1881.

NEW ZEALAND.

INTERCOLONIAL METEOROLOGICAL CONFERENCE HELD AT MELBOURNE IN 1881

(MINUTES OF PROCEEDINGS OF THE).

Presented to both Houses of the General Assembly by Command of His Excellency.

MINUTES OF PROCEEDINGS OF THE INTERCOLONIAL METEOROLOGICAL CONFERENCE HELD AT THE OBSERVATORY, MELBOURNE.

THURSDAY, 21ST APRIL, 1881.

THE Conference commenced at 2.30 p.m.

Present: R. L. J Ellery, Esq., F.R.S., F.R.A.S., Government Astronomer, Victoria; James Hector, Esq., M.D., C.M.G., F.R.S., Inspector of Meteorological Stations, New Zealand; H. C. Russell, Esq., B.A., F.R.A.S., Government Astronomer, New South Wales; C. Todd, Esq., C.M.G., F.R.A.S., Government Astronomer, South Australia.

R. L. J Ellery, Esq., was called to the chair.

1. The Chairman stated that, in accordance with the understanding between the members at the close of the Conference held at Sydney in November, 1879,—that it was desirable to hold a second Conference in Melbourne early in 1881,—he had addressed the following letter to the Hon. the Chief Secretary of Victoria:—

SIR,— Observatory, Melbourne, 17th March, 1881.

In November, 1879, the New South Wales Government invited the different colonial meteorologists to meet in Sydney and hold a Conference with a view of bringing about a more satisfactory intercolonial weather-telegram system, and to decide upon the best means of improving our knowledge of Australian meteorology generally. This Conference was held, and among other matters it was decided, if possible, to hold a similar Conference in Melbourne about twelve months later for a similar purpose. I now find that the gentlemen representing this science in New Zealand, New South Wales, and South Australia will be able to attend in Melbourne about the middle of April. I have now the honor, therefore, to inquire if you approve of such a Conference being held here, and, if so, whether you will cause an invitation to be sent to the Governments of New South Wales, South Australia, and New Zealand, asking that their respective Astronomers or Chief Meteorologists may be authorized to attend such a Conference about the second or third week in April. I would also respectfully suggest that the Governments of Tasmania, Western Australia, and Queensland be invited to send representatives.

I have, &c.,
ROB. L. J ELLERY,
Government Astronomer.

The Hon. the Chief Secretary, Melbourne.

The Minister approved of the proposal to hold a Conference, and at once invited the various colonies to send representatives. Replies from New South Wales, South Australia, and New Zealand agreeing to do so were received. Telegrams were also received from Queensland and Western Australia to the effect that those colonies were unable to send representatives. The following message from the Government of Tasmania was also received:—

2nd April, 1881.

We have no such officer as the one mentioned in your telegram. This Government cannot send delegates to proposed Conference, but concurs generally in objects sought to be obtained, and if Conference is held will communicate their views to the Chairman by letter or memorandum.

To Chief Secretary, Melbourne. WM. MOORE.

The only colonies, therefore, represented at this Conference were New South Wales, South Australia, New Zealand, and Victoria. The Chairman also stated that the Government had placed the services of a shorthand writer at the disposal of the Conference.

It was then resolved that the Government be thanked for their consent to grant the services of a shorthand writer.

2. The Chairman reported that the following resolutions were adopted by the Conference held at Sydney in November, 1879:—

I. That, in view of the great importance which a better knowledge of the movement and origin of strong gales and storms on our coast-lines and neighbouring seas is to the shipping and commercial interest generally, it is desirable to secure, as far as possible, co-operation in all the Australasian Colonies for the investigation of storms, as well as for agricultural and general climatological purposes.

II. That, with the view of giving effect to the foregoing resolution, similar observations and the same form of publication should, as far as possible, be adopted throughout the colonies.

III. That, in order effectively to carry out the objects of the Conference as affirmed in the foregoing resolutions, it is desirable to establish first-class meteorological stations in certain well-selected positions in the several Australasian Colonies, including New Zealand, in addition to those now existing.

IV That the definition of the work of a first-class station, given in the preface to the New Zealand Meteorological Report for 1873, be adopted, viz.,—

"The observations taken are limited to those for determining atmospheric pressure; maximum and minimum daily temperature of atmosphere, and of insulation and radiation; the average daily amount of moisture; the rainfall and number of rainy days; the force and direction of wind; and amount and character of cloud."

V That the instruments at each first-class station consist of a mercurial barometer of either the standard or Board of Trade form; thermometers of Kew or approved patterns, compared with standards as frequently as possible; rain-gauges of 8 inches collecting diameter; and wind-gauges of any approved form. The local hours of observation to be 9 a.m., 3 p.m., and 9 p.m. Beaufort's scale of wind to be adopted; the observations to be recorded in equivalents in velocity and pressure.

VI. That it is very desirable to obtain the co-operation of the Government of Tasmania, and to persuade them to establish a station at the public expense at Hobart Town.

VII. That it is desirable to secure the co-operation of the Governments of Western Australia, New Zealand, and Tasmania in the system of weather telegrams which now embraces the Colonies of South Australia, Victoria, New South Wales, and Queensland.

VIII. That, in the opinion of this Conference, it is desirable that weather telegrams and forecasst shall in all cases depend upon the observations used for general meteorological and climatological statistics, and be under the direction of the head of the Meteorological Department in each colony

IX. That this Conference, having been informed that the Eastern Extension Telegraph Company will charge half rates for the transmission of weather reports through the cable connecting Australia and Tasmania, and probably also the cable to New Zealand, recommend that the cost of such reports be defrayed by the participating colonies in equal proportions; and that, in the opinion of this Conference, such cost need not exceed in the aggregate £350 per annum.

X. That, in the opinion of the Conference, this expenditure is justified by the extreme importance to the shipping interest of early information of the approach of dangerous easterly and westerly gales.

XI. That the several Governments be requested to cause precedence to be given to the regular weather telegrams and special storm reports.

XII. That, in the opinion of this Conference, there should be established in each of the colonies, upon a high mountain-peak, a meteorological observatory for the special study of winds and other meteorological phenomena; and that the most desirable positions for them would be the following:—

	About
South Australia—Mount Lofty	2,500 feet above sea level.
New South Wales—Kiandra ..	4,600 feet above sea level.
New Zealand—Tauhara, Taupo ..	4,600 feet above sea level.
New Zealand—Mount Herbert	4,000 feet above sea level.
Tasmania—Mount Wellington	4,000 feet above sea level.
Victoria—Mount Macedon	3,500 feet above sea level.

XIII. That the revision of the present telegraph weather code be referred to Messrs. Russell and Ellery, with a view to its simplification and extension.

XIV That the interchange of weather statistics, in carrying out the suggestions of this Conference, between the different Australasian stations, should be in the form of a diagram; and that this should not interfere with the printing of statistics by the different colonies in any way they like.

XV. (1.) That the monthly graphic records for interchange consist of curves, showing barometer, velocity and direction of wind, temperature, humidity, rainfall; with remarks upon weather, especially with reference to storms and atmospheric disturbances; and that specific forms be prepared and distributed to the co-operating colonies. (2.) That the mean humidity curve be derived from the means of maximum and minimum of wet- and dry-bulb thermometers. (3.) The barometer curve to be constructed from barographic records, so as to depict the turning points. (4.) The temperature curve to represent maximum and minimum and mean for each day (5.) The velocity and direction of the wind to be deduced from the anemometer.

XVI. That, in the transmission of telegrams, the reports be generalized from the local weather reports.

For New Zealand the following subdivision into districts is recommended for convenience of reporting:—

A.	N.E. aspect ...	North Cape to East Cape.
B.	N W aspect ..	Cape Maria to West Cape (exclusive of Cook Straits).
C. ...	S. aspect ...	West Cape to Moeraki.
D.	S.E. aspect ...	Moeraki to East Cape (exclusive of Cook Straits)
E. ..	Cook Straits .	Comprising Wanganui, Wellington, Cape Campbell, and Cape Farewell, Nelson.

A code to be framed to express the weather in each of the above aspects in general terms, according to the judgment of the reporter, thus: Aspect. Wind and Weather. | Rain. | Sea. No remark, to indicate absence of marked phenomena.

XVII. That the telegrams furnished to Melbourne by Tasmania should conform with those between the Australian Colonies.

XVIII. That weather telegrams from the Australian Colonies shall comprise—(1) Barometer reduced to 32° and sea-level; (2) dry bulb; (3) humidity; (4) maximum and minimum; (5) direction

and velocity of wind; (6) state of weather; (7) rainfall; (8) sea disturbances; with a synoptical report of the weather generally: and that within New Zealand the same system should be adopted.

XIX. That the extreme importance of the weather system proposed be strongly urged upon the Queensland Government, with a view to obtain their more active co-operation.

XX. That Australia be divided into six meteorological areas for transmission of reports to New Zealand—namely, Western Australia, South Australia, Victoria, New South Wales, and Queensland; South Australia being divided into two districts, tropical and extra-tropical.

XXI. That weather telegrams be written on paper of a special colour, so as to be readily distinguishable in the offices.

XXII. That the solar-radiation thermometers should be blackened-bulb thermometers *in vacuo*, and should be exposed on an open space at an elevation of 4 feet 6 inches from the surface of the ground, supported by a post carrying two light arms.

XXIII. That radiation thermometers be placed over grass.

XXIV That the following subjects for experiment be referred to each member of the Conference, for future consideration and report: (1.) Shade temperature. (2.) Swinging thermometer, and thermometer sheds in use. (3.) Standards to be swung with 2 feet 6 inches string during sunshine and after sunset. (4.) Observations to determine the difference in humidity by self-registering maximum and minimum thermometers, and by other methods. (5.) The best method of measuring the velocity and pressure of wind. (6.) Whether any better method than the black-bulb thermometer can be devised for measuring the direct effect of the sun. (7.) As to the best method of determining spontaneous evaporation.

XXV That, as investigation of the Newcastle tide-gauges has shown that such instruments give valuable indications of distant earthquakes, gales, and sea disturbances, it is desirable, in the opinion of the Conference, that self-registering tide-gauges be established in as many convenient places as possible on the coast in connection with the Meteorological Departments of the different colonies.

XXVI. That the foregoing minutes be adopted as the report of this Conference on the various matters referred to it, and that the Chairman be requested to report to the Government of New South Wales.

REPORTS.

3. Resolved:—XXVII. That, as a preliminary proceeding, each member should report the action taken in the colony represented by him with regard to the recommendations of the last Conference.

Report by Dr. Hector.

4. Dr. Hector accordingly reported as follows:—With regard to Resolution II.: The forms for the publication of meteorological statistics have been altered so as to meet the views adopted at the last Conference. The forms now used by first-, second-, and third-class stations respectively now submitted.

5. Under Resolution III.: Changes in the department have led to a reduction of the first-class stations from eighteen to three, which he thought to be quite a sufficient number to afford all the data required for complete meteorological statistics, especially as it is contemplated to furnish these stations with complete sets of continuous self-recording apparatus. The number of second-class stations has, however, been largely increased, and their equipment very much improved.

6. Under Resolution VII.: The New Zealand Government are favourably disposed in regard to the co-operation requested, and to provide the means suggested by the Conference, but the matter has not yet been brought before Parliament, the proposition being considered somewhat indefinite.

7 Under Resolution VIII.: Correspondence was read and handed in relative to the changes that had been made in the relations of the Meteorological and Weather Departments of New Zealand, partly in accordance with the recommendation of the Conference and partly on account of certain changes in the direction of retrenchment. Since 1874 there has been a Weather Signal Department under the charge of Captain Edwin, quite distinct from the Meteorological Department, which furnished the statistics. The papers handed in by Dr. Hector, and marked "A," showed that he had recommended the reference to Captain Edwin of the report made by the Sydney Conference, for report—(1) As to how far the suggestions could be given effect to by his department; (2) as to preventing duplication of observations by combining the work of the two departments; and (3) as to preserving the reports on which the weather signals are founded, in order that the conclusions may be reviewed in the future. In Captain Edwin's reply, he drew attention to the expense involved in sending the daily synoptical report; to certain phenomena, indicating that, in his opinion, the meteorological connection between Australia and New Zealand is not so close as might be reasonably supposed; to the probability that information from Queensland would be more useful to New Zealand than that from other colonies; to Mount Peel as a site for a mountain station, and to the doubt whether the results from only one such station would be worth the expense; and to the desirableness of assimilating the system of registration to that used in the United Kingdom; he stated his preference for a direct statement (in weather-warnings sent to New Zealand) of the position and route of any storm-centre affecting that country, with an example; he considered that certain suggestions in regard to telegraphic messages were not necessary; that, while high tides are now predicted in New Zealand, additional information would improve these warnings, and that tide-gauges would collect valuable data. Attached to this paper were notes thereon by Mr. Ellery and Mr. Russell. Mr. Ellery remarked that the cost of telegrams would be but a trivial sum to each colony, say £90 or £100, and would be reduced by the joining of other colonies; that the weather telegrams should not be complicated by any deductions regarding a single locality—though early intimation of any great disturbance, if added to the ordinary telegram from the colony where it originated, would be very valuable. The suggestions as to telegraphic messages, considered by Captain Edwin unnecessary, would secure promptitude in telegraph offices. The tide-gauges were not for prediction purposes, but to furnish knowledge concerning abnormal tides, or disturbances of normal ones. Mr. Russell expressed in his remarks the same view as Mr. Ellery did concerning the expense of telegrams; observed that, the Conference

having unanimously resolved in favour of cablegrams between Australia and New Zealand, it was very desirable to test the proposition; remarked that it was proposed to send information from Queensland; and pointed out that the messages proposed by the Conference were merely statements of existing conditions, unburdened by any theoretical matter which might not be correct, though it might, if of great importance, be appended as a remark, as it sometimes now is, in the cypher telegrams exchanged by Australian Colonies.

