

1887.
—
VICTORIA.

TWENTY-SECOND REPORT

OF THE

BOARD OF VISITORS

TO

THE OBSERVATORY;

TOGETHER WITH THE

Annual Report of the Government Astronomer.

PRESENTED TO BOTH HOUSES OF PARLIAMENT BY HIS EXCELLENCY'S COMMAND.

By Authority:

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TWENTY-SECOND REPORT

OF THE

BOARD OF VISITORS TO THE OBSERVATORY.

TO HIS EXCELLENCY SIR HENRY BROUGHAM LOCH, *Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Knight Commander of the Most Honorable Order of the Bath, Governor and Commander-in-Chief in and over the Colony of Victoria and its Dependencies, &c., &c., &c.*

We have the honour to report to Your Excellency that the annual visitation of the Observatory has been duly made, and that we found the establishment in good order and working efficiently.

In our last Report we referred to the condition of the mirrors of the Great Telescope. They are now so dull that they must be re-polished before the nebular work can be satisfactorily continued. We recommend that the Government Astronomer be authorized to get this done as soon as possible, and that, as it appears from his Report annexed that it may be found possible to have the work carried out in Victoria, he be requested to get at least one of the mirrors polished on the spot.

A more direct and convenient approach to the Observatory is necessary, the proper entrance having been stopped by cutting down the St. Kilda-road. At present, visitors are obliged to go all the way to the Domain-road, and then turn back, to enter the grounds. As we understand that the edge of the Domain is to be sloped down to meet the road, it would be easy to make an entrance near the gates of Government House, and we beg leave to advise that this improvement, which is needed for the convenience of the public, may be carried out.

The work of the Observatory requires that the officers shall live in close proximity to it. The Government Astronomer and the chief assistant have quarters within the reserve, but others receive an allowance in lieu of rent, and are compelled to live at a greater distance from their work than is desirable. We think that it would be well to build quarters for the Astronomer much nearer to the Observatory, and so make his present house available for one of his assistants. At all the Observatories with which we are acquainted the Astronomer lives very near to them, if not actually within the walls which contain the instruments, and, for obvious reasons, we think it should be so here. As the rent paid by the Government instead of quarters would go against the interest on the capital sum required for the new building, its actual cost would not be great.

We are very glad to learn from Mr. Ellery's Report that Your Excellency's Government has decided that the Observatory shall take the part assigned to it in the great international work of making photographic charts of the heavens. Our co-operation is the more important because there are so few Observatories in the Southern Hemisphere, and it is essential to the success of the undertaking that everyone in these latitudes having the necessary establishment shall share in it.

GEORGE VERDON, F.R.S., Chairman,
F. STANLEY DOBSON, LL.D., F.L.S.,
JAMES MOORE, M.A.,
M. H. IRVING, M.A.,
W. C. KERNOT, M.A.,
J. E. BROMBY, Hon. Sec.

Melbourne, 14th September, 1887.

REPORT OF THE GOVERNMENT ASTRONOMER TO THE BOARD OF VISITORS TO THE OBSERVATORY.

THE Report which I have now the honour to present refers to the year ending July 1st, 1887, and describes the state of the establishment at that date.

The last visitation of the Board took place on September 16th, 1886, and, with the exception of some changes in the personal staff, the establishment is in much the same position as at that date. In May last, Mr. J. E. Gilbert, clerical assistant, and who had been connected with the Observatory since 1857, was promoted to a position in the General Post Office. In accordance with the *Public Service Act*, this vacancy has been placed in the professional division by the Public Service Board, and steps have been taken to select from gentlemen already in the service an officer possessing the necessary qualifications.

The personal establishment on June 30th was as follows:—

Mr. ELLERY, Director, Government Astronomer;
 Mr. WHITE, Chief Assistant;
 Mr. MOERLIN, Assistant;
 Mr. BARACCHI, „
 Mr. PRINGLE, „
 Mr. KEMP, „
 Mr. INGAMILLS, „
 G. SWANSON, Mechanic;
 G. POWER, Messenger.
 A. E. HALE, „

The duties of the various officers remain much the same as at the date of my last Report. At that time Mr. Baracchi was recovering from a severe illness, but he rapidly improved, and resumed his full duties in October. The promotion of Mr. Gilbert and the appointment of a new assistant in his place will probably render it necessary to make some minor alterations in the duties of the several members of the staff.

