

G.O. No. 940-41. Public
21-11-1893

21ST NOVEMBER 1893, Nos. 910, 911, PUBLIC.

GOVERNMENT OF MADRAS.

PUBLIC DEPARTMENT.

READ—the following paper:—

From Sir E. C. BUCK, *Kt.*, c.s.i., Secretary to the Government of India, Revenue and Agricultural Department (Meteorology), to the Chief Secretary to the Government of Madras, dated Simla, the 4th November 1893, No. 3930—14.

In continuation of my telegram of the 30th September, I am directed to forward, for information and guidance, a copy of the despatches marginally-noted regarding the establishment of a Solar Physics Observatory on the Kodaikānal hills, together with a copy of some further correspondence with the Meteorological Reporter to the Government of India on the same subject.

Despatch to Secretary of State, No. 37, dated 20th June 1893.
Despatch from Secretary of State, No. 117, dated 31st August 1893.
Letter, No. 2371, dated 14th July 1893, to Meteorological Reporter.
Letter, No. 533-S., dated 27th July 1893, from Meteorological Reporter.

2. It will be observed from the Meteorological Reporter's letter of the 27th July that if the new buildings are commenced soon after April next and are ready for use by the 1st January 1895, the additional expenditure involved during the financial year 1894-95 will be approximately Rs. 27,500. The Government of India are ready to accept this as an Imperial charge, but will not be able to tell before February next whether the requisite funds will be forthcoming or not.

3. Meantime there will be no objection to the immediate preparation of plans and estimates, provided that the cost of these and of any small additional expenditure caused by Mr. Michie-Smith's movements to and from the proposed site can be met from funds at the disposal of the Madras Government for the current year.

4. A provisional budget should also be prepared without delay for submission to the Government of India, with a view to obtaining provision for the anticipated expenditure of next year in case this can be met. I am in this connection to enquire whether His Excellency the Governor in Council would have any objection to the transfer of the control over the Madras Observatory and of the funds connected with it to the Imperial Government from 1st April 1894, and to placing the organization and management of the new Solar Physics Observatory under the Meteorological Reporter to the Government of India. In anticipation of the expression of His Excellency's wishes on this point and in order to save time, the Meteorological Reporter to the Government of India has been asked to submit at once a supplementary budget including the estimated expenditure on the Madras Observatory and on the new Observatory at Kodaikānal, and I am to request that Mr. Michie-Smith may be instructed to supply him with such information as he may require for the due preparation of this budget.

ENCLOSURES.

Despatch from the Government of India, Revenue and Agricultural Department (Meteorology), to the Right Honorable the Secretary of State for India, dated Simla, the 20th June 1893, No. 37.

With reference to your Lordship's despatch No. 111 (Revenue), dated 10th November 1893, we have now the honour to submit definite proposals concerning the establishment of a new observatory on the high country in the south of India, and we enclose a letter No. 147-S., dated 1st March 1893, from our Meteorological Reporter on the subject of the respective merits of the three sites at which observations have been taken.

2. We agree with Mr. Eliot that, for the reasons stated in his letter, Kodaikānal in the Palni hills affords the most suitable site for the proposed Solar Physics Observatory.

3. In a further letter of the 4th March 1893, No. 149-S., which is also appended, Mr. Eliot has recommended that the consideration of the question of the permanent site of the Astronomical Observatory be deferred for some five years; that a Solar Physics Observatory be established at Kodaikanal without delay; that Mr. Michie-Smith, now officiating as Government Astronomer, be placed in charge of the Solar Physics work with a staff of observers, assistants, &c., and that Miss Pogson, the present Meteorological Reporter for Madras, be appointed Assistant Superintendent at the Madras Observatory to carry on the current astronomical work under the supervision of Mr. Michie-Smith. These proposals meet with the approval both of ourselves and of the Madras Government, and are now submitted for your Lordship's sanction. They involve, as Mr. Eliot shows, the abandonment for the present of the original scheme which contemplated a complete observatory with two branches, but in view of the existing financial position we are constrained to adopt the suggestion of the Solar Physics Committee communicated in your Lordship's despatch No. 111, dated 10th November 1892, that partial effect should be given to the scheme by the establishment of a Solar Physics Observatory only.

4. We append (1) a rough estimate of the expenditure entailed by the modified scheme, and (2) a proposition statement in respect of the establishment required. The additional charges entailed will not exceed Rs. 1,619 per annum.