8. Dr. Hector then handed in certain papers on the subject of amalgamating and reorganizing the Weather Forecast and Meteorological Departments of New Zealand. The correspondence showed that on the 5th of April, 1880, Dr. Hector addressed to the Hon. the Colonial Secretary a letter pointing out that a saving might be effected, and drawing attention to the fact that in 1867 and on several occasions since he had suggested a complete reorganization of the department with a view to a better application of the vote, though nothing had been done. This letter enclosed extracts—(1) From a memorandum, dated the 12th of June, 1867; and (2) from a letter to the Hon. the Colonial Secretary, dated the 23rd of September, 1874, both signed by Dr. Hector. In the former it was proposed to establish four principal stations where the daily periodic elements would be determined by frequent direct observations, and twenty second-class stations at which daily records should be taken of the indications of self-registering instruments. These could be maintained for £600 per annum, and would be quite sufficient for scientific purposes. The new arrangements were proposed to be brought into operation on the 1st of January, 1868. In the latter, Dr. Hector recommended the reduction of the number of first-class meteorological stations to three, and the placing of the other stations under the Weather Signal Department. He advised that self-registering instruments should be procured; that no break in the continuity of the observations should be allowed to occur; and that the changes should be deferred to the end of 1875. In reply to the letter dated 5th April, 1880, and its enclosures, Captain Edwin sent a memorandum, dated 11th September, 1880, wherein he set forth the impossibility of maintaining efficient weather forecasts with a reduced expenditure, the necessity for an assistant in that branch of the service, the impossibility that one person could discharge efficiently the duties of both departments, and several facts which in his opinion made the duties of a meteorological observer incompatible with those of an observer for the Forecast Department. Captain Edwin laid stress on the difference which he conceived to separate meteorology from weather forecast, remarking that the former required trained observers, exact registration, and laborious calculation, in order to obtain results which it was hoped would prove valuable in the future for the prediction of seasons and climatic changes, though they had not yet been found reliable for those purposes even where (as in Great Britain) observations had been made carefully for over fifty years; while the latter, requiring no special training of observers, demanded of the forecasting officer skill and despatch, while it gave daily value for the daily expenditure.

9. In order to explain to the Conference the method on which Captain Edwin conducted the Signal Department, Dr. Hector laid before the Conference a copy of Captain Edwin's paper communicated to the New Zealand Institute on the Principles of Weather Forecast in New Zealand, with a sheet showing the succession of weather as recorded in that colony, plotted on his principle for a period of six months from January to June, 1880. He explained that Captain Edwin's method was in the main the same as that adopted by the Meteorological Council of Great Britain, although it involved the acceptance of certain hypotheses which are not yet generally received. Since the beginning of the year, the Weather Signal Department having been placed under the charge of Dr. Hector as Meteorological Director, the method of observing, recording, and reporting has been modified so as to agree with the wishes of the Conference.

10. Thirty-seven reporting stations are now fitted with complete instruments, and supply information at 9 a.m. of every day as to the wind, pressure, temperature, humidity, and general weather. These telegrams are grouped according to the aspects decided on by the Conference—viz., (*A*) north-east, (*B*) north-west, (*C*) southern, (*D*) south-eastern, and (*E*) Cook Strait. From the data thus obtained, and from telegrams when found necessary, an isobaric map is constructed each day, and a general report for each of the above aspects is prepared, below which the forecast for each aspect is written in such a way as, if correct, would agree with the report for the following day, and warnings are issued when necessary to any part of the coast where dangerous winds are apprehended. The data thus obtained will be used as second-class station returns for statistical purposes.

11. Dr. Hector submitted these isobaric maps and the data upon which they were founded for the months of February and March, during which the new system was in operation, and stated as the result of his experience that it afforded the most satisfactory method of tracing and recording the changes of weather, and distinguishing the characteristics of a season.

12. The correspondence had resulted in arrangements for the future, whereby one or all of the three first-class stations should be gradually so improved as to approximate in their equipment to that of the central or observatory stations in Australia, while, in addition to the thirty-seven second-class stations, a large number of third-class or rainfall stations are being established. These last will be kept by lighthouse-keepers (where not in telegraphic communication), by pilots, by harbourmasters, and by other Government officers, and by amateurs. At these stations temperature, rain, wind, and weather observations are made.

13. Valuable meteorological observations are received from Fiji, and were published in Dr. Hector's last report for the years 1877, 1878, and 1879. An additional first-class station has been established at the Chatham Islands, and has been in operation since January, 1879. The results for that year having been published in the report just mentioned, a copy thereof was laid upon the table, and attention was drawn to the fact that it contained daily readings for the three stations at Auckland, Wellington, and Dunedin for pressure, wind, and rainfall for a period of three years, accompanied by curves which showed a very remarkable agreement of the atmospheric disturbances throughout that range of latitude, which is equal to a distance of 800 miles. Dr. Hector also submitted the daily observations for 1880 made at the Wellington Station, and the monthly abstracts from all stations for the same year.

14. Under Resolution IX.: It was reported that the Government of New Zealand had agreed to bear, for the present, the cost of any necessary cablegrams, but desired, before bringing the matter before Parliament, that the Conference should express more clearly what they consider to be the particular value of those cablegrams, and what their probable cost, and what arrangements in regard to payment are suggested to give effect to the recommendation.

15. Under Resolution XI.: All weather warnings and the reports from stations are forwarded with the greatest celerity, and no difficulty is experienced in New Zealand from delay of weather telegrams, a result largely due to the interest which the Superintendent of Telegraphs, Dr Lemon, takes in the subject.

16. Under Resolution XII. No steps have been taken to get a high-level station. The establishment is not at present able to cope with this work, and it is doubtful whether for some time to come a vote can be got to make it so. Observations are, however, taken at Taupo, at an altitude of 1,200 feet, in the centre of the North Island, and Bealey (2,140) in the centre of the South Island.

17 Under Resolution XIII.: The present agreement with Mr. Russell is that cablegrams shall be sent only for any remarkable phases of weather in New Zealand, and that they shall indicate excessive pressure or abnormal differences in pressure within the New Zealand area.

18. Under Resolution XIV : A form of diagram was submitted, in which the meteorological statistics have for some years been displayed at the Wellington Station, and in which they are to be communicated to Sydney, from the beginning of the present year, from Auckland, Wellington, and Dunedin.

19. Under Resolution XVI.: The classification and grouping of the weather reports has been strictly adapted to this recommendation, but, in practice, the arrangement is not found to be the most convenient, so that the definition of the aspects may probably be revised with advantage.

20. Under Resolution XVIII.: The requirements of this resolution have been met with respect to New Zealand, and a synoptical report of the weather generally for the colony is published in the evening papers each day

21. Under Resolution XXV : Several tide-gauges have been procured, but at present they are utilized for the local requirements of Harbour Boards, and are not yet available for general investigations such as are contemplated by the Conference.

22. It was arranged that data should be obtained from Sydney, Adelaide, New Zealand, and Melbourne for the months of January, February, and March, with a view of testing the applicability to Australia of the system of weather forecasts adopted in the Northern Hemisphere.

The Conference adjourned to to-morrow at 10 o'clock a.m.

FRIDAY, 22ND APRIL, 1881.

The Conference met at the Observatory at 10 o'clock a.m.

Present: Mr. Ellery (Chairman), Dr. Hector, Mr. Russell, and Mr. Todd.

23. Resolved,—XXVIII. That the paragraphs of the report shall be numbered with consecutive Arabic numerals.

24. Resolved,—XXIX. That the resolutions and important points shall be numbered consecutively with Roman numerals.

Report by Mr. Russell.

25. Mr. Russell reported, in accordance with Resolution XXVII., as follows:—Under Resolution II.: Had extended the range of the weather map by taking in new stations established in agreement with report; had published daily a barometer curve including all the coast stations, as this was a method which appeared to convey to the public better than could be done by figures the passage of barometric depressions. He desired to call the attention of the members of the Conference to the fact that this curve pointed to the insufficiency of the present telegrams because they did not give turning-points of the barometer; hence some depressions appeared to pass from Eucla in two days, and others in one day This, no doubt, was owing to the fact that the 9 a.m. observations were taken to represent the turning-points. He submitted copies of the weather map printed daily at Sydney and distributed gratis.

26. Under Resolution III.: Additional stations (first-class) have been established at Kiandra, Menindie, Hay, and Wollongong, making altogether 29 in New South Wales (*see* list in Appendix No. 1); besides these, reports were received from 9 first-class private stations, from 72 thermometer and rain stations, and from 100 rain stations, making the total 210 stations.

27 Under Resolution VII.: Had been unable to secure active co-operation from the Government of Queensland in the weather system.

28. Under Resolution VIII.: Had continued to make the same observations serve for weather-signal purposes and statistics.

29. Under Resolution IX.: Submitted a letter from the Superintendent of the New Zealand cable, showing the liberal rates at which the Eastern Extension Telegraph Company are prepared to transmit weather telegrams. He was authorized to say that the Government of New South Wales would share the cost of the proposed weather cablegrams to the extent of £75 per annum, which was probably more than would be required.

30. Under Resolution XII.: A mountain station has been established on Kiandra, 4,600 feet above sea.

31. Under Resolution XVIII.: Had regularly sent, but had not received, synoptical reports.

32. Under Resolutions XXII. and XXIII.: These resolutions had been conformed to.

33. Mr. Ellery, referring to the letter read by Mr Russell (cf. par. 29), remarked that in 1877 he received a letter from the Superintendent of the Tasmanian cable, stating that cable messages from Tasmania would be transmitted at half the ordinary rate, inclusive of the address and signature. In 1880 he had asked that this concession might be extended, and had received a reply to the effect that, if more than one message was required each way daily, an endeavour would be made to induce the directors to extend the concession to a second message.

Report by Mr. Todd.

34. Mr. Todd, in accordance with Resolution XXVII., reported as follows:—Under Resolution I.: That he would hereafter lay before the Conference the form of weather bulletin posted at the Adelaide Telegraph Office, at the Exchange, and at Port Adelaide.

35. Under Resolution II.: That nothing had been done, since the Sydney Conference had not arrived at any decision as to the form to be adopted, leaving it open to each Director to publish the results of his own observations for his own purposes in his own way A copy of the observations for January, 1879, was put in, to show the form in which the observations for South Australia had been published; also a copy of the weather map taking in the whole of Australia and New Zealand upon which it is proposed to lay down isobars.

36. Under Resolution III.: That, as the outcome of the last Conference, a vote has been obtained from Parliament for providing the Observatory at Adelaide with self-recording instruments—namely, a barograph, thermograph, anemometer, and ombrograph. Had deferred ordering the anemometer, knowing that Mr. Ellery was making one on an improved principle, and it was probable that a similar instrument would be adopted at the Adelaide Observatory

37 Under Resolution IV: That the following are the first-class stations (as defined at the Sydney Conference) in South Australia: Adelaide, Cape Northumberland, Cape Borda, Alice Springs, Port Darwin, Eucla, Mount Gambier, Robe, Strathalbyn, and Kapunda. Barometer stations have been established at Streaky Bay, Port Augusta, and Daly Waters. There are thermometer stations at Goolwa, Mount Barker, and Clare. At Cape Northumberland, Cape Borda, Alice Springs, and Port Darwin observations are taken every three hours, day and night. At the other stations observations are taken generally at 9 a.m., 3 p.m., and 9 p.m.; but at some of them at 9 a.m., 12, 3 p.m., 6 p.m., and 9 p.m. It is intended to establish additional barometrical stations, and to make them first-class stations. The proposed first-class stations are Streaky Bay, Port Augusta, Farina, and The Peak. In addition to the stations named, there are nearly 200 rainfall stations throughout South Australia.