II.—GROUNDS AND BUILDINGS.

The grounds are now showing the effects of the little attention I have been able to bestow on them for the last two or three years, and the shrubberies very much improve the surroundings of the Observatory. The suggestion made in my last Report relative to maintaining a good plantation between the Observatory and the St. Kilda-road has been approved by the Government, and Mr. Guilfoyle informs me he is increasing the group of trees considerably this season in the locality referred to.

The approach to the Observatory from town and the public thoroughfares has been unsatisfactory ever since the St. Kilda-road was lowered. Before that took place, the drive from this road into the Domain gave convenient and ready access to the Observatory for vehicles, but since then the only vehicular approach is from the Domain-road at the back entrance to Government House, so that vehicles from Melbourne have to go nearly double the distance, and then come back. An entrance to the old drive near the gates to the Government House might be easily made, and a very great convenience afforded to numerous visitors to the Observatory.

The buildings are all in good repair, the roof of the Great Telescope building was thoroughly renovated last spring. A thorough repair of the interior of the house for absolute magnetic observations is required, which will, I trust, be effected during the coming summer. With this exception, and some little external painting, the buildings generally may be regarded as in a satisfactory condition.

Some changes in the occupation of the rooms will shortly be made. It is necessary to provide better sleeping rooms for the resident messenger and attendant; to effect this, the south room, hitherto used for a workshop, will be converted into a laboratory and experimental room, and the two small rooms used for these purposes will be made into messengers' rooms. A new workshop is to be erected close to the engine-room attached to the Great Telescope house, and the room in the main building hitherto used as the messengers' room will be converted into a storeroom for books.

III.—INSTRUMENTS.

The instruments are in good working order, and remain as they were at the time of the last visitation. Some exception, however, must be taken to this statement as regards the Great Telescope which, although mechanically in excellent order and optically still fit for certain classes of work, is now subject to so serious a loss of light through tarnish of the mirrors as to render it undesirable to make further observation of the fainter nebula with those now in position. We have still mirror A covered up on the polishing machine, which maintains a much better polish than B (now in the telescope) and as soon as the winter is over I propose removing B and replacing by A, and hope

by this means to continue the nebular work without intermission. In my last Report I stated I had under consideration the question what course to advise in this direction. The mirrors could be sent home one by one to Mr. Grubb, of Dublin, and be re-polished; or could the work be done here if we can secure the services of one of two persons in the colony who have had considerable experience in the grinding and polishing mirrors of large dimensions, one of whom is now engaged on a thirty-inch mirror for the Ballarat Observatory. Taking into consideration the risk of sending the mirrors home and out (for with their cells they weigh between two and three tons), it would probably be best to get the polishing done on the spot. I expect to hear from Mr. Grubb very shortly concerning the cost of re-polishing, &c.

The New Transit Circle is in excellent order, and has been in constant use throughout the year. The stability of the instrument has somewhat improved, the azimuth error is very constant, and the level error which I spoke of in my last Report as subject to very sensible changes has become steadier, although the excessive wet weather we have experienced of late gave rise to an increased lowering of the west pivot, which has, however, now almost entirely ceased. The Paris mercury bath, described in my last Report, has proved very satisfactory, and has been in continuous use. The south collimating mark and long focus lens also referred to at the last meeting has proved of great service, except in the summer months when the unsteadiness of the air from the heated surface of the earth prevents satisfactory measurement. The result of the use of this Collimator so far is to show that there are no marked diurnal changes in the azimuth of the Transit Circle.

The South and North Equatorials (8-inch and 4½-inch respectively) are both in good order. The electric illumination of the former proves very convenient, and continues to give great satisfaction to the observers.

The Photoheliograph, since the change from the 4-inch to the 8-inch pictures, has not been so satisfactory as could be desired. The secondary magnifier has its first lens in such a position with regard to the principal focus that any minute particles of dust produce dark patches at the photographic focus, which are very troublesome, and it is necessary to frequently take out the magnifier to clean it, for unless absolutely clean these defects occur.

All the instruments and apparatus pertaining to the *Meteorological and Magnetical* work are in a satisfactory condition, and no changes have been made with regard to their disposal since my last Report. A new apparatus for comparing thermometers with the standard has been made in the workshop, and a vacuum chamber for testing aneroid and mercurial barometers has been commenced, and will probably be completed by the end of the present month. These accessories have been much wanted, for although we have made shift for many years with some rather primitive apparatus, the increasing demand on the time of the staff to meet the growing requirements in this direction makes it desirable to adopt the most complete and convenient methods.