5. Your Lordship will observe that we have suggested for Mr. Michie-Smith a salary of only Rs. 800 per mensem in place of one rising from Rs. 800 to Rs. 1,200 as proposed by Mr. Elliot. We consider that in view of Mr. Smith's previous position the lower salary will, at any rate for some years, be sufficient, and we should prefer to make separate recommendations hereafter if it should at any time be found expedient to increase the pay of the appointment.

6. Mr. Michie-Smith's substantive post is, however, at present that of Professor at the Madras Christian College, and the authorities of the College, who have hitherto permitted him, while holding the post of Astronomer, to retain a lien on his professorship, are unable to extend this concession beyond the middle of August next. We, therefore, beg that, whatever arrangements may be made as to the rest of the scheme, we may be allowed to assure Mr. Michie-Smith of a permanent appointment under us of the value of Rs. 800 per mensem, whether as Astronomer merely, or as Superintendent of the Solar Physics Observatory, with control over astronomical work, and we should be glad if your Lordship would communicate orders to us on this point by telegram.

7. From the reports of the Solar Physics and Indian Observatories Committees forwarded to us with your Lordship's despatch of 10th November 1892, No. 111, there appears to be no doubt that Mr. Michie-Smith possesses qualifications for the post of Superintendent of the Solar Physics Observatory. As to his fitness for astronomical work, we have not at present received advice from competent judges, but we believe that, either under present arrangements or under the scheme proposed by us, Mr. Michie-Smith will at any rate be found fully qualified to carry on or to supervise the work of the Madras Observatory.

SCHEDULE I.

Rough estimate of cost of proposals made in despatch.

Initial cost.	Buildings and apparatus	..	..	..	..	Rs.	25,000
Recurring cost per annum—							
Staff and establishments	..	..	..	..	..		21,975
Contingencies	..	..	..	..	..		2,024
						Total recurring	23,999
Deduct existing establishment—							
						Rs.	
Madras	..	..	..	..	..		16,020
Dehra Dun	..	..	..	..	..		2,061
							18,081
And existing contingencies, chemicals, &c.,							
about ..	..	..	..	..	..		4,299
							22,380
Extra cost per annum							1,619

SCHEDULE II

Proposition Statement showing cost of present and proposed establishments.

[illegible]

* Not yet verified by Accountant-General, but believed to be correct.

From E. D. MACLAGAN, Esq., Officiating Under Secretary to the Government of India, Revenue and Agricultural Department, to the Meteorological Reporter to the Government of India, dated Calcutta, the 21st December 1892, No. 3578:

I am directed to forward copy of a despatch from Her Majesty's Secretary of State, No. 111, dated 10th November 1892, and of its enclosures, and to request that, during your visit to Madras, you will be good enough to discuss with the Madras Government the questions therein referred to, and submit your recommendation regarding them to the Government of India with your proposed report on the best site for the new Imperial Observatory. It will be advisable that among other matters you should state—

- (1) Whether you can recommend the establishment of a Solar Physics Observatory or continuance of the Astronomical Observatory alone;
- (2) Whether in the former case you would recommend that Mr. Michie-Smith should have superintendence of the Solar Physics observations;
- (3) What part of the work hitherto conducted at the Madras Astronomical Observatory should be continued if only a Solar Physics Observatory be maintained in its entirety;

and that you should submit a rough estimate of the cost of your proposals.

2. I am to request that a copy of your report may be furnished at the same time to the Madras Government.

No. 3577-1, dated 21st December 1892.

Copy forwarded to the Government of Madras for information.

From E. D. MACLAGAN, Esq., Officiating Under Secretary to the Government of India, Revenue and Agricultural Department, to the Chief Secretary to the Government of Madras, dated Calcutta, the 21st December 1892, No. 3578.

With reference to the correspondence ending with your letter No. 649, dated the 16th September last, I am directed to forward copy of a despatch from Her Majesty's Secretary of State, No. 111, dated 10th November 1892, and of its enclosures, and to request that, during the visit to Madras of the Meteorological Reporter to the Government of India, he may be fully consulted on the different points referred to therein. Mr. Eliot has been instructed to report on the correspondence and to submit a copy of his report to the Government of Madras. I am desired to ask that the Government of India may be favored with the views of His Excellency the Governor in Council on any recommendations that may be made by Mr. Eliot.

2. I am to add that Mr. Michie-Smith's services as Officiating Astronomer, Madras, may be retained till such time permanent arrangements are made for the new observatory.