38. Under Resolution V: That barometers of Fortin's construction are used, not the Board of Trade form.

39. Under Resolution VII.: That it had been left to him to secure the co-operation of Western Australia, which he had accomplished by the kind courtesy of the Hon. Mr. Fraser, Surveyor-General. That recently observations had been made at 7.30 a.m., in order that the report might reach the eastern colonies early enough to be included in their daily reports.

40. Under Resolution IX.: That he was able to say that the South Australian Government would bear its share of the expense of the cable weather telegrams.

41. Under Resolution XI.: That in the South Australian Telegraph Department precedence is given to all weather telegrams before everything else, but that the same rule did not appear to apply to the other Australian Colonies.

42. Under Resolution XII.: That no action had been taken, but desired to mention, *en passant*, that Alice Springs Station is at an elevation of 2,100 feet above sea-level.

43. Under Resolution XVIII.: That the daily weather telegrams are not precisely consistent with the resolution, the Sydney Observatory, for instance, sending the humidity, whilst from Melbourne were sent the readings of the wet- and dry-bulb thermometers. The synoptic reports are not regularly received.

44. Under Resolution XX.: That South Australia has been divided into the tropical and extra-tropical districts, the stations in the tropics being Port Darwin, Daly Waters, Powell's Creek, Tennent's Creek, and Alice Springs.

45. Under Resolutions XXII. and XXIII.: That the resolutions are strictly carried out.

46. Under Resolution XXIV: That experiments with swinging thermometers had been carried out, the results of which would be presented to this Conference at a future meeting.

47 Under Resolution XXV: That he had not yet succeeded in getting records of self-registering tide-gauges.

48. That the meteorological statistics had always been in his hands.

Report by Mr. Ellery.

49. Mr. Ellery, in accordance with Resolution XXVII., reported as follows:—Under Resolution II.: That he had not changed the mode of publication, for the reason that nothing had been definitely decided on by the Sydney Conference.

50. Under Resolution III.: That there are now in Victoria the following first-class stations—viz., Melbourne, Portland, Cape Otway, Wilson's Promontory, Gabo Island, Sandhurst, Ballarat, and Echuca. That Mount Macedon and Omeo are about being made first-class stations. Echuca is the only first-class station established since the last Conference, any extension of the system during that time, beside the alterations mentioned, being confined to third-class stations.

51. Under Resolution VII.: That soon after the last Conference he had requested the Victorian Government to place him in communication with the Tasmanian Government in order to secure their co-operation in the scheme. Through some misunderstanding, the application was not made to Tasmania, but he had subsequently taken the best steps open to him to induce the Tasmanian authorities to join in the Australian scheme. The Government had been again directly invited to send a delegate to the Conference, but in the telegram produced they stated that they could not send one, although they concurred in the objects sought to be attained by the Conference, and promised to communicate with the Chairman by letter or memorandum. The Hon. the Chief Secretary of Victoria had been requested to convey to them the information that the Conference would commence its sittings on the 21st instant, and would be very glad to hear from them. He had no doubt that the co-operation of Tasmania would in a very short time be secured.

52. Under Resolutions IX. and X.: That the Victorian Government had consented to exchange weather telegrams, and had placed upon the estimates for the current year a sum of £90 to meet Victoria's share of the cost. They had been prepared ever since last June to bear this expense.

53. Under Resolution XI.: That, after the last Conference, a copy of the report was sent to the Government, attention being drawn to this paragraph, with a request that precedence and promptitude be accorded to weather telegrams. A perceptible improvement had taken place since then, but he was still of opinion that further improvement in promptitude might be made if the Conference pressed the matter.

54. Under Resolution XII.: That last week a large obelisk station had been completed upon the extreme south-west point of Mount Macedon, at an altitude of 3,500 feet, for the erection of a self-registering anemograph, which would be in charge of an observer who, about 100 feet lower, has a barometer, thermometers, and all the appliances of a first-class station. This would be worked as a first-class station in about a month, with a continuous registration of the direction of the wind. The form of anemometer to be used will be a direction-vane with pressure-plate.

55. Under Resolution XIII.: That Mr. Russell, subsequent to the last Conference, communicated to Mr. Ellery some proposed improvements in or additions to the code, but the matter had not yet been discussed.

56. Under Resolutions XIV and XV: That nothing had been done in Victoria.

57 Under Resolution XVIII.: That the recommendation as to weather telegrams was carried out in the telegrams from this station to the other colonies, except that the readings of dry and wet bulbs were sent instead of the dry bulb and humidity No synoptical report is sent from this station to other colonies, and none is received. A long time ago two or three came, and then they ceased.

58. Under Resolution XXI.: That nothing has been done in this colony in regard to the use of a coloured paper for weather telegrams.

59. Under Resolution XXII.: That the recommendation has been carried out.

60. Under Resolution XXIV: That he will hereafter report on Nos. 1, 2, 3, 5, and 6.

61. Under Resolution XXV: That inquiries had been made as to the best spot in which to place a tide-gauge on the south coast of Australia. That Gabo Island had been recommended as the best position on the south-east coast, and Portland as another site. It was desired to have Wilson's Promontory made a station, but there was no place for it. He hoped to get one or two of these tide-gauges erected in the course of the next eight or nine months.

Definition of First-class Station.

62. Resolved, on the motion of Mr. Russell,—XXX.: That, instead of the definition in Resolution IV., the Congress adopt the definition of the stations given at the Vienna Congress, and contained in the introduction to the Instructions for the Use of Meteorological Instruments.

The Conference adjourned to Monday next, the 25th April, at 10 o'clock a.m.

MONDAY, 25TH APRIL, 1881.

The Conference met at the Observatory at 10 o'clock a.m.

Present: Mr. Ellery (Chairman), Dr. Hector, Mr. Russell, and Mr. Todd.

The minutes of the meetings held on Thursday and Friday last were read and confirmed.

65. Mr. Todd laid before the Conference the following suggestions to be discussed hereafter, viz.:—

(*a.*) That, with a view to the observations being referred to one uniform standard, a complete set of standard instruments be purchased for circulation between the four chief stations —viz., Melbourne, Sydney, Wellington, and Adelaide—the cost to be divided between the four colonies represented at this Conference. The instruments to comprise barometer, thermometer, maximum solar thermometer, anemometer, and rain-gauge.

(*b.*) All readings of the several instruments to be reduced to the readings of the standards.

(*c.*) That, although absolute uniformity in the form of publication of meteorological statistics is not considered essential, whatever form is adopted should give—α. Barometer reduced to 32° and sea-level, at least at one of the hours agreed upon at the last Conference (9 a.m., 3 p.m., 9 p.m.), and the principal turning-points, also reduced, with the times of their occurrence. β. The temperature of the air at the same hour or hours, also maximum and minimum. The maximum should be read at 9 p.m., and the minimum at 9 a.m. γ. Wet-bulb thermometer readings at same hour or hours, or humidity δ. Amount and character of cloud, and upper current of cirri, or high cloud. ϵ. Direction and force of wind. ζ. Rain during previous twenty-four hours recorded at 9 a.m. It would be better to read the gauge at 9 a.m. and 9 p.m., and distinguish between night and day rain.

(*d.*) The chief stations at Melbourne, Sydney, Wellington, and Adelaide, in addition to the foregoing, should give maximum solar thermometer; minimum on grass and wool; hours of sunshine; ozone, 9 a.m. and 9 p.m.; evaporation, read off at 9 a.m. and 9 p.m.

(*e.*) In addition to this, Melbourne, Sydney, Wellington, and Adelaide should publish hourly readings of barograph (reduced to 32° and sea-level), thermograph, and anemograph.

(*f.*) Carrying out Resolution XIV., passed at the previous Conference,—that curve sheets, with synoptic reports on weather, should be exchanged monthly,—it is recommended that these curves should show barometrical pressure at sea-level, temperature of air, relative humidity, direction and force of velocity of wind, and rainfall; and that the synopsis should be in sufficient detail to trace storms and other atmospheric disturbances. There should be a sufficient number of stations selected in each colony to supply data for forming isobaric maps for every day

(*g.*) The adopted mean temperature to be deduced from the minimum, 9 a.m., maximum, and 9 p.m. readings; and at the four principal stations this mean should be compared with the hourly means.

(*h.*) Exposure of thermometer to be uniform, or, if that cannot be effected, the four principal stations, or one of them, should mount thermometers on each plan adopted by the other colonies, and compare the readings on each kind of stand with the readings of a rotatory thermometer in the shade.

(*i.*) The dry- and wet-bulb thermograph readings should be compared with the readings of the standard or ordinary dry- and wet-bulb thermometers at 9 a.m., 3 p.m., and 9 p.m.; and the readings of the thermograph should be referred to those of the ordinary dry and wet, or the correction supplied.

(*k.*) The readings of the barograph should also be compared with the readings of the standard barometer at the same hours, and the differences given if not applied.

(*l.*) Rain-gauges to be of one uniform pattern and size of receiving surface—viz., 8″ in diameter, and the mouth of receiver to be 1 foot above the surface of the ground, in such a position as to be wholly unsheltered in all directions.

(*m.*) Atmometer.—The form adopted at Adelaide is recommended. This consists of an outer tank of brick cemented, 4 feet square, internal measurement; and an inner tank of slate or marble, 3 feet square; both tanks being filled with water to the same level. The amount of evaporation is read off by means of a float carrying a graduated rod and vernier, divided 0·01 inch.

(*n.*) Observations to be taken at Melbourne, Sydney, Wellington, and Adelaide, at 0h. 43m., Gr. m. t., or 7h. 35m., Washington, in compliance with the request of the late Brigadier-General A. J Myer, Chief Signal Officer, U.S.

Reports on Resolution XXIV

66. Dr. Hector reported that he had experiments in progress upon the velocity and pressure of the wind, and upon solar thermometers, but they were not sufficiently advanced to be reported upon. Experiments had also been made with the swinging thermometer.

67 Mr. Todd reported that he also had made experiments on the subjects referred to members, but that they were not sufficiently advanced to be reported. He found that the swinging thermometers agreed very closely with the thermometers upon the stand, but were always lower than those upon the old Greenwich stand, which had been in use for so many years. For shade temperature he had for a number of years adopted two modes of mounting thermometers. In one case the instruments were mounted on a modified form of Greenwich stand, which was always kept turned with its back to the sun. The instruments are about 5 feet 6 inches above the ground, and are protected from rain by a wooden shade. His experience did not lead him to think that this is the best mode of mounting thermometers. The best plan, he considered, was a shed with an open louvre roof, which will effectually screen the stand (which should be simply a skeleton frame) and instruments from the sun, and yet leave free access to currents of air. This is the other method adopted at Adelaide, and is well well shown in a photograph submitted to the Conference [put in].

The shed is octagon-shaped, 10 feet wide, the louvre roof being supported by eight stout posts at a height (at the eaves) of about 7 feet 6 inches above the ground. The shed is floored, and the whole painted white. The skeleton frame, on which the thermometers are mounted, revolves on a wooden standard, and has a sloping back of well-oiled and painted canvas.

Comparing the results of the two methods, it is found that the mean temperatures on the stand and in the shed, as well as those at 6 p.m. and 9 p.m., and the minima are nearly identical, whilst the mid-day readings and maxima are higher on the stand. The maximum reading in the summer on the stand is often 3° or 4° higher than in the shed. The difference is less in the winter.

Taking the year through, the temperature on the stand exceeds that in the shed at different hours in the day by the following quantities:—

Mean readings on stand exceed mean readings in shed—

	°		°
Minimum	−0·1	3 p.m.	+1·2
9 a.m.	+0·4	6 p.m.	−0·1
Noon	+1·0	9 p.m.	−0·1
Maximum	+1·6		

Approximate mean temperature of the year (mean of max. and min.)—

	°
Stand	63·6
Shed	62·9

Shade Temperature.

68. Mr. Russell reported that he had made experiments with the Greenwich stand that had to be turned twice a day With another, in which the exterior was composed of louvres, and the interior a box in which perfectly free and carefully arranged ventilation was provided for, at the same time that no radiation from the ground could affect the thermometers, he found that, if the south side of the box was removed, it gave a temperature the same as the shed; but, if the south side or door was shut, the temperature was thereby raised two degrees. Had found that thermometers placed on the south side of a wall, with a box to protect them from morning and evening sun, gave same mean temperature as shed.

69. That he had made a series of comparisons between a swung thermometer and a thermometer in the shed, with the following results:—

Mean difference	0·2	Swung thermometer being highest.
Morning, 10·5 a.m.—Greatest difference	2·3	Swung highest.
Evening, 10·30 p.m.—Greatest difference	0·6	Swung lowest.

Swung in sun sometimes as much as 3·7 higher than swung in shade.