The Clocks and Chronographs continue most satisfactory. Our second sidereal clock, by Frodsham (Zone clock), since its removal from its original position in the library to the new transit room, did not exhibit the remarkable steadiness of rate which formerly characterized its performance, and repeated examinations to discover the cause of this threw no fresh light on the matter. The clock stood on a solid pier of masonry, and was secured to the heavy internal wall of the transit room, but it was not close to the wall, being about three-quarters of an inch away from it. The case, however, was firmly bolted to the wall, through a packing block of wood three-quarters of an inch thick. The clock was dismantled, the packing taken away, and the clock case bolted quite close to the wall. The effect was most satisfactory, for the rate regained its former remarkable steadiness, and has retained it ever since.

We have for some time past been expecting to receive a new sidereal clock, ordered from Dent, Strand, London, nearly two years ago, but up to the present no news has been received beyond the fact that it is in progress.

A *Seismometer* of the Gray-Milne form has been ordered from Mr. White, of Glasgow, and it may be expected to arrive in a few months. As it can be made sufficiently sensitive for our mild earthquake disturbances, it is hoped it will thoroughly meet our requirements in this direction.

IV.—THE LIBRARY.

This has been considerably increased during the year, chiefly by donations and exchanges, a catalogue of which is given in the Appendix. During the year, besides periodicals, 258 volumes have been added to the library.

V.—THE WORK OF THE OBSERVATORY.

As indicated in the concluding passage of my last Report, there is little to mark the past year's history of the Observatory. No important astronomical events have occurred, and but little deviation from the ordinary routine work has been made. *The observations with the Transit Circle* are still regarded as the standard astronomical work of the Observatory, and consequently claim our chief attention. The work done in this direction since my last Report comprises, besides the usual observations of fundamental clock stars, standard circumpolar stars for determination of the azimuth error, faint stars selected from the Melbourne Zones, stars observed differentially with comets, stars culminating near the north and south horizons for determining the refraction, and a list of stars observed at the request of the Bureau des Longitudes for insertion in the *Connaissance des Temps*.

The observations with the Transit Circle consist of :—

Right Ascension Observations	...	...	...	2,487
Polar Distance Observations	...	...	...	1,301
Observations for Instrumental Errors, viz.:—				
Collimation	...	...	...	162
Level	...	...	...	234
Nadir	...	...	...	215
Runs of Microscopes	...	...	...	50
Flexure of Telescope	...	...	...	12

The work done with the *Great Telescope* is as follows:—Southern Nebulæ—

Re-examination of nebulæ already examined by former observers	...	...	...	33
Nebulæ of General Catalogue (H), 1st revision	...	...	...	54
Nebulæ searched for and not found	...	...	...	4
Total	...	...	...	91

Of these, 39 do not agree with former observations and require further examination; the remainder have been recorded as finally revised.

There are still 41 nebulæ revised by previous observers which require a second revision before entering in the catalogue. These revisions were to have been made in April, May, and June, but the weather has been so unusually cloudy and bad that there have been few opportunities for using the telescope, and scarcely a night clear enough for nebular work; 39 nights were allotted to visitors, but only 19 turned out clear.

Observations made with the South Equatorial (8") include observations of Finlay's and Barnard's comets, observations for micrometer values, and measures of α Centauri on several nights.

Photoheliography.—The persistent cloudy weather since April last has seriously interfered with sun-photography, and only 121 pictures have been secured during the year; these are all large-size plates (8" diameter) since the use of the secondary magnifier attached to the instrument in July last year.

Meteorology and Terrestrial Magnetism.—The ordinary work in this direction has been assiduously carried out as in former years. The intercolonial meteorological work is increasing every year, and the demands on our Observatory grow proportionately. The whole equipment of self-recording instruments has been in continuous operation throughout the year, and has furnished satisfactory and unbroken records. The monthly determinations of the absolute force of terrestrial magnetism have also been continued.

The country meteorological stations have been in full operation during the year, and rainfall statistics are now gathered from 356 localities. During the year we distributed 73 new rain-gauges, all in new districts.

The daily weather chart with morning and afternoon forecasts has been continued.