No. 3579.

Copy forwarded to the Meteorological Reporter to the Government of India for information.

Telegram from the Chief Secretary to the Government of Madras, to the Secretary to the Government of India, Revenue Department, Calcutta, dated Madras, the 22nd February 1893, No. 96.

Your No. 3578, 21st December. Michie-Smith represents he must return Christian College end June, or give reasonable notice of resignation from them. This Government would like to confirm him in present position, and also give him definite assurance that whatever finally arranged, he will not be without emoluments at least equal to those of present Astronomership, namely, Rs. 800 per mensem. Importance of early decision was impressed on Mr. Eliot. Please wire early orders.

Telegram from the Secretary to the Government of India, Revenue Department, Calcutta, to the Meteorological Reporter to the Government of India, Simla, dated the 3rd March 1893.

Madras Government wires that immediate orders are required regarding Michie-Smith's future position, as he must give notice to Christian College. Please send your report on Madras Observatory at once, or at any rate sufficient to enable us to address Secretary of State immediately regarding permanent retention of Michie-Smith, whose further employment does not involve consideration of all issues in which you may desire to write. Madras Government requires an assurance that he will receive not less than Rs. 800 a month, and you may recommend this.

Telegram from the Meteorological Reporter to the Government of India, Simla, to the Secretary to the Government of India, Revenue Department, Calcutta, dated the 4th March 1893.

Report on relative merits of Kodaikānal and Kōttagiri as sites for Solar Physics Observatory is being printed at Government Press here; also letter in reply to your No. 3578, dated 21st December, containing my proposals, has also been sent to Press, as I thought it would be best to send printed reply. Have asked Press to print them as quickly as possible. Meanwhile send copy of letter by to-day's post in order you may take any immediate steps you consider best under circumstances.

From the Meteorological Reporter to the Government of India, to the Secretary to the Government of India, Revenue and Agricultural Department, dated Simla, the 1st March 1893, No. 147-S.

I have the honour to submit the following report on the comparative observations taken at Madras, Kodaikānal, and Kōttagiri during the past year with the view of determining the most suitable locality for the Solar Physics Observatory which it is proposed to establish.

A summary of the observations is given in an appendix to the report. They are also plotted out for ready examination in Plates I and II accompanying the report.

The following gives a verbal summary of the observations:—

(1) *Brief description of the hill stations.*—Kodaikānal is the hill station on the Palni hills, a nearly isolated group of mountains in the Madura district.

The Palnis are divided into two groups—an eastern and a western portion, of which the latter is considerably more elevated than the former, averaging about 7,000 feet. Kodaikānal is in the western portion at an elevation of about 7,200 feet. The ascent to it (from the south) is steep. The summit may almost be described as a rolling plateau. There is in the neighbourhood of Kodaikānal very little forest, and the hill country to the north, east and west resembles the downs in the south of England. To the south lies the upper valley of the Vaigai, at present slightly cultivated, but which will, when the Periyar scheme has been accomplished, be speedily brought into a state of high cultivation by the system of irrigation which will then be opened.

Kōttagiri is a small hill station in the Nilgiris. These hills form a mountain plateau which is united by a narrow and precipitous range of granitic peaks at the western extremity to the West Ghāts. Kōttagiri is situated at the north-east end of the plateau, at an average height of about 6,500 feet above the sea. The plateau consists chiefly of grassy undulating hills, divided by narrow valleys. A large portion of the land near Kōttagiri is taken up with tea and coffee plantations. The ground is much more broken up and uneven than at Kodaikānal.

It would hence be much easier to find an almost perfect location for a Solar Physics Observatory at Kodaikānal than at Kōttagiri. Mr. Michie-Smith in his report (paragraph 5) discusses this point, and he is fully qualified to speak on it from his acquaintance with the topography of both districts. He says the formation of the hills at Kōttagiri is much less favorable for observational work than the formation about Kodaikānal. Kōttagiri lies in a basin, surrounded by hills rising to a moderate height on all sides. At Kodaikānal, on the other hand, there is a large plateau rising in the centre, and this situation seems to be exactly what would be desired on general principles as the site of an observatory. He also adds that he endeavoured to find an equally favorable site in the Nilgiris hills, but failed.

It may hence be fairly concluded that Kodaikānal offers an admirably exposed site for such an observatory, and that Kōttagiri does not.