70. That to determine the difference of humidity as obtained from maximum and minimum thermometers, and from the three daily observations of wet- and dry-bulb thermometers, he had made the following comparisons of observations taken in July, 1880, and January, 1881, the result showing a difference of 4·1° in July and 2·6° in January between the two methods:—

July, 1880.	Max. (1).	Max. Wet.	Humidity.	Min. (1).	Min. Wet.	Humidity.	Jan. 1881.	Max. (1).	Max. Wet.	Humidity.	Min. (1).	Min. Wet.	Humidity.
1	55·6	47·4	55	41·3	38·1	75	1	76·7	69·0	63	62·7	59·1	79
2	53·4	...	...	39·7	37·2	79	2	77·1	68·1	59	67·5	62·5	73
3	55·4	52·2	79	41·0		...	3	71·7	62·0	55	63·7	57·9	68
4	54·7	47·9	60	42·8	39·4	74	4	71·1	62·4	58	59·7	54·3	69
5	54·6	48·8	65	40·7	38·2	79	5	71·4	65·6	70	59·2	56·9	85
6	55·0	48·3	61	42·5	39·7	78	6	77·6	67·7	56	59·8	57·8	87
7	58·7	50·7	57	8·8	47·8	92	7	72·1	65·5	67	65·0	62·1	83
8	59·4	52·0	60	41·4	39·7	86	8	76·2	64·0	48	64·6	57·6	64
9	57·6	50·4	60	40·7	39·1	87	9	73·7	64·1	56	63·5	60·2	80
10	59·5	52·2	60	42·4	39·1	75	10	75·2	66·1	58	61·7	dry	...
11	55·6	50·0	67	43·9	41·1	79	11	72·4	67·0	72	63·4	61·2	86
12	59·0	52·7	64	45·3	42·3	78	12	72·0	66·9	74	64·7	63·3	91
13	56·4	51·7	71	42·8	41·3	88	13	73·8	66·9	66	62·7	dry	...
14	60·0	57·6	77	45·3	43·0	82	14	69·9	64·2	70	56·7	dry	...
15	59·3	57·6	89	49·2	48·2	92	15	72·9	67·6	73	60·7	57·1	78
16	57·8	51·7	65	46·8	45·9	92	16	78·1	71·1	67	64·1	62·1	87
17	57·0	50·8	64	42·6	41·3	89	17	75·9	67·8	62	66·5	61·7	73
18	55·2	52·4	81	43·4	42·1	89	18	73·7	67·2	68	64·1	61·0	82
19	55·3	48·9	62	41·0	39·7	88	19	78·3	74·4	80	66·5	61·1	71
20	58·1	48·9	51	45·1	42·0	77	20	89·7	79·7	58	69·1	66·1	83
21	58·3	49·3	52	46·5	41·8	68	21	68·8	65·9	89	63·6	59·1	74
22	57·4	49·0	54	43·7	40·0	73	22	79·0	72·0	67	63·2	59·6	79
23	60·2	50·8	52	44·1	41·0	77	23	69·8	68·6	92	67·3	61·2	68
24	56·6	46·2	45	47·6	43·0	69	24	78·1	65·7	48	73·0	62·1	51
25	61·2	50·4	50	43·6	39·5	70	25	74·1	67·2	66	67·6	64·6	82
26	61·0	51·3	51	43·7	41·2	80	26	77·4	69·9	65	64·7	63·1	90
27	67·1	52·6	38	44·9	42·1	79	27	78·7	...	...	65·4	64·9	97
28	62·3	52·4	51	50·8	45·0	64	28	86·3	74·3	51	70·4	68·1	87
29	61·4	50·3	46	43·2	40·9	82	29	74·4	69·7	75	64·7	62·8	88
30	62·8	51·0	45	41·9	40·3	87	30	83·5	74·9	62	64·8	63·8	93
31	66·7	55·3	47	40·6	39·0	87	31	74·4	68·8	72	66·8	61·2	70
			30) 1,779			30) 2,415				30) 1,967			28) 2,218
Means	...		59·3	...	...	80·5	Means	...		65·6	...	...	79·2
				Mean ...		69·7					Mean ...		72·4
				Mean 9 a.m., 3 p.m., 9 p.m.		73·8					Mean 9 a.m., 3 p.m., 9 p.m.		75·0
						4·1							2·6

Evaporation.

71. Having for the past ten years carried on observations with three forms of evaporators, he thought the condensed results might be of interest to the members of the Conference. He mentioned that observations with the glass evaporator were begun at Sydney Observatory in 1860, but it was not until 1871 that the other two forms were placed beside it for the purpose of comparison. It was simply because the glass instrument was the one in use that it was assumed to be the standard for comparison, and not for any advantage in form or substance which it might be supposed to possess. The tin one had been adopted for use in the country, because its cost was little, and the large one was started because it seemed to put the water into the condition which obtains in an ordinary open reservoir. The following details will form a sufficient description of these instruments:—

No. 1.—A glass vessel standing on the ground 8 inches high and 8 inches in diameter, in which the water is usually about 6 inches deep; it is read by a vernier scale attached to a point which is every morning made to touch the water by screw motion.

No. 2.—A tin vessel, painted white, standing on the ground, 12 inches high and 8 inches in diameter, in which the water is usually about 8 inches deep; the amount of evaporation is ascertained by weighing it every morning.

No. 3—Is a galvanized iron vessel, sunk into the ground 2 feet 4 inches; it is 2 feet 6 inches deep, and 4 feet in diameter. In it is a small float, to the top of which is attached a light vertical rod passing through two guides; this is graduated to tenths of an inch, and read to $\frac{1}{1000}$ of an inch by means of a microscope fixed on a firm support; the edge of the vessel is only 2 inches above the ground, to prevent surface-water from running into it; and the grass is allowed to grow level with the top, to prevent rain splashing in, and sun-heat on the metal outside.

72. The table herewith shows the result from each evaporator, together with temperature, humidity, wind, and rainfall, for ten years, 1871 to 1880. It will be observed that the tin one shows the greatest amount, the glass second, and the large one least, on the average for ten years; but it is worth noting that in 1876, when the velocity of wind greatly exceeded other years, the tin one gave the evaporation only 7 per cent. above the average, the large one 20, and the glass 28 per cent.

Observations on the temperature of the water in the evaporators show that the glass one is most affected by the sun, the tin next, and the large one least.

73. In the course of the experiments the question arose whether more or less evaporation took place during the day as compared with the night. The day was divided at 9 a.m. and 9 p.m., and the observations confined to the glass and large evaporators; and it was found that the glass one gave

42 per cent. more during the day than during the night, and the large one 18 per cent. more during day than night, and it sometimes happened that it was more during the night than during the day The result of these observations may be expressed in another way: Comparing the two, the large one gave 13 per cent. less than the glass one during the day, and 23 per cent. *more* during the night, which seems to prove that the heat absorbed by the large one during the day was given off in vapour during the night, and not by radiation from the sides, as in the glass one.

74.

Year.	Shade Temp.	Humidity.	Miles of Wind.	Total Rainfall.	Evaporators.					Large greater than Glass.
					Amount in Tin.	Tin greater than Glass.	Amount in Glass.	Large less than Glass.	Amount in Large.	
1871*	62·4	74·9	96·821	52·147	65·756	22·785	42·971	9·643	33·130	In May and June large greater than glass.
1872	62·6	75·9	98·830	37·001	66·589	25·001	41·588	11·495	30·093	Greater in May.
1873	63·0	75·9	91·306	73·263	54·622	6·761	47·861	18·427	29·432	
1874	63·0	75·6	97·651	63·478	59·622	8·682	50·940	18·934	32·006	
1875	63·4	73·2	96·003	46·209	59·243	0·607	58·636	22·521	36·115	
1876	63·6	74·2	103·373	45·647	59·790	−3·692	63·482	24·699	38·783	
1877	63·8	74·6	95·087	59·517	49·599	−5·567	54·166	22·544	31·622	
1878	63·6	73·5	97·945	49·617	50·355	−3·733	54·088	21·404	32·684	
1879	62·1	75·1	99·061	63·193	43·785	4·887	38·898	10·081	28·817	In May greater than glass.
1880	62·8	73·2	91·112	29·513	47·556	7·350	40·206	8·690	31·516	In May greater than glass.
Means	63·0	74·6	96·719	51·959	55·692	6·409	49·283	16·863	32·420	

* Corrected for two months, January and February, when observations were not taken. Large evaporators started in March.

75. Another question presented itself, and was answered by several months' observation. It was, What ratio does evaporation in the shade bear to that in the sun? The shade chosen was the thermometer-shed, where the air has free access, but there is complete protection from the sun. The mean result of the measures was that 26 per cent. less evaporation took place in the shed than in the glass evaporator in the sun, or, comparing it with the large one, the result in shade was 9 per cent. more than in the large one; but, as the shade evaporator was placed 3 feet above the ground, where the air would probably be drier than on the surface of the ground, where it affects the large evaporator, it is probable that a small evaporator in the shade would give about the same result as one 4 feet over and sunk into the ground.

76. It will appear from what has been said that every change of condition under which evaporation is measured produces a change in the result, and, since the conditions are infinitely variable, so the results must be. Therefore, before any comparable results can be obtained, we must determine what it is that we want to measure. Is it the evaporation from water in the ground, from water in a glass or metal vessel on the ground, or from water at some distance above the ground? For the mere purpose of comparison, any one of these positions would do; but since the one in the ground comes nearest to the condition of a natural reservoir, I prefer it, because the results would be directly useful for a practical purpose, as well as for science.

Shade Temperature and Thermometer-Sheds.

77 Mr. Ellery reported as follows: Experiments with regard to true shade temperature, and best form of thermometer-shed, were made here early in 1880. The thermometer-stands previously in use at the Melbourne Observatory were—a Lawson's stand, and, for a short time, a modified Stevenson's stand. Prior to 1865 a form of Lawson stand, movable about a central column, so as to place its back to the sun three times a day, was exclusively used, but this was done away with in favour of an ordinary fixed stand, of the same form, in 1865.

78. Occasional experiments with a swing thermometer had shown that on hot days, in which a rapid change of temperature had occurred in the afternoon, the thermometers always indicated a higher temperature than that indicated by a thermometer swung in the air, and *vice versâ* after a cold night, showing that the stand itself retained a temperature different from that of the air a considerable time after an actual fall or rise of shade temperature; and further experiments showed that, in the ordinary small stands used for thermometer exposure, the temperature of the material or the stand itself always lagged behind that of the air.

79. In a Stevenson's stand, made for one of the country stations (with vertical instead of horizontal louvres), the indications were half-way between the Lawson stand thermometers and the swing thermometer. It was evident, therefore, that, if we assume a correct thermometer swung in the open air will give true shade temperature, thermometers shaded in the ordinary wooden stands (Lawson's or Stevenson's) do not always do so; and also that the mass of material in the stand, want of free traverse of the air through all its parts, its slow conductivity, and its proximity to the thermometers themselves, were probably the chief causes. It therefore appeared that the required shelter should be formed of some better and more rapid conductor than wood, that the mass of material used should be as small as possible, and that the circulation of air around every part of this mass should be as free as possible; also that the thermometers themselves should be as far as convenient from at least the more massive or worst-conducting portions of the stand, and thus free from the retarding effects of radiation.

80. Acting upon this, trials were made with shades constructed of zinc and galvanized iron, and it was soon found that under such shades the thermometers followed the swing thermometer very closely; and when a sufficient and thoroughly open air space was allowed between the sheets of a

double screen of this material, and when no side screen was interposed, the swing and fixed thermometers always read alike, even when the temperature of the air was over 100°, and the sun temperature 150° Trials were made by day and at night, in both cloudy and clear weather, and the indications were always within a fraction of a degree of that of the swing thermometer, while thermometers in the other stands differed from it frequently two or three degrees, and in some cases four or five degrees.

81. After these experiments were completed, a new shed was erected at the Observatory in March, 1880, which has been used ever since for shading the thermometers, and has given every satisfaction; and, whenever an occasional trial with the swing thermometer has been made, the thermometers fixed in it have always agreed very closely indeed. Sometimes, after a very cold night, they have shown a slightly higher temperature (sometimes fully half a degree) than the swing thermometer, which is perhaps due to the ground beneath the shelter being less cooled by radiation during the night. The shed itself consists of six uprights of wood fixed in the ground, carrying a double roof of galvanized iron, with low gables north and south, and eaves east and west. The area covered is 12 feet by 12 feet; height of ridge above ground, 8 feet; height of eaves, 6 feet; space between two roofs, 9 inches. On the north gable a light trellis extends from the apex of the gable to within 4 feet 6 inches of the ground. The three other sides are fully open, except three louvre-boards just below the eaves on the east and west sides, to keep the direct rays of the rising or setting sun from reaching the thermometers. The 9-inch space between the two roofs is also open all round. The thermometers themselves are exposed in a cage of open wire netting hung from the roof, and about 1 foot below the iron of the inner roof, and, while fully exposed to the air in all directions, are out of the reach of driving rain. A photograph appended shows the form.