Intercolonial Weather Service.—As may be expected, this work increases year by year, and gradually becomes more complete. Since my last Report, six new registering stations have been added to our list. Queensland has remodelled her meteorological service under the direction of Mr. Wragge, and not only have several new reporting stations been established, but the reports are now far more regular and useful than formerly, and add most materially to the completeness of the intercolonial system.

Time Ball, Time Service, Tidal Observations, &c.—The signal at Williamstown for the time ball has been sent from the Observatory on 298 days—but failed on 11 occasions. Of these failures, two were traced to mistakes made at the Observatory, and one to error of signal man; the remainder were due to faults on telegraph line. The telegraphic time service as well as the clock control service continue in operation, and the Post-office clock has maintained its character as an excellent time-keeper. It automatically records on the Observatory chronograph a few minutes after one o'clock each day, and when its rate has accumulated to an error exceeding 10 or 12 seconds, it is gradually set right by the addition or subtraction of small weights to or from the pendulum. The maximum errors during the past year were—13·6 secs. slow, and 12·8 secs. fast. The tide-gauge at Williamstown has furnished a continuous record of the tides in Hobson's Bay.

The Instruments tested or placed under trial at the Observatory during the year were as follows:—

Aneroid barometers	...	...	...	...	18
Thermometers	...	...	...	...	24
Chronometers	...	...	...	...	40
Surveying chains or other linear measures	...	...	...	...	17

VI.—PUBLICATIONS.

No astronomical publications have been issued during the year. The Second General Catalogue is finished and being copied for the printer. The yearly catalogues and separate results for 1880–85, to form volume VII., are also nearly ready for the printer.

As regards meteorological publications, the Monthly Records of Meteorology and Terrestrial Magnetism have been published and issued to the end of March last, the Monthly Rainfall Register has also been issued up till the end of April, and the Monthly Rainfall Maps till the end of May.

VII.—GENERAL.

It is intended to carry on the regular or routine work of the Observatory as usual during the current year, and I hope to make some improvements in one or two particulars, especially as regards the photoheliography and the reproduction of the Great Telescope drawings for publication, which still remains a difficulty with us.

A very important and novel astronomical work is about to be entered on as an international undertaking, namely, charting the stellar heavens by photography.

For the last year or two most successful attempts to obtain photographs of stars from the brightest down to the 13th and 14th magnitudes have been carried out at the Paris Observatory, in America, and by several private observers in England. The results have been so successful as to convince astronomers that an immense and vastly important service may be done to science by obtaining photographic charts of the whole of the stellar heavens. Such a work could only be accomplished by the hearty co-operation of national and well-equipped observatories in all parts of the world. To secure this co-operation, and arrange details of the necessary appliances, and of the various steps in the undertaking, French astronomers invited astronomers from all parts of the world to meet last Easter in Paris and confer on the subject. I duly received a prospectus of the proposed conference, containing numerous questions, and an invitation to attend. Although I fully concurred in the proposition, and recognised the immense importance of carrying out such an undertaking, I did not consider it necessary for me to attend the conference, more especially as I heard that my colleague, Mr. Russell, of Sydney, who intended visiting Europe at that time, would probably be present. I, therefore, wrote to Admiral Mouchez, replying to the several questions submitted, and stating that I had little doubt, if the conference came to an agreement about the undertaking, and the necessary appliances, &c., that our Government would supply the necessary means—(provided the cost to each observatory was not too great)—to enable the Melbourne Observatory to take its share of the expense and the work. I also informed the Honorable the Chief Secretary of the invitation to the conference and my reply thereto.

We have since had news that the conference met, and the members unanimously agreed to co-operate in this great work. It has also transpired that the probable cost to each observatory will be about £4,000, spread over several years, and that the cost of the necessary instruments will be from £1,300 to £1,800; also that, owing to the small number of observatories in the Southern Hemisphere, the conference decided to request the respective Governments to establish special observatories in the south of New Zealand and in the island of Reunion. Mr. Russell told the conference he had little doubt our Governments would enable Melbourne and Sydney to co-operate, and he communicated with our Agent-General in London concerning the result of the conference, and Sir Graham Berry has notified the same to the Premier (the Hon. Duncan Gillies). I am glad to report that the Government concur in our joining in the undertaking, and have placed £1,000 on the estimates of the current year towards the necessary expenditure.