In order to test the atmospheric conditions of these two hill stations, and determine which would be most suitable for the Solar Physics Observatory, temporary meteorological observatories were established, and regular observations taken from January 1892 up to March 1893. The following observations were taken daily:—

- (1) Temperature at 8, 10 and 16 hours.
- (2) Humidity at 8, 10 and 16 hours.
- (3) Wind direction and amount at 8, 10 and 16 hours.
- (4) Cloud amount and kind at two-hourly intervals from 8 A.M. to 10 P.M.
- (5) Amount of sunshine as measured by sunshine recorders.
- (6) Special mist observations.
- (7) Solar and terrestrial radiation observations.

The monthly means of these observations and the corresponding means for Madras are given in the tables in the appendix to this letter. They are also charted in Plates I and II in such a manner as to show the relative merits of the stations for the more important elements of observation. The following gives a verbal summary of the more important features for a comparison of the relative merits of the stations:—

(2) *Temperature.*—Table I, Appendix I, gives the mean temperature of each month of 1892 at Madras, Kodaikānal and Kōttagiri, and the normal monthly temperature of Simla for comparison with the southern hill stations. The mean monthly temperature of Kodaikānal in 1892 ranged between 54.1° in December and 62.3° in May, thus giving an annual variation of only 8.1°. The mean monthly temperature at Kōttagiri varied from 55.3° (in January) to 64.8°

(in April), thus giving an annual range of 9.5° . The mean temperature of the year at Kodaikānal was 58.5° , agreeing almost exactly with that of Simla (58.0°). The range of the mean monthly temperature at Kodaikānal (viz., 8.1°) was, however, less than a third of the normal range at Simla (25.6°). Another important feature of the temperature conditions is the diurnal range. Table II gives comparative data for the same stations. It may be noted that the annual range of temperature in India depends chiefly upon the varying intensity of solar radiation at the earth's surface, and hence is small in Southern India and large in Upper India. On the other hand, the diurnal range, especially at the hill stations, depends largely upon the convective actions and currents set up by the changes in that intensity during the day with the varying altitude of the sun; and hence the differences in this feature are comparatively small between hill stations in Southern and Northern India. The mean monthly diurnal range of temperature in 1892 at Kodaikānal varied from 11.5° to 16.8° , and averaged 14.2° ; at Kottagiri it varied from 12.4° to 21.2° , and averaged 17.0° ; whilst at Simla it ranges normally between 10.6° and 19.3° , and averages 15.9° . Hence, the diurnal mean range of temperature is slightly less at Kodaikānal than at Simla and also at Kottagiri. The mean daily range of temperature at Madras is somewhat greater than at the hill stations. Hence the characteristic features of the air temperature at the southern hill stations are:—

- (1) Moderate temperature.
- (2) Very small range or variation of temperature during the year.
- (3) Moderate diurnal range of temperature.

In each of these respects Kodaikānal is superior to Kottagiri, its temperature being on the average of the year about 2° lower, and the annual range about 1° less, and the diurnal range about 2° less.

Hence, so far as uniform and moderate temperature conditions are concerned, Kodaikānal is superior to Kottagiri.

(3) *Solar and Terrestrial Radiation Observations.*—Means of these observations have not been included in the tables, Appendix I, as they show practically no difference between the hill stations. The observations for the months May to October give a mean difference of 62.4° thermometer. The corresponding mean difference of the same period for Kottagiri was 62.4° , practically identical with the former. Similarly, the difference between the grass radiation thermometer and minimum in shade for the same period at Kodaikānal was 5.5° and at Kottagiri 5.8° .

These observations were not taken at Madras. Normal means for three stations similarly situated to Madras are given below for the same period of the year:—

Stations.	Difference solar thermometer and maximum.	Difference grass radiation thermometer and minimum.
Port Blair	51.4	3.7
Bombay	52.8	3.6
Negapatam	55.3	4.0

It may hence be assumed that at Madras the corresponding means would be very approximately 52.0° and 4° , or $\frac{1}{4}$ th and $\frac{1}{4}$ th respectively less than the means for the hill stations. These differences measure roughly the superiority of the hill stations as compared with Madras for all solar physics work, but more especially actinometric work. With respect to the latter, it should be kept in mind that it involves much exposure to the sun, and, as Mr. Michie-Smith points out, 'Solar observations at Madras in the hot weather are carried on with great difficulty, not with actual danger, to the health of the observer; whereas at a hill station, though the direct solar radiation may be more intense, the coolness of the air renders the work comparatively pleasant as soon as the observer has once got thoroughly sunburnt.'