82. The ombrograph is placed beneath this shed, with the collector on the roof.

83. The swing thermometer is a very good one, in glass tube, by Greiner of Berlin. It is attached to a silk cord, about 2 feet 6 inches long, with loop to pass over finger. It is usually swung at full length eight or ten revolutions at a moderate speed, then stopped and immediately read, while the fixed thermometer is read by another observer.

The Best Method of measuring the Velocity and Pressure of the Wind.

84. I have made numerous experiments in these directions since the first meeting of the Conference, but I am certainly not prepared to give any opinion yet as to the best method. According to my experience, the mean velocity for short periods, as furnished by the Robinson's anemograph, does not answer all the questions that arise, and a good method of measuring the pressure of gusts is wanted. There is no doubt that the Robinson, if kept in good order, is the most satisfactory of all forms now generally in use; but in the Kew pattern used here the register scale is too small and close—unnecessarily so, I think—so that it is almost impossible to obtain the maximum velocities in high winds, which generally take place in very short periods.

85. It was necessary, some months ago, to thoroughly repair, indeed to remake, our anemograph, as nearly twenty years' wear had made it very shaky in all its parts. I therefore took the opportunity of introducing some modifications, especially in the registering portion of the apparatus, and in replacing the original anti-friction ball bearings by the oil-cup and Smeaton ring, as now used at Kew, with the effect of securing a beautifully silent and smooth motion, combined with equal sensitiveness.

86. The registering apparatus is quite different from the old form, and the record sheet much larger, being 12 inches wide and 18¾ inches long. The direction record for a full revolution of the wind covers 4¼ inches wide, and the velocity 5 inches for fifty miles' motion. An hour's movement of the record proper equals about ¾ of an inch. The velocity pen—a glass one, charged with aniline ink—falls back to zero every hour by means of a clutch on the velocity-shaft, which is released by an electro-magnet every hour, the contact for which is made by the clock. Should the velocity exceed fifty miles an hour, the pen moves a lever at the end of its range and makes contact, allowing the pen to fall back to zero at the completion of the fifty miles. This acts exceedingly well, and the pen commences its new curve the instant it has fallen back to zero.

87 In order to facilitate measurements for short intervals during strong winds there is a second electro-magnet, which gives the pen an upward movement, when in action, forming a short off-set on the velocity curve. By inserting a plug the clock actuates this electro-magnet every minute; the velocity curve is thus divided by cross marks every minute, and an easy way of obtaining the velocity for short intervals is thus supplied.

88. The direction record is given by spring pencils on a pair of endless chains running over two rollers, a cam plate throwing the pencils, not in position for registering, out of action. The more open scale of the record sheet, and return of the velocity pencil to zero every hour, enables the sheets to be much more easily read off, furnishes more precise results, and the minute marks on the curve made when the second electro-magnet is connected promises to be a very useful addition for occasional requirements.

89. There still seems to be some question as to the exact ratio of the rotation of the cups to the velocity of the wind in Robinson's anemometer, as it is stated that this varies with the length of the arms and size of the cups. It appears to me, therefore, very desirable to adopt some method by which the results of the several anemometers in Australia shall be comparable. With this in view I have lately made some experiments with Hagemann's vacuum anemometer, described in the Journal of the Meteorological Society for October, 1879, because it appears probable that exactly similar conditions can be easily secured at each observatory for such an instrument, which, moreover, has the advantage of being simple and cheap in construction. The conditions necessary are, that the height above buildings or trees, or like disturbing causes, and the size and shape of the orifice of the top of the vertical tube, shall be similar in each case; and perhaps it may be also desirable to have the capacity of the floating air-chamber nearly similar.

90. I have had placed on the Observatory a light mast carrying a ¼-inch gas-pipe, about 25 feet above the main roof, terminating in a nozzle similar to that described by Hagemann, having an aperture of about 3 or 4 millimetres diameter. The pipe leads to a "gasometer" arrangement in a chamber

below, where a dial and index shows the amount of exhaustion in the floating chamber of the gasometer, or in other words the velocity of the wind, according to the law referred to in Hagemann's paper.

91. This apparatus has now been at work some weeks, and has furnished very satisfactory results; the movements of the index are steady, making gentle sweeps around the dial with the lighter winds, and bold and rapid ones in the strong gusts of a high wind. The steadiness of its action will render making it self-registering an easy task.

From observations made with a dial roughly graduated to millimetres water-pressure and miles per hour, its indications appear to agree very closely with the Robinson anemograph, but of course all the rapid variations of velocity lost in the Robinson are plainly observable in this apparatus. I am so well satisfied with this form of anemometer that I have had constructed a more perfect dial and index movement and carefully made spring than at first used, and propose to make it self-registering by means of a lever marking on a drum covered with smoked paper.*

Shade Temperature.

92. In regard to the experiments on shade temperature, Mr. Ellery mentioned that, during the erection of the shed, experiments were made with side-screens, which made a very great difference in the readings, the thermometer, as soon as the current of air was stopped, showing an elevation of temperature to the extent of 4° or 5°

Swinging Thermometers.

93. Dr. Hector inquired whether in swinging thermometers the shape of the bulb had been observed to modify the results. Mr. Ellery replied that he had found that the shoulder bulbs always registered too low when swung, although when placed upon the stand they read correctly

94. Dr. Hector remarked that this coincided with his experience, and had led him to discard the shoulder bulb for the form in which the bulb was of the same diameter with the stem.

Evaporation.

95. Mr. Ellery stated that he had for many years adopted only one system of measuring spontaneous evaporation—namely, that of a tank level with the surface of the ground. The height of the surface in this tank was measured every morning at 9 a.m.

Black-Bulb Thermometers.

96. Some years ago he made experiments upon black-bulb thermometers, the results of which were given in a paper read before the Royal Society of Victoria, and showed that, while the thermometer registered correctly up to about 125° or 130°, at temperatures over 125°, even with the best instruments, variations appeared amounting sometimes to 16° The experiments were made in a room by means of dark radiation from a heated copper surface, within about three feet of which the thermometers were placed.

97 Dr. Hector inquired whether, after such an experiment, the thermometer returned to its normal registration. Mr. Ellery replied in the affirmative: the instruments acted quite correctly when placed in hot water; the variations appeared to result from variations in the diathermancy of the glass. His opinion was that not the slightest confidence was to be placed in black-bulb thermometers at temperatures over about 130°

98. Dr. Hector stated that he had found that after 130° had been reached these thermometers radiated heat from the back at a very different rate from that at lower temperatures. He considered that the back should always be in contact with a substance of the same nature and the same colour. When the back was covered with a white cambric handkerchief, he obtained higher readings than when any other material was used, while contact with black substances, such as black wool, gave quite different results. The highest readings had always been got when white substances were used, though these were not reflecting substances. It would appear that after attaining a certain temperature the material of the instrument was altered in its power of dispersive radiation; in other words the curve of dispersive radiation did not coincide with the curve of absorptive radiation.

99. Mr. Ellery suggested that the difficulty might be got over by using a bulb one half of which was blackened and the other half left bright.

100. Mr. Todd said that, in comparing a thermometer whose bulb was lampblacked with one whose bulb was of black glass, he found that the greatest difference appeared between them when the sun suddenly shone out upon them. The lampblacked thermometer then showed sometimes as much as 13° higher than the black glass.

101. Mr. Russell said that he had observed similar facts to those reported by Mr. Todd. He remarked that the difficulty with the black bulb was to know the exact amount of vacuum in the tube. Those instruments which he had lately got were provided with an electric contact to test the vacuum.

102. Mr. Ellery said that the electric indications of the nature of the vacuum varied with the purity of the air and other circumstances, and that probably observers would have to revert to Pouillet's or some other of the old forms.

Anemometer.

103. Mr. Russell suggested that, pending the solution of the best method of determining the velocity of the wind, the form of hand anemometer now laid upon the table by him should be used at first-class stations. He had ordered twelve of these instruments from London, at a cost of 15s. each. He explained the mode of using the anemometer, which was to be held in the hand, and gave the velocity and pressure of the wind for two minutes at each experiment.

Discussion ensued.

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* This apparatus has since been completed, and is found to work extremely well. The pressure or velocity of gusts of wind is easily measured off from the smoked-paper curves, while a mean curve will give the velocity for any period.—R.L.J.E.

104. Moved, That the Conference recommend that, pending their final decision as to the method of ascertaining the velocity of the wind, observers at second-class stations should use Mr. Russell's hand form of Robinson's anemometer.

The decision on this motion was deferred.

Cable Arrangements, and Financial Matters connected therewith.

105. Moved by Dr. Hector, seconded by Mr. Todd, and resolved,—XXXII. That all accounts for weather cablegrams be rendered to Mr. Russell, and be paid by him.

Synoptical Telegrams.

106. The consideration of this subject was deferred, to be resumed in connection with the subject of isobaric analysis to be brought forward by Dr. Hector.

Time at which Observations are to be made in the various Colonies.

107 Mr. Todd, in introducing the subject, said that he considered it desirable to take the observations at the same hour by local time, but that in order to get out the results in time to be of service to the general public, especially to persons interested in shipping, they should be taken earlier than at present—say at 8 o'clock a.m. If this were done, South Australia would receive Sydney and Melbourne observations at 9 a.m., and the eastern colonies would receive South Australian observations about 9 30.

108. Mr. Russell considered that no alteration in the present system was practicable.

109. Dr. Hector said that evening observations were far preferable for weather prediction purposes to observations taken at 9 a.m.

110. Mr. Russell suggested that if 9 a.m. observations were transmitted with the 9 p.m. observations of the previous evening predictions could fairly be made for the one day

111. Mr. Todd moved, and it was resolved,—XXXIII. That no alteration be made at present in the time at which observations are to be made. A standing footnote to be made that the observations taken in Western Australia are made at 7.30 a.m. local time.

Form of Telegrams from Tasmania.

112. Resolved,—XXXIV., That weather telegrams from Tasmania shall be similar to those received from Cape Otway, Portland, &c., and shall be transmitted in this form to Adelaide and Sydney

Form of Telegrams to New Zealand.—Adoption of Isobaric Analysis.

113. Dr. Hector submitted the outline of a telegraphic code based on the isobaric analysis, and pointed out that the whole system depended upon the asumption that the deductions which had led to the adoption of the isobaric system in the Northern Hemisphere were applicable to these colonies, and, with sufficient accuracy, to our present observing stations. He considered that the work done in New Zealand since 1877 had completely established that proposition. He saw no benefit in any other system that could not be secured by the one he proposed, which would confer this one in addition—namely, that the members of this Conference would use the terms now used by meteorologists at Home, those terms having been hitherto avoided in order to prevent any appearance of attachment, on the part of the members, to certain theories. The method of curves hitherto adopted was well adapted for the study of storms after the disturbances had passed over, but did not show where the centres of storms passed, the observing stations not being movable to follow the centres, which moved very irregularly The geographical curves used by the Sydney Observatory were very useful, but he did not think that they gave a true idea of the grades of the atmospheric disturbances. He moved that it was desirable to use the isobaric method of representing the weather upon our coasts.

114. Mr. Russell concurred with Dr. Hector's remarks as to isobars. He had not hitherto adopted them, because he had felt that the observatories were not sufficiently numerous to enable us to trace the lines; but as the number of stations was being increased from time to time, and as New Zealand and Tasmania were now probably about to join in the scheme, he would be very glad to adopt the isobaric system.

115. Dr. Hector pointed out that the use of isobars would prevent the need for communicating so many instrumental readings for weather purposes as are now sent, since, if a centre was mentioned and the grade given for particular winds, the general character of the weather would be a matter of almost necessary inference. He had no doubt, however, that for other purposes those readings would be desirable.

116. Mr. Todd was in favour of the isobaric method, and had been carrying it out for some time in connection with the intercolonial system of weather telegraphy, but had not published the results, feeling that they rested upon insufficient data, owing to the fewness of barometric stations.

117 Mr. Ellery said that seventeen years ago work was done at the Melbourne Observatory in drawing curves from logs of ships and tracing out the isobars. This was continued for nearly two years, but had been given up as perfectly useless, since there were no observations to be combined with those made at the Observatory, except such as were got at sea. The work was only given up because there were not a sufficient number of observing stations in Australia to carry on the system. He thought it could now be carried out, and therefore supported the motion.

118. Resolved, unanimously,—XXXV That the isobaric system of analysis of the weather reports as in use in America and Europe be adopted throughout Australasia on the basis of the instructions contained in the pamphlet by Mr Ley, published by the Meteorological Council of Great Britain.