The details of the results of the conference have, so far, only reached me in outline, but it may be gathered :—

1st. That the form, dimensions, and cost of the instruments (which it is desired shall be all alike) have been agreed on as follow :—

Aperture ...	...	...	...	·33 metres = 13 inches.
Focal length	...	...	...	3·43 metres = 10 feet 5 inches.

Approximate cost of the telescope, with objective specially constructed for photographic work, £500.

Approximate cost of mounting of same, from £1,000 to £1,300.

2nd. It was decided at the conference that four degrees of the heavens should be taken in each picture, and that a second set should also be obtained of all stars down to the fourteenth magnitude, the stars on one corner of the first being in the centre of the second. Further, that another set with shorter exposure, to reach stars of the eleventh magnitude only, should be obtained, to ensure accuracy, and to furnish the means of forming a complete catalogue. There will be over 20,000 photographs required to cover this undertaking, and the work will probably be divided among fifteen to twenty observatories, in which case 1,000 pictures would fall to the lot of each. It is not expected that any observatories will be in a position to commence operations till 1889, and at present no limit of time for the completion of the work has been fixed, nor have the arrangements for constructing the charts or formation of catalogue of stars from the photographs been decided upon. We shall not be able to commence preparations here until further details of the scheme have reached us. I see it was suggested by Mr. Russell to the Agent-General that possibly Melbourne already possessed a mounting that could be adapted to the photographic telescope, and I presume he thought it might be used on the mounting of the Great Telescope; but this would certainly not be desirable. In the first place, it is not well fitted for the purpose, and, in the second, it would render our Great Telescope useless for its special work while the photographic work was in progress. I believe it will be necessary to obtain a special mounting, and to erect the instrument in a separate and temporary building.

ROB. L. J. ELLERY,
Government Astronomer.

Melbourne Observatory, August 16th, 1887.

APPENDIX.

BOOKS, ETC., PRESENTED TO THE OBSERVATORY.

