of Barometrical Tendency.

- | | |
|---|--|
| 0—steady | } The barometer now
higher than three
hours ago. |
| 1—rising | |
| 2—rising, then steady | |
| 3—rising, then falling | |
| 4—falling, then rising, or steady, then rising | |
| 5—falling | } The barometer now
lower than three
hours ago. |
| 6—falling, then steady | |
| 7—falling, then rising | |
| 8—rising, then falling, or steady, then falling | |
| 9—unsteady | |

See Fig. I. on page 23.

CODE III.

Velocity—the Drift of Lower Clouds.

- 0—no drift.
- 1—slow drift.
- 2—medium drift.
- 3—rapid drift.
- 9—no observation.

CODE IV.

Hour of the Beginning of Rainfall.

- 01—12 $\frac{1}{2}$ a.m.
- 02—12 $\frac{1}{2}$ a.m.
- etc.
- 95—11 $\frac{1}{2}$ p.m.
- 96—12 midnight.

Further is—

- 98—rainfall began before last hour of observation.
- 99—hour of the beginning of rainfall cannot be given.
- 00—no rainfall since the last hour of observation.

The hour of the beginning of the rainfall shall only be given when it has begun after the last hour of observation. If it began before last hour of observation shall 98 be written in the telegram. If the rain falls in showers, the hour of the beginning of the first shower is to be given.

CODE V.

Hour of the Cessation of Rainfall.

- 01—12 $\frac{1}{2}$ a.m.
- 02—12 $\frac{1}{2}$ a.m.
- etc.
- 95—11 $\frac{1}{2}$ p.m.
- 96—midnight.

Further is—

- 98—rainfall has not yet ceased.
- 99—hour of the cessation of rainfall cannot be given.
- 00—no rainfall since the last hour of observation.

The hour of cessation of rainfall shall only be given when it has ceased after the last hour of observation. If it is raining at the present hour of observation 98 is to be written in the telegram. If the rain falls in showers, the hour of the cessation of the last shower shall be given.

CODE VI.

Characteristic of Past Weather.

- 0—chiefly clear weather without precipitation.
- 1—chiefly overcast weather without precipitation.
- 2—chiefly mist or fog without precipitation.
- 3—distant thunder and lightning without rainfall at the station.
- 4—one or more light rainshowers (snowshowers).

- 5—one or a few squalls of rain (snow).
- 6—thunder and lightning with precipitation.
- 7—frequent squalls of rain (snow) with gleams of sunshine.
- 8—frequent squalls of rain (snow) without gleams of sunshine.
- 9—steady rainfall (snowfall).

REMARKS.

I.—Concerning TTT.

We consider it important to get the tenths of the temperature, because we wish to draw with great accuracy the limits between cold and warmer currents of air. These limits are very nearly connected with the rainfalls. Further it is necessary to have the tenths of degrees to get accurate values of the humidity. For the observer it is more easy to give the reading direct than to give the nearest whole degree.

II.—Concerning HHH.

We consider it important to have as accurate values of the humidity as possible to be able to draw accurate limits between the different currents of air. Further, it must be mentioned, that by great humidity precipitation falls more easily than by lower humidities. We, therefore, have found our charts of the absolute humidity to be one of the most important charts for forecasting of precipitation. These charts are also necessary for the forecasting of night frosts.

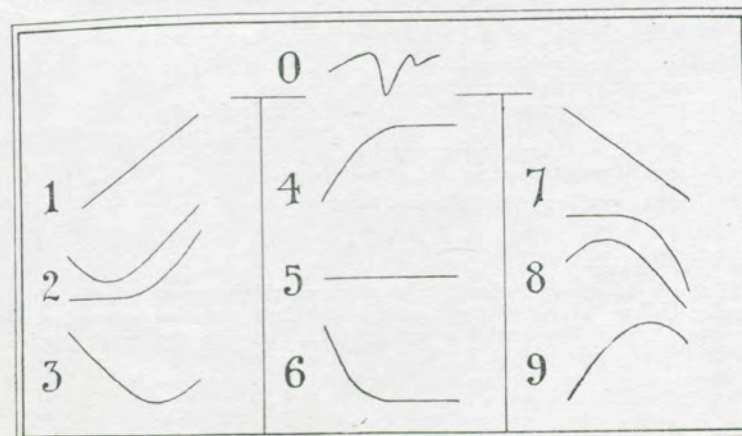
III.—Concerning A.

We find our code for cloudforms good, because it gives only the most important forms. Our observers (about 150) have no difficulties in giving the cloudforms after this code. They have no special education.

IV.—Concerning β .

This code gives without artifices (without any adding of 50) the types which are of importance for weather forecasting. The numbers 1-4 give positive tendency, the numbers 5-8 negative tendency, the number 0 gives tendency zero, and the number 9 means that the curve is so unsteady that it has no significance if the tendency is positive or negative.

After conference with the weather service of the Admiralty the following altered code was made:—



The number 0 then gives unsteady; the numbers 1, 2, 4 and 9 give positive tendency; the numbers 3, 6, 7 and 8 give negative tendency and the number 5 tendency zero. The advantage of this code is that the numbers 1-3 give now rising, the numbers 4-6 now steady, and the numbers 7-9 now falling barometer. Linesquall should be included in the weather code.

V.—Concerning *bb*.

When the millimetre is used as unit of pressure it is necessary to have tenths of it in the tendency. When the characteristic of tendency is given as above this can easily be attained. The characteristic gives the sign of the tendency. We therefore have to give here only the numerical value of it.

VI.—Concerning *Report of Sub-Committee on Barometrical Characteristic and Tendency*. (Appendix III., p. 22.)

The double check mentioned under point 2 we do not consider a check, but a trap for the observer. The best observers often make mistakes by the adding of 50. This has several times led to false forecasts. As to the proposal under point 5, we will make the remark that such complex artifices are too difficult for the observer, and will lead to errors.

VII.—Concerning *RRR*.

For the daily control of the forecasts and the understanding of the situation, it is necessary to know when the precipitation has fallen, and how much. Without the tenths we are not able to draw good charts giving the rainfall in 6 hours. We think it important to have measurement of the precipitation at each hour of observation.

VIII.—Concerning *rrcck*.

This group is very important. It gives us the progress of the rainfall. It shows us where the local showers and squalls arise and how they move. Further it gives the rate of propagation of the great rain areas. When this group is given it should be unnecessary to give more about the past weather. When weather telegrams are sent 4 times daily the hours of the beginning and cessation of the precipitation can be given with one cipher.

Beginning of precipitation:—

- 0—no precipitation since the last telegram.
- 1—precipitation began in the first hour after last telegram.
- 2— " " second hour after last telegram.
- 3— " " third hour after last telegram.
- 4— " " fourth hour after last telegram.
- 5— " " fifth hour after last telegram.
- 6— " " sixth hour after last telegram.
- 7— " " seventh hour after last telegram.
- 8— " " before last telegram.
- 9—hour of beginning of precipitation cannot be given.

Cessation of precipitation:—

- 0—no precipitation since last telegram.
- 1—precipitation ceased in the first hour after last telegram.
- 7— " " seventh hour after last telegram.
- 8— " " has not yet ceased.
- 9—hour of cessation of rainfall cannot be given.

If the past weather is given in any other way the characteristic *k* might fall out.

General Remarks.

Above we have only made remarks where we think our code better than the British one. It should be a general principle that the meteorological measurements in the weather telegrams are given with the accuracy with which the readings are made. Even if the last figure is not sure it is an essential help in the drawing of the charts.