119. Dr. Hector, as a basis for suggestions, had taken the study of two months' isobaric charts, which he produced. He had not been able to find any critical place for New Zealand, the atmospheric relations of different parts of that colony being so varied that no one place would give the means in Australia of carrying the isobars through New Zealand: in other words, the range of pressure within the New Zealand area was greater than the great range between the centre and the outside of a dis-

turbance. Thus a disturbance, which ranged from the Leuwin to Melbourne, might be so distorted as to be all existent within the small area of New Zealand. He thought, therefore, that it would be best to give the highest and lowest pressures in New Zealand. These islands lie right athwart of all the disturbances that pass over them, which, as a rule, follow the East Coast line, under its lee from south to north. If, therefore, the extremes of pressure each day were telegraphed when a well-defined centre of disturbance was shown passing any of the aspects (but only in those cases where the grade might be considered as a source of dangerous winds),—if, for instance, a depression was making off Foveaux Strait, *i.e.*, off Aspect D, and if the depression had a light grade for N W winds—that information might be of great use to Australia, since such depressions have frequently been observed to bring in a change to strong wind from the S.W., and this might be the beginning of a very large depression, whose diameter might exceed a thousand miles. Thus, if the grade was given, Australia might form some idea of the weather to be expected along its east coast. He did not see that in any other way the telegrams from New Zealand would as yet be of immediate use except for purposes of study Another point to be mentioned was, that when these disturbances—which often form a consecutive series—had heavy N W grades, the series is inclined to the meridian at a different angle from those previously mentioned. These points were not yet completely settled, but he thought it would be necessary to indicate when a depression existed with a grade above 0·02 for every fifteen miles of horizontal distance.

120. The general weather and all remarks would be referred to aspects as decided at the last Conference. When in his report he said that these aspects were not satisfactory, he did not mean to imply that he had yet sufficient knowledge to say how they should be amended. As an instance, he mentioned Bealey, the central station in the South Island, which is considered to be in Aspect D, but experience has shown that it ought to be regarded as in the West Coast aspect, and not that of the East Coast, although it is upon the east side of the mountains. If at any time he had to change the definition of an aspect, he would give notice of it, and explain the reason.

121. He proposed to give the cyclonic weather for north or south winds, and what aspect they are in, and the anti-cyclonics, which are of great interest, since, for some unknown reason, in summer, when they should have low pressure, a high pressure occurred over the land.

122. Dr. Hector then submitted a double-entry code, prepared to exhibit the aspects of the New Zealand coast, and the cyclones, anti-cyclones, &c.

123. Mr. Russell considered that what was wanted was to give such information as would be useful to the public. It might not appear to be of much interest to the Sydney public to know the general weather in New Zealand, but in reality it was of interest to business men and all connected with shipping. Particulars would therefore be extremely valuable.

124. Mr. Ellery agreed with this view, and considered that a little extension of the cypher code for New Zealand would give all that was required.

125. Mr. Russell thought that the telegrams should show the general state of the weather, and the particular state, if such existed. He thought that the synoptical view of the weather in each colony should be compiled by the chief officer of that colony

126. Further discussion ensued, after which the principle of the form for synoptical telegrams from New Zealand to Australia was adopted.

The Conference adjourned to to-morrow at 10 o'clock a.m.

TUESDAY, 26TH APRIL, 1881.

The Conference met at the Observatory at 10 o'clock a.m.

Present: Mr. Ellery (Chairman), Dr Hector, Mr. Russell, and Mr Todd.

The minutes of the last meeting were read and confirmed.

Form of Telegrams from New Zealand to Australia, and vice versâ.

The discussion on this subject was resumed.

127 Dr. Hector, in submitting a form of code, said that he had divided Australia into districts somewhat similar to those into which New Zealand had been divided.

128. He proposed that, under the column headed "Over the Land," Australia should be divided into the West Central and East Central Districts, the word "General" being used when the phenomena reported were common to the whole. He proposed that the name of each station should be only one word: thus, for "Alice Springs" the word "Alice" alone should be used. Reports should be sent from only one station in each district, unless some unusual phenomenon appeared at one of the others, in which case its importance would justify the cost of reporting it in full. The western section extended across the continent from Darwin to Adelaide, including as its principal stations Darwin, Alice, and Adelaide. He suggested that Alice should be the station selected for the Central District. The Eastern District he proposed should take a similar range in longitude, its stations being Ravenswood, Bourke, Deniliquin, and Melbourne. The section through Darwin and Adelaide he regarded as the plain country That from Ravenswood to Melbourne would embrace the country westward from the foot of the mountain range.

129. Mr. Todd observed that Darwin would report the tropical rains.

130. Dr. Hector considered that that would be very valuable information, as the weather would probably be found to be to some extent controlled by these rains.

131. Mr. Todd remarked that the monsoon rains this year did not extend farther than twelve miles south of Tennent's Creek.

132. After some discussion, Gunnedah, Tamworth, Bathurst, and Melbourne were selected as the stations for the Eastern District, Bathurst to be the reporting station.

Dr. Hector proceeded further to explain the draft code, pointing out that the station selected to report was underlined, and proposed to be printed in italic letter.

133. The coast he had divided into aspects. Aspect A would be the promontory from Perth to Israelite Bay (Weld), including the stations Perth and Albany, the latter to be the reporting station; Aspect B was proposed to extend from Israelite Bay to Cape Borda, including Eucla, Borda being the reporting station; Aspect C, from Cape Borda to Cape Otway, would include Robe, Cape Northumberland, Portland, and Cape Otway, Portland to be the reporting station; Aspect D comprised Tasmania, Hobart being its station; Aspect E, he suggested, should extend from Cape Otway to Gabo Island, including Georgetown, Wilson's Promontory and Gabo being its reporting stations; Aspect F to include Jervis Bay, Sydney (reporting station), Newcastle, and Macquarie; and Aspect G should comprise Brisbane (reporting station), Rockhampton, and Bowen. For exceptional phenomena he considered that ordinary words should be used, and the particular station be referred to by name if necessary He moved that the decision of the Sydney Conference relative to the division of Australia into aspects should be amended according to the schedule handed in.

134. Mr. Russell considered that the arrangement made at the Sydney Conference, by which each colony or aspect sent an account of its own weather, was better than that proposed.

135. Resolved,—XXXVI. That the coastal aspects proposed by Dr. Hector be adopted.

136. Upon the proposition to adopt Dr. Hector's division of inland Australia, Mr. Todd proposed as an amendment that Port Darwin should be made a separate aspect, to be named the North Coast Aspect, it having a climate peculiar to itself and quite distinct from that of Central Australia, as represented by Alice Springs; also that, instead of East Central and West Central, the inland portion of the continent be divided into "Central Australia" and "the Riverine District."

137 Mr. Russell considered that storm centres were the most important phenomena to be watched, and that for this purpose the lines of barometers in the South Australian stations, on the overland telegraph line, should be taken, and similar lines through the other colonies.

138. Dr. Hector explained that in laying out the proposed divisions he had looked upon Australia as a large plain country, with a range of mountains on its eastern border. He had therefore divided it into a Western and an Eastern District; the former being the whole of the plain country, and the latter the country at the western face of the range. The deductions regarding changes of weather arising in the south-east would be made by the coastal aspects on the east coast, while changes passing to the south of Australia (which are of the greatest importance to New Zealand) would be inferred from the successive coastal aspects along the south coast of the continent.

139. Resolved,—XXXVII. That the interior of Australia be divided into East Central and West Central.

140. Resclved,—XXXVIII. That the specimen code prepared by Dr. Hector be adopted, provisionally

141. On the motion of Mr. Russell, it was resolved,—XXXIX. That the daily telegrams exchanged within Australia shall include the time of turning-points of the barometer and shift of wind.

142. On the motion of Mr. Todd, it was resolved,—XL. That the members of the Conference undertake to impress upon their respective Governments the need for promptitude in the despatch of weather telegrams, and the desirableness of using coloured paper for the forms on which these messages are written.

Alterations in Code.

143. Mr. Ellery pointed out that the code had been found to be not quite perfect; but he had no doubt that the American word method adopted in Australia was preferable to the figure code, in which opinion all the members concurred.

144. Mr. Russell suggested that the present extensive table for direction and force of the wind might be advantageously reduced to sixteen or even to eight words, since the clerks would soon learn by heart so short a code, and there would be no need of constant reference to the printed code.

145. Dr. Hector pointed out that, though as few as four points might be sufficient for merely keeping a general record of the weather, yet for the purposes of isobaric analysis the information should be as minute as possible.

146. Resolved,—XLI. That the present form of the code in Table IV be altered, as suggested by Mr. Russell, and that the selection of code words be left to Mr. Ellery

147 Dr. Hector suggested that every code word should consist of two syllables.

148. Mr. Russell recommended that, in any reprint of the code, the sheet-form should be adopted.

Mode of carrying out Resolution XIV

149. Mr. Russell submitted the form of diagram used in New South Wales. Mr. Ellery stated that he now published no diagrams. Mr. Todd was of opinion that if the barometer temperature, direction and force of wind, and rainfall records appeared on the diagram it would be sufficient.

150. On the motion of Mr. Russell, it was resolved,—XLII. That in carrying out Resolution XIV diagrams be used in the form now submitted, on which shall be represented the barometer, temperature, direction and force of wind, and rainfall curves. That the following shall be the weather diagram stations, viz.: Alice Springs, Brisbane, Albany, Adelaide, Sydney, Melbourne, Hobart, Auckland, Wellington, and Dunedin; and, provisionally, that the stations shall appear upon the diagram in the order above named.

Co-operation of all Australasian Colonies.

151. On the motion of Mr. Todd, it was resolved,—XLIII. That the Government of New South Wales be asked to move the Government of Queensland to co-operate in the meteorological scheme of Australia, and to furnish to the Sydney Observatory daily telegrams from Brisbane, Rockhampton, Cooktown, Normantown, and Cloncurrie.

152. In the discussion on this motion the members unanimously expressed their sense of the great importance attached to the co-operation of Queensland.

153. Moved by Mr. Russell, seconded by Mr. Todd, and unanimously resolved,—XLIV That, in the opinion of this Conference, the results obtained under the present weather-telegram system prove

that storm centres pass from west to east over Australia and New Zealand at such a rate as permits of important telegraphic warning being given of approaching gales; and that it is of very great importance so to extend and complete this system that it may include all Australia and New Zealand.

154. In the discussion upon the above resolution, Mr. Russell, Mr Todd, and Dr. Hector detailed minutely numerous and well-marked instances of the facts upon which the resolution was based. (*Vide* Appendix No. 2.)

155. On the motion of Dr. Hector, it was resolved unanimously,—XLV That additional barometer stations be established in the interior of Australia, with the view of tracing the latitude of passing storm centres.

156. On the motion of Mr. Todd, it was resolved,—XLVI. That the Government of New South Wales be requested to communicate with the Government of New Caledonia, and that the Government of New Zealand be requested to communicate with the Government of Fiji, in order to obtain regular observations from those countries.

157 Dr. Hector stated that Mr. Holmes, a resident of Fiji, an able observer, had been furnished by the Government of New Zealand with a complete set of instruments, and had supplied statistics regularly since 1872, which had all been published.

158. Mr. Russell said that he had sent instruments to New Caledonia, with a request that observations might be regularly sent to him, but that these had ceased to be received after the first two months.

Daily Weather Map.

159. Mr. Russell proposed that a map, including Australia and New Zealand, be adopted for plotting the information upon for daily publication.

Mr. Ellery submitted a specimen map.

160. Dr. Hector said that it was necessary that, upon any map used for this purpose, the gaps in the mountains should be marked.

161. Mr. Russell remarked that in New South Wales there was a meteorological pass of very great importance, which was a low place in the mountains at the head of the valley cut by the Hunter River; and stated that he could often see the storms coming from the other side of the range long before they reached Sydney These disturbances came along the valleys and passed out upon the coast at Port Macquarie.

162. On the motion of Mr. Russell, it was resolved,—XLVII. That the weather map be upon the scale of the map submitted by Mr. Ellery; that the projection to be used shall be Mercator's; that the direction of the wind be indicated by arrows; and that the map shall include New Zealand, Fiji, New Caledonia, and Batavia, &c.

163. It was agreed that Mr. Ellery should have proof-maps struck off, which should be sent to the delegates, in order that each may put in the principal features of his colony

Tide-Gauges.

164. On the motion of Mr. Ellery, it was resolved,—XLVIII. That self-registering tide-gauges be established at the Semaphore, Guichen Bay, and Victor Harbour, in South Australia; at Portland and Gabo Island, in Victoria; in New South Wales, one at Clarence River in addition to those now in use at Sydney and Newcastle; at Brisbane, in Queensland; and at Pencarrow, the Bay of Islands, Lyttelton Heads, Otago Heads, Puysegur Point, and New Plymouth, in New Zealand.

165. Resolved,—XLIX. That Messrs. Ellery and Russell be requested to report upon the best form for, and the cost of, a tide-gauge to be adopted; the report to be forwarded to each member of the Conference as soon as the inquiry is completed.