Title and Author.	By whom Presented.	
Greenwich Observations, 1884	Greenwich Observatory ...	England.
Greenwich Astronomical Results, 1884	Ditto	"
Greenwich Meteorological Results, 1884	Ditto	"
Greenwich Spectroscopic and Photographic Observations, 1884	Ditto	"
Corrections to R.A. of Nautical Almanac Stars, 1887	Ditto	"
Spectroscopic Results for Motion of Stars in the Line of Sight, obtained at the Royal Observatory, Greenwich, in the year 1886. No. X.	Ditto	"
Report of the British Association for the Advancement of Science, 1885	The British Association ...	"
Second Report of the Committee on Comparing and Reducing Magnetic Observations	Ditto	"
Proceedings of the Royal Society. Vols. XXXVIII., No. 238; XXXIX., Nos. 239 to 241, XL.; Nos. 242 to 244	The Royal Society	"
Catalogue of the Library of the Royal Astronomical Society	Royal Astronomical Society ...	"
Monthly Notices. Vol. XLVI., No. 8, to Vol. XLVII., No. 6	Ditto	"
Nautical Almanac for 1890	The Lords Commissioners of the Admiralty	"
Observations of the International Polar Expedition, 1882-3. British Observations at Fort Rae	Meteorological Office	"
Atlantic Weather Charts. Part I., official No. 71	Ditto	"
Meteorological Observations at Stations of the Second Order for the year 1882	Ditto	"
Daily Weather Reports, 1st January to 30th June, 1886	Ditto	"
Report of the 3rd Meeting of the International Meteorological Committee at Paris, 1885	Ditto	"
Report of the Meteorological Council to the Royal Society for the year ending 31st March, 1886	Ditto	"
Quarterly Weather Reports, January to September, 1878	Ditto	"
Hourly Readings, January to June, October to December, 1884	Ditto	"
Weekly Weather Report, Vol. III., No. 16, to Vol. IV., No. 11, and Appendices, &c.	Ditto	"
Monthly Weather Report, February to November, 1886	Ditto	"
The Quarterly Journal, April, 1886, to January, 1887	Royal Meteorological Society	"
The Meteorological Record. Vol. VI., Nos. 21, 22, 23	Ditto	"
Report of the Kew Committee for the year ending October 31st, 1886 ...	The Kew Observatory	"
Results of Meteorological and Magnetical Observations, 1885	The Stonyhurst Observatory	"
Supplementary Measures of Magnitudes (of Equatorial Stars)	Professor Pritchard	"
Magnitudes of a Zone of Equatorial Stars	Ditto	"
Researches in Spectrum Photography	Ditto	"
Results of Astronomical and Meteorological Observations, 1883	The Radcliffe Observer, Oxford	"
Temperature and Rainfall of the Croydon District, 1881-85. H. S. Eaton	H. S. Eaton, Esq., Croydon Microscopical and Natural History Club	"
Meteorological Observations for the year 1886 at the Rousden Observatory, Devon	C. E. Peek, Esq., Rousden Observatory	"
On the working of the Harmonic Analyser at the Meteorological Office. R. H. Scott and R. H. Curtis	R. H. Scott, Esq.	"
Second Armagh Catalogue of 3,300 Stars. Dr. Dreyer	Armagh Observatory	Ireland.
Star Photographs. C. P. Smyth	C. P. Smyth, Esq.	Scotland.
Astronomical Observations made at the Royal Observatory, Edinburgh. Vol. XV., for 1878 to 1886	Royal Observatory, Edinburgh	"
Journal of the Scottish Meteorological Society, 1880. 3rd series. No. 3	Scottish Meteorological Society	"
Proceedings of the Philosophical Society of Glasgow	Philosophical Society of Glasgow	"
Observations on a Green Sun and Associated Phenomena	Professor C. Michie Smith ...	India.
On the Variations in the Prices of Food Grains in the Bombay Presidency	F. Chambers, Esq.	"
Brief Sketch of the Meteorology of the Bombay Presidency in 1885-6 ...	The Meteorological Reporter to the Government of Bombay	"
Magnetical and Meteorological Observations made at the Government Observatory, Bombay	The Government Observatory, Colaba, Bombay	"
Results of Observations of the Fixed Stars made with the Meridian Circle, Madras (2 copies)	The Government Astronomer, Madras	"
Account of the Operations of the Great Trigonometrical Survey of India. Volume IV A	The Surveyor-General	"
Report on the Administration of the Meteorological Department of the Government of India, 1885-6	The Meteorological Reporter to the Government of India	"
Results of Meteorological Observations at Six Stations in India. Title pages for 1879 to 1886, preface for 1885-86, and monthly numbers from December, 1885, to January, 1887, excepting July, 1886	Ditto	"
Rainfall in Bengal, May, 1886, to April, 1887	Ditto	"
Results of Meteorological Observations in Bengal, 30th May, 1886, to 7th May, 1887	Ditto	"
Abstract of Thermometrical Observations at Chowringhee and Alipore, May, 1886, to April, 1887	Ditto	"
Results of Meteorological Observations, 1885	The J. V. Juggarow Observatory, Daba Gardens, Vizagapatam	"

APPENDIX—continued.