Standard Instruments.

166. On the motion of Mr. Todd, it was resolved,—L. That, with a view to the observations being referred to one uniform standard, a complete set of standard instruments be purchased for circulation between the four chief stations—viz., Melbourne, Sydney, Wellington, and Adelaide—the cost to be divided between the four colonies represented at this Conference. The instruments to comprise—Barometer, thermometer, maximum solar thermometer, and anemometer.

167 At the suggestion of Mr. Russell, it was agreed that the results of comparison should be sent on with the instruments.

Conditions of Observation.

168. On the motion of Mr. Ellery, it was resolved,—LI. That the following conditions of observation be observed—viz., that thermometers be exposed on the stands and close to those with which they are to be compared; the barometer to be hung close alongside the standard with which it is compared; the solar thermometer to be exposed in exactly the same conditions as that used for ordinary registration; and the anemometer to be exposed near to, and upon the same level with, the fixed instrument.

169. Mr. Todd moved, That all readings of the several instruments in use be reduced to a common standard.

The consideration of this motion was deferred until the results of the experiments should be known.

Form of Statistics.

170. On the motion of Mr. Todd, it was resolved,—LII. That, although absolute uniformity in the form of publication of meteorological statistics is not considered essential, whatever form is adopted should give—(*a*) Barometer reduced to 32° and sea-level at least at one of the hours agreed upon at the last Conference (9 a.m., 3 p.m., 9 p.m.), and the principal turning-points (also reduced), with the times of their occurrence; (*b*) the temperature of the air at the same hour or hours, also the maximum and minimum; (*c*) wet-bulb thermometer readings at the same hour or hours, or the humidity; (*d*)

amount and character of cloud, and upper current of cirri or high cloud; (*e*) direction and force or velocity of wind; (*f*) rain during previous twenty-four hours, recorded at 9 a.m.

171. It was agreed that 9 a.m. local time should be adopted as the common epoch of these observations.

172. During the discussion on the above resolutions, Mr. Russell asked Mr. Ellery whether in his experience so many as 1 per cent. of cases occurred where the maximum temperature of the day occurred in the morning before 9 a.m. Mr. Ellery having replied in the affirmative, Mr. Russell expressed a doubt whether the cases were numerous enough to make their record of any value, and his conviction that that value would never compensate for the disadvantage of heating the thermometers with a lamp at night when reading them.

173. The suggestion contained in Mr. Todd's notice of motion (*vide* par. 65, *c*, *β*), that a maximum reading be taken at 9 p.m., was therefore rejected.

174. On the motion of Mr. Todd, it was resolved,—LIII. That the chief stations at Melbourne, Sydney, Wellington, and Adelaide should, in addition to the foregoing, give maximum solar thermometer, and minimum on grass, hours of sunshine, and the evaporation read off at 9 a.m. and 9 p.m.

Ozone.

175. On the proposition contained in Mr. Todd's notice of motion, that ozone observations be made at 9 a.m. and 9 p.m., Dr. Hector moved, Mr. Russell seconded, and it was unanimously resolved,—LIV. That, on account of the uncertainty of the tests adopted to detect ozone, the continuance of observations on ozone be optional with each Director.

Hourly Readings at Principal Stations.

176. Mr. Todd moved, That, in addition to the observations already resolved on, Melbourne, Sydney, Wellington, and Adelaide should publish hourly readings of barograph (reduced to 32° and sea-level), thermograph, and anemograph. The motion was negatived.

Curve-sheets and Synopses.

177 On the motion of Mr. Todd, it was resolved,—LV That (carrying out Resolution XIV. passed at the previous Conference curve-sheets with synoptic reports on weather should be exchanged monthly It is recommended that these curves should show barometrical pressure at sea-level, temperature of air, direction and force or velocity of wind, and rainfall, and that the synopsis should be in sufficient detail to trace storms and other atmospheric disturbances. There should be a sufficient number of stations selected in each colony to supply data for forming isobaric maps for every day

Adopted Mean Temperature.

178. Mr. Todd moved, That the adopted mean temperature should be deduced from the minimum, the 9 a.m., the maximum, and the 9 p.m. readings, and that at the four principal stations this mean should be compared with the hourly means.

179. Mr. Ellery, in reply to a question, stated that at his Observatory the mean was arrived at by taking the mean of all the observations of the day, and applying to it a correction deduced from the hourly observations.

180. Mr. Russell preferred to have the maximum and minimum observations without any correction.

181. Mr. Todd concurred with Mr. Russell, and explained that he read his minimum at 9 a.m. and maximum at 9 p.m. It of course occasionally happened in the summer that a lower temperature than the minimum recorded at 9 a.m. was reached at a later hour during the same day when a southerly wind set in after a hot wind.

182. Dr. Hector considered it would be sufficient to take as the mean for the day the mean of the maximum and minimum, as the thermograph gave all the intermediate variations. He much preferred morning readings to those taken in the evening.

183. In deference to a general consensus of opinion, Mr. Todd consented to omit the recommendation of using the 9 a.m. and 9 p.m. readings in deducing mean temperature.

184. Whereupon it was resolved,—LVI. That the adopted mean temperature be deduced from the maximum and minimum of the day read at 9 a.m., and at the four principal stations this mean should be compared with the hourly means obtained from the thermograph.

Exposure of Thermometers.

185. Mr. Todd moved, That the exposure of thermometers be uniform, or, if that cannot be effected, the four principal stations, or one of them, should mount thermometers on each plan adopted by the other colonies and compare the readings on each kind of stand with the readings of a rotatory thermometer in the shade.

186. Mr. Russell suggested that this would not be necessary if a thermometer were sent round for comparison.

187 Mr. Ellery remarked that the proposal might be referred for a report to be brought up with the further experiments to be made with swing-thermometers; and the motion was postponed accordingly

Dry- and Wet-Bulb Thermometers.

188. Mr. Todd moved, That the dry- and wet-bulb thermograph readings should be compared with the readings of the standard or ordinary dry- and wet-bulb thermometers at 9 a.m., 3 p.m., and 9 p.m., and the readings of the thermograph should be referred to those of the ordinary dry and wet, or the corrections supplied. He suggested that this might be left to each person who had a thermograph.

189. Mr. Russell inquired what was to be done with the thermograph registrations—were they published?

Mr. Ellery and Mr. Todd replied that theirs were not.

Dr. Hector said that he had never taken any

190. The motion was negatived.

Rain-Gauges.

191. On the motion of Mr. Todd, it was resolved,—LVII. That rain-gauges be of one uniform pattern and size of receiving surface, viz., 8″ in diameter, and that the height of the mouth of the receiver above the surface of the ground be stated in the published observations.

192. In the discussion upon this resolution, Dr. Hector mentioned that he was in the habit of causing a small mound of earth to be raised, into which the rain-gauge was sunk up to within 6 inches of the lip.

193. Mr. Ellery disapproved of the artificial knoll.

Atmometer.

194. Mr. Todd moved, That the form of atmometer adopted at Adelaide be recommended. This consists of an outer tank of brick cemented, 4 feet square internal measurement, and an inner tank of slate or marble, 3 feet square or 3 feet in diameter, both tanks being filled with water to the same level. The amount of evaporation is read off by means of a float carrying a graduated rod and vernier divided into 0·01 inch.

195. Resolved,—LVIII. That the consideration of the best form of evaporator be deferred to the next meeting of the Conference.

Form for Reports on Stations.

196. Mr. Russell said it had been remitted to him to prepare some form in which the members should furnish a description of their stations. He produced form providing for—(1) A description of the instruments in use at the observatory, or on stations containing recording instruments; (2) the names and positions of stations having barometers and thermometers, &c.; and (3) the number of stations having rain-gauges, or rain-gauges and thermometers.

197 Resolved,—LIX. That the form of return prepared by Mr. Russell for reporting stations and their equipment be adopted.

Defective Maximum and Minimum Thermometers.

198. Mr. Todd drew the attention of the Conference to a common defect in maximum thermometers received from Messrs. Negretti and Zambra. When these instruments were put into the ordinary approximately horizontal position the column of mercury ran down two or three degrees from the expansion of the air near the bend of the tube.

199. Mr. Russell said he had had much experience with these instruments, and had found that many were sent out in a defective state. He detailed the method of examination applied when thermometers were offered to him for sale, and stated that if they passed that examination they seldom went wrong afterwards. He suggested that Mr. Todd should return imperfect instruments to the makers.

200. Mr. Ellery said that he formerly had much trouble with these instruments, but it had never occurred since he had obtained them through the Kew authorities.

201. Mr. Todd remarked that he got most of his in the same way, but nearly all were similarly defective. To return them was practically impossible, partly because of the distance and partly because the goods were already paid for.

202. After some further discussion, it was agreed that it would be best to draw the attention of the Meteorological Department of the Board of Trade to the facts, in order that the evil might be remedied.

Estimates of Force, &c., of Wind.—Anemometer.

203. Mr. Russell again drew attention to the question whether the present mode of estimating the velocity of the wind where there was no anemometer should be continued, or whether some better means should be adopted.

204. Dr. Hector considered that, for ordinary weather-reporting stations, the estimates were sufficient.

205. Mr. Todd placed very little reliance upon estimates, but feared that, at most of the stations, the instrument devised by Mr. Russell would be of little use, since the officer would seldom take the trouble to go out of the shelter of the building. At lighthouses and such places he would be quite prepared to place a Robinson's anemometer, and have it registered.

206. Mr. Ellery said he proposed to try Mr. Russell's form of Robinson's anemometer at some of the lighthouses on the coast, in order to test its value for measuring velocity of the wind.

The Conference then adjourned to to-morrow at 10 o'clock a.m.

WEDNESDAY, 27TH APRIL, 1881.

The Conference met at the Observatory at 10 o'clock a.m.

Present: Mr. Ellery (Chairman), Dr. Hector, Mr. Russell, and Mr. Todd.

The minutes of the last meeting were read and confirmed.

Co-operation of Tasmania.

207 Mr. Ellery drew attention to the fact that the communication from the Tasmanian Government, which the Conference had been informed would be made before the meetings terminated, had not yet been received.

208. On the motion of Dr. Hector, it was unanimously resolved,—LX. That the evidence before the Conference shows the paramount importance of obtaining the co-operation of Tasmania in Australian meteorology; and the Conference therefore requests Mr. Ellery, the representative of Victoria, to continue the steps he has already taken to secure the practical co-operation of that Government as soon as possible.

Weather Maps.

209. The method of securing perfect uniformity in the maps was discussed and agreed upon.

Rain-Gauges.

210. Mr. Russell stated that it had come to his knowledge that rain-gauges were offered for sale, and were actually sold, which had an error of as much as 10 per cent.; and that he thought it desirable to point out to all persons interested in rain measurement the necessity for having accurate means of measurement. On his motion it was resolved,—

211. LXI. That this Conference, in view of the importance of and general interest taken in rain observations, recommend private observers to use none but certified eight-inch rain-gauges; and that each member of the Conference undertakes to certify to the accuracy of rain-gauges gratis.

Sliding Scale for reducing Barometrical Observations.

212. Mr. Russell stated that during the past few months he had devised a sliding scale for reducing barometrical observations for weather purposes, a copy of which he submitted. In his experience it had to a great extent obviated the risk of error in reduction. Its use could be taken up immediately, only a few minutes' instruction being required even by a person who had no knowledge of the ordinary forms of computation. A calculation had to be made for each station, and from its result a curve was plotted: this curve varied with the altitude.

213. Mr. Ellery suggested that a series of diagrams might be constructed which should serve for all altitudes.

214. Mr. Russell agreed that the suggestion was practicable, but had found that, for actual use, it was best to compute for each station and plot it with its name upon the scale, so that it could be easily seen.

215. Mr. Ellery inquired whether the index error of each barometer was indicated upon the scale.

216. Mr. Russell replied that he had introduced that element, so that the diagram gave the reading corrected for index temperature and altitude.

217 Mr. Todd stated that he had for each station a small card, upon which all the corrections were included for index error, altitude, and reduction to 32°

218. Mr. Russell said that in constructing the diagrams computations were made for 40° and 80°

219. Mr. Ellery said that in his opinion the method would be found as valuable as Mr. Russell's hygrometric sheet had been; and the other members of the Conference agreed in approving of Mr. Russell's plan.

Report.

220. Dr. Hector moved, and it was unanimously resolved,—LXII. That the foregoing minutes be adopted as the Report of the Conference, and that the Chairman be requested to report them to the Government of Victoria, with a request that copies of them may be transmitted to the other colonies.

221. A vote of thanks to Mr. Ellery for his services as Chairman, and for the accommodation afforded to the Conference at the Observatory, was passed unanimously

The Conference then terminated.

APPENDIX No. 1.

METEOROLOGICAL STATIONS in New Zealand, New South Wales, South Australia, and Victoria, with Standard or Corrected Barometers, Thermometers, &c., at which complete and regular Observations are made.

NEW ZEALAND.

Stations.	South Latitude.	East Longitude.	Altitude above Sea.
	Deg. min.	Deg. min.	Feet.
Mongonui	35 1	173 28	70
Auckland	36 50	174 50	258
Taranaki	39 3	174 5	42
Napier	39 29	176 55	14
Wanganui	39 56	175 6	80
Wellington	41 16	174 47	140
Nelson	41 16	173 18	34
Cape Campbell	41 43	174 18	7
Christchurch	43 32	172 39	21
Bealey	43 2	171 31	2,104
Hokitika	42 41	170 59	12
Dunedin	45 52	170 31	550
Queenstown	45 2	168 39	1,070
Southland	46 17	168 20	79
Waitangi, Chatham Islands	43 55	176 42	100

NEW SOUTH WALES.

Stations.	Altitude in Feet.	South Latitude.	East Longitude.
		Deg. min.	Deg. min.
Clarence River Heads	120	29 28	153 21
Inverell	1,953	29 48	159 10
Walgett	...	30 2	148 0
Bourke	456	30 3	145 58
Armidale	3,278	30 34	151 46
Gunnedah	925	31 1	150 15
Tamworth	1,271	31 7	150 55
Coonabarabran ...	..	31 16	149 18
Port Macquarie ...	53	31 25	152 54
Cobar	...	31 32	145 50
Menindie	...	32 23	142 26
Newcastle	112	32 55	152 50
Bathurst	2,200	33 24	149 37
Forbes	1,120	33 27	148 5
Mount Victoria ...	3,490	33 36	150 15
Sydney	155	33 51	151 12
Wentworth	144	34 8	142 0
Wollongong ...	67	34 25	150 56
Hay	...	34 30	144 56
Goulburn	2,129	34 45	149 45
Wagga Wagga ...	739	35 8	147 24
Cape St. George ...	175	35 12	150 45
Milton	...	35 14	150 20
Deniliquin	320	35 32	145 2
Kiandra	4,640	35 52	148 32
Moruya	50	35 53	150 6
Albury	572	36 6	147 0
Cooma	2,637	36 12	149 9
Eden	107	37 0	149 59

SOUTH AUSTRALIA.

Stations.	Latitude.	Longitude.	Height above M.S.L.
	Deg. min.	Deg. min.	Feet.
Port Darwin ...	12 28	130 51	70
Daly Waters ..	16 18	133 25	750
Alice Springs ...	23 41	133 37	2,100
Port Augusta	32 30	137 45	10
Adelaide	34 57	138 35	140
Eucla	31 45	128 58	7
Streaky Bay ...	32 50	134 12	40
Cape Borda ...	35 45	136 35	506
Robe ...	37 10	139 42	19
Mount Gambier ..	37 50	140 50	130
Cape Northumberland..	38 5	140 40	117
Strathalbyn... ...	35 16	138 55	220
Kapunda	34 32	138 57	800

VICTORIA.

Echuca	36 7	144 48	314
Sandhurst	36 47	144 17	758
Omeo	37 6	147 36	2,108
Ararat	37 18	142 58	1,050
Upper Macedon ...	37 23	144 35	3,000
Ballarat	37 34	143 49	1,438
Gabo Island ...	37 35	149 55	50
Melbourne Observatory	37 50	144 59	91
Lakes entrance ...	37 52	148 1	
Portland	38 20	141 35	37
Cape Schanck ...	38 28	144 53	277
Port Albert... ...	38 39	146 41	10
Cape Otway ...	38 54	143 31	270
Wilson's Promontory...	39 8	146 26	300

APPENDIX No. 2.—(*Vide* paragraph 154.)

The following extract from the Adelaide Meteorological Report for the month of May, 1879, was put in by Mr. Todd, and affords evidence of the easterly progressive motion of atmospheric disturbances :—

The mean barometer was about 0·06 inch to 0·07 below the average of the previous twenty-two years. It ranged high —or above 30—during the first half of the month, or until the 17th, attaining a maximum (30·485) at Adelaide on the 9th ; and was below 30 from the 17th to the 29th, reaching a minimum (29·482) on the evening of the 20th, or 26·358 at Cape Borda on the morning of the 21st. The high pressure prevailed over the centre of Australia till the 17th, and the records of other colonies, as well as ships' logs, show that this area of high pressure extended not only over the whole of Australia, but far to the westward in the Indian Ocean, probably even to longitude 70° E., as vessels from the westward report high barometer, one stating that it stood as high as 30·400 for fourteen days during the first half of May. It was broken by a depression between the 10th and 12th at Eucla, where however, it was only slight, not going below 30·1 ; but more marked to the eastward, at Cape Northumberland, where the barometer fell from 30·45 on the 9th to 29·78 at midnight on the 12th and 13th ; the depression was also slightly felt at Alice Springs, in the centre of the continent. The prominent barometrical feature of the month was the large depression, which commenced generally on the 15th, setting in from the westward. Thus Perth, on the west coast, reports a fall of about one-quarter of an inch between the 12th and 13th, but at Cape Borda the downward tendency did not commence till noon of the 15th, and Tasmania on the 16th. By ships' reports, the centre of this depression appears to have passed about 200 miles south of Cape Leuwin on the 19th. The minimum pressure at Perth occurred also on the 19th, 29·381 ; Eucla, 29·34, at 3 p.m. on the 20th ; Cape Borda, 29·358, at 3 a.m. on the 21st ; Cape Northumberland, 29·401, at 3 p.m. on the same day ; and Hobart, 29·05, about midnight on 21st and 22nd. It reached New Zealand on the 25th, the barometer at Auckland falling to 29·497 ; Wellington, 29·290 ; and Dunedin, 29·293.

On the south coast this depression was preceded by rains between the 13th and 14th, the wind being from the S. along the coast as far as Cape Otway, and S.E. and southerly with high seas to Cape Howe, to the north of which along the east coast the winds were W and S.W., with a relatively low barometer, being four-tenths lower there than at Kangaroo Island. On the 15th the S.E. winds reached along the south coast from Wilson's Promontory to Kangaroo Island, with clouded skies, whilst at Eucla it was N.N.E. and overcast, under the influence of the advancing depression. On the east coast the winds were S. and S.E., the weather being generally clouded from Sydney round to Eucla, the barometer showing a rise of two-tenths at Cape Howe. On the 16th the wind was still from N.N.E. at Eucla, with falling barometer, but S.E. and easterly along south coast from Wilson's Promontory to Cape Borda, and southerly with heavy seas and rain on east coast ; barometer steady then at Eucla. On the 17th wind still N.N.E. at Eucla, E. and S.E. along south coast from Cape Howe to Kangaroo Island, and southerly with high seas and falling barometer on east coast, accompanied with rain. On the 19th the wind was from N and N.E. in South Australia, and along the south coast to Melbourne ; but on the east coast the general direction was westerly, with falling barometer and clear skies. On the 20th the wind was N.N.E. from Eucla throughout South Australia to Cape Otway, and westerly on east coast, the sky being clouded in South Australia and Victoria, also in the interior of New South Wales and along east coast. The north winds are maintained on the south coast, veering to the N.W on the 22nd. Westerly through Bass's Straits and east coast on the 22nd and 23rd.

In connection with the extended area of high pressure prevailing during the first half of the month, and the subsequent large depression, the progress of which we have just traced, it may be well to call attention to a cyclonic disturbance to the west and south of the Mauritius, reported by Mr. Meldrun, as it seems not improbable that the disturbance just referred to here originated in the Indian Ocean, to the north of that island.

The following is extracted from the Monthly Notices of the Meteorological Society, Mauritius, 17th June, 1879, page 105 :—

" Barometric depression of 25th April to 10th May, 1879 : The mean height of the barometer on the 25th April was 30·103 inches, from which it gradually fell to 30·043 on the 29th. On the 30th April and 1st May it recovered a little, but in the evening of the 1st it began to go down again, and continued falling till the 5th, on which day its mean height was 29·895. It then began to rise, and on the 10th was at 30·033. The highest reading (corrected and reduced) was : 0·146 at 9 a.m. on the 25th April, and the lowest, 29·862, at 3 p.m. on the 4th May.

"From the 25th to the 29th April the wind veered from S.E. to E. On the 30th it backed to S.E. × E., and then veered to N.E. on the 3rd May; was light and variable on the 4th, from N.N.W to W on the 5th and 6th, from W to S.W on the 7th, from W.S.W on the 8th and 9th, and from the S. on the 10th.

"On the night of the 3rd to the 4th May there was a thunderstorm, and also some thunder and lightning throughout the 4th. From 9 a.m. of the 3rd to 9 a.m. on the 4th, 3·75 inches of rain fell at the Observatory.

"These atmospheric disturbances indicated the existence of heavy weather away to the southward and westward, and it is now known that on the 6th May two vessels, the 'Maria Elizabeth' and the 'Wagrien, were dismasted in about latitude 29° S. and longitude 53° E."

This last position, it will be seen, is about 420 miles E.S.E. of the locality given by the ship "Windsor Castle" on the 4th, in the following paragraph, which would show the storm to have had a progressive motion of about 210 miles per day in an E.S.E. direction.

The ship "Windsor Castle," from Port Pirie, in South Australia, to Antwerp, appears to have felt the full force of the storm on 4th May, in latitude 27° 10′ longitude 45° 45′ E., or about 200 miles south of Madagascar. The captain reports as follows:—

"Left Port Pirie Roads (South Australia) on 13th March; passed Cape Borda on the 19th. Had light S.E. trades across the Indian Ocean to latitude 27° 10′ S., longitude 45° 45′ E., when, on 4th May, was overtaken by a cyclone, which came on at the N and veered by the W to S.E. During this gale, and for several hours before its commencement, a mountainous sea was running from S.W Had for four days previous hot sultry weather, with light variable winds. In the height of the storm the vessel was forced over on her beam-ends, and everything movable on deck washed overboard; two harness casks full of beef and pork, which were lashed under the topgallant forecastle for present use, were washed adrift, and their contents went overboard; the carpenter's tool-chest, which was lashed in the same place as the cask, was stove in, and some of the tools washed overboard; the half-deck and galley doors stove in, and one of the iron posts wrenched off its hinges; the gig was floated out of her chocks, and dashed against the lifeboat, both boats received damage; the fore-pump was washed about the main deck and broken."

On the 18th May the barque "Elizabeth" reports experiencing a storm in 118° E., latitude 39° S., the barometer falling to 28·9 inches.

The clipper ship "Oberon," from England, on the same day, in longitude 115° E., latitude 39° S., had a violent S.E. gale, the barometer falling to 21·16 on the 19th, having evidently sailed into the S.W quadrant of the storm.

The barque "Alice Mary," from Port Louis, on the 18th, in longitude 114° E., latitude 37° S., reports the wind to have veered to S.E., blowing a heavy gale with high confused sea. Fierce gale on the 19th, and the ship was hove-to from the 20th to the 23rd.

The central depression passed therefore from the meridian of Cape Leuwin to Hobart in about sixty hours, more or less, and had a mean velocity of about 26 miles an hour; but the velocity increased as the disturbance advanced eastward, as between Cape Leuwin and Eucla it moved at about the rate of 570 miles a day, 650 per day between Eucla and Cape Northumberland, and 960 miles per day between Cape Northumberland and Tasmania: this increased velocity in the neighbourhood of Tasmania may be accounted for by the supposition that the area of low pressure then lying to the S.E. of Cape Howe in a great measure lessened the resisting medium in front. The storm off Madagascar had a velocity of about 210 a day, and assuming a gradually increased velocity to a mean of about 300 miles a day between the 6th and 19th would bring it off the Leuwin on the 18th or 19th. It seems not improbable, therefore, that the storms were identical, and that, having passed southwards between Madagascar and the mainland of Africa, it recurved to the eastward, traversing the Indian Ocean to Australia, on the south side of the area of high pressure, which, however, did not move bodily off the continent to the eastward, but gradually contracted and was dissipated; thus we find on the 10th that the isobar of 30·4, which on the 9th embraced an area of about 800,000 square miles, extending from Melbourne to beyond Eucla, with an average breadth from N. to S. of about 500 miles, was restricted to an area of only some 20,000 square miles over the Riverina District of New South Wales, north of the Murray, Deniliquin being about the centre. It should be added that the barometrical depression which we have described as setting in from the westward, passing Perth on the 19th, was felt slightly on the north coast at Port Darwin, and was very marked in the centre of the Continent, where, at Alice Springs, the mercury fell from 30·46 on the 15th, to 29·72 on the afternoon of the 18th, remaining low till the afternoon of the 22nd, the barometer at all other times of the month being there over 30 inches.

By Authority: George Didsbury, Government Printer, Wellington.—1881.