Title and Author.	By whom Presented.	
Mauritius Meteorological Results for 1884 and 1885	Royal Alfred Observatory ...	Mauritius.
Synoptic Weather Charts of the Indian Ocean, January, 1861	Ditto	"
A Tabular Statement of the Dates at which, and the Localities where, Pumice or Volcanic Dust was seen in the Indian Ocean in 1833-4. Dr. Charles Meldrum	Ditto	"
Mineral Statistics of Victoria for the year 1885. Reports of the Secretary for Mines (two copies)	The Department of Mines ...	Victoria.
Annual Report on the Working of the Regulation and Inspection of Mines and Mining Machinery Act during the year 1885	Ditto	"
Irrigation Reports	Ditto	"
Goldfields of Victoria. Reports of the Mining Registrars for the Quarters ending 31st March, 30th June, 30th September, and 31st December, 1886	Ditto	"
Transactions and Proceedings of the Royal Society of Victoria. Vols. XV., XVI., XVII., XVIII., XIX., XX., XXI., XXII., XXIII.	Royal Society of Victoria ...	"
The Victorian Year-book for 1885-6	The Government Statist ...	"
Results of Rain and River Observations, 1885	The Government Astronomer	New South Wales
Local Variations and Vibrations of the Earth's Surface. H. C. Russell	Ditto	"
Anniversary Address to the Royal Society of N.S.W.	H. C. Russell	"
Daily Weather Charts, July, 1886, to May, 1887	The Government Astronomer	"
Journal and Proceedings of the Royal Society of New South Wales. Vol. XIX, 1885	The Royal Society of New South Wales	"
Meteorological Observations in Tasmania, 1885	Meteorological Recorder ...	Tasmania.
Statistics of the Colony of Tasmania for the year 1885	The Government Statist ...	"
The Adelaide University Calendar 1887	The Adelaide University ...	South Australia.
Report on the Surveys of New Zealand, 1885-6	The Surveyor-General ...	New Zealand.
Report of the Superintendent of the Natal Observatory for the year 1885	The Natal Observatory ...	Natal.
Annals of the Royal Observatory of the Cape of Good Hope. Vol. II., part I. Observations of the Great Comet 1882—II.	Royal Observatory	Cape Colony.
Monthly Weather Review, May, 1886, to March, 1887	Canadian Meteorological Office	Canada.
Toronto General Meteorological Register for the year 1886	Ditto	"
Annual Report (N.S.) Vol. I., 1885. Maps, &c.	Geological and Natural History Survey	"
Astronomical Papers of the American Ephemeris and Nautical Almanac. Vol. II., parts 3 and 4; Vol. III., part 4	American Nautical Almanac Office	United States.
The American Ephemeris and Nautical Almanac for 1889	Ditto	"
On the Flexure of Meridian Instruments. W. Harkness	Washington Naval Observatory	"
Annular Eclipse of the Sun, 1885	Ditto	"
Washington Astronomical and Meteorological Observations. 1881, Vol. XXVIII.; 1882, Vol. XXIX.	Ditto	"
The Six Inner Satellites of Saturn. Asaph Hall. (Appendix I. to Washington Observations, 1883)	Ditto	"
Observations for Stellar Parallax. (Appendix II. to do.)	Ditto	"
Report of the Superintendent for the year ending June 30, 1886	Ditto	"
Memoirs of the National Academy of Sciences. Vol. III.	National Academy of Sciences	"
Reports of the National Academy of Sciences, 1882-3-4	Ditto	"
Proceedings of the National Academy of Sciences. Vol. I., part 2	Ditto	"
Annual Report of the Comptroller of the Currency, 1885	Comptroller of the Currency...	"
Professional Papers of the Signal Service, No. XVI. Tornado Studies for 1884. Finley	Chief Signal Officer	"
Professional Papers of the Signal Service, No. XVIII. Tornado Studies for 1885. Finley	Ditto	"
Thermometer Exposure. Hazen	Ditto	"
Report for 1884	Ditto	"
International Meteorological Observations, Summary and Review. January, 1885, to January, 1886, February to June, 1884	Ditto	"
Monthly Weather Review. January, 1885, to June, 1886	Ditto	"
International Meteorological Observations, Daily Bulletins, January to June, 1884	Ditto	"
A Series of Charts from January 1st to 10th, 1886, typical of a Cyclonic System in the United States	Ditto	"
Pilot Chart of North Atlantic, July, 1886	Hydrographic Office, Washington	"
Publications of the Washburn Observatory. III. 1885 and IV.	Washburn Observatory ...	"
Publications of the Cincinnati Observatory, 8	Cincinnati Observatory ...	"
Bulletin of the American Geographical Society. 1882, No. 6; 1883, No. 7; 1884, No. 5; 1885, No. 3; 1886, Nos. 1 to 5; 1887, No. 1	American Geographical Society	"
Annual Report for 1883	The Smithsonian Institute ...	"
Annual Report for 1884, parts 1 and 2	Ditto	"
Account of the Progress of Astronomy, 1885. Smithsonian, 641	Ditto	"
Science Observer. Vol. V., Nos. 1 and 2 (49 and 50)	The Boston Scientific Society	"
An Investigation in Stellar Photometry. E. C. Pickering	Harvard College Observatory	"
Annals of the Astronomical Observatory of Harvard College. Volume XV., Vol. XVI., part I.	Ditto	"
Monthly Record of Meteorological Observations, May, 1886, to March, 1887, except July, 1886, and February, 1887	New York Central Park Observatory	"
Publications of the Leander McCormick Observatory of the University of Virginia. Vol. I., part 3	Leander McCormick Observatory	"
Report of the Director, 1885	Ditto	"
History and Work of the Warner Observatory, Rochester, N.Y. 1883-86	Warner Observatory	"
Memoir of John William Draper	Dr. Draper, New York	"
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