Rainfall.—The actual monthly rainfall and the number of rainy days of the three stations, Madras, Kottagiri and Kodaikānal, are given in Tables IV and V. Normal rainfall data for these stations are also available, and are given in Tables VI and VII. A comparison of the actuals of 1892 with the normals show that the rainfall at the hill stations in 1892 was very abnormal, the number of rainy days being very largely in excess at Kodaikānal as compared with the excess at Kottagiri. This was apparently not due to larger rainfall than usual, as the total rainfall of the year was considerably below the normal at Kodaikānal, whilst it was slightly in excess at Kottagiri. This may be possibly due to the position of the observatory at Kodaikānal, which is close to the edge of the precipice facing the plains to the south, whilst the normals are for the revenue rain-gauge station which is at some distance from the cliff. This

exaggeration of the number of rainy days due to the peculiar position of the observatory is of importance, as it is almost certain that the same condition would exaggerate the cloud amount; and hence it is very probable that the cloud amounts obtained for the observatory are larger than would have been obtained if the observatory had been located on the open rolling ground, away from the edge of the plateau on which Kottagiri is situated, and where, for various reasons, it was not possible to locate the temporary observatory.

The chief facts of the normal rainfall data are the following:—

Kodaikānal receives slightly more rain than Kottagiri (about twelve per cent. more). This distribution is dependent on the fact that the Nilgiris are some distance to the north of the Palnis, and hence slightly differently situated relative to the rain-bearing currents of the south-west monsoon from the West Coast, and these from the Coromandel Coast during the retreating south-west monsoon. Kodaikānal obtains more rain in March and April and less in May and November, and more in August and December. The differences in the remaining months are small and of little importance.

Table VII of the mean number of rainy days furnishes similar evidence. The number of rainy days at Kodaikānal is 98.7, or 9.0 in excess of Kottagiri, and hence almost exactly 10 per cent. in excess. Kodaikānal has more rainy days in March, April, June, August, September and December, and less in July and October, than Kottagiri.

The number of rainy days is, as might be expected, considerably greater at these hill stations than at Madras. The mean daily rainfall per rainy day at Kodaikānal is .618 inch and at Kottagiri .588 inch.

(4) *Humidity.*—The observations indicate that there is no marked difference between the humidity conditions of Kodaikānal and Kottagiri. Kodaikānal appears to be slightly drier than Kottagiri, but the difference is too small to be of any importance. Both stations appear to be much subject to mists and fogs. Hence an attempt was made to measure the amount of mist; but the observations appear to be of little value, as in many instances they conflict with the evidence of the sunshine recorder. The fogs are chiefly due to the forced ascensional movement of the air, and hence form most largely during the period when convective action is most vigorous, i.e., from about 10 A.M. to 4 P.M.

(5) *Cloud.*—In order to test this important factor in the value of a station for astronomical purposes, observations of the amount and kind of cloud were taken every two hours between 8 A.M. and 10 P.M. The observers at Kottagiri and Kodaikānal were both trained by Miss Pogson, and no attempt was made to alter the standards of their eye estimates during the year. The observations appear on the whole to have been carefully taken, and may be accepted as fairly representing the cloud conditions of the two observatories. As already noted in the rainfall section, it is probable the cloud amount of Kodaikānal is exaggerated to some extent from the position of the observatory.

The monthly means of amount of cloud are given in Tables IX, X and XI of the Appendix and are plotted in Fig. I to 13 of Plate I. The monthly means show that there is less cloud at Kodaikānal from February to June, and that there is more cloud during the remainder of the year. On the average of the whole year, there is practically no difference.

The curves, Fig. 1 to 12, Plate I, present the following features:—

(1) The cloud curves of January are almost identical in form, and show that there is more cloud throughout the whole day at Kodaikānal than at Kottagiri.

(2) During the dry and hot weather months from February to May the amount of cloud is considerably less at Kodaikānal. March is especially free from cloud at that station. In all these months, but more especially in February and May, cloud forms to a much larger extent in the hottest part of the day at Kodaikānal than at Kottagiri. Hence, although the cloud amount is much less at the former station during the morning up to 10 or 11 A.M., and again in the afternoon from about 3 or 4 P.M., it is frequently greater during the intervening interval from 10 A.M. to 3 P.M.

(3) During the south-west monsoon period from June to September the cloud amount is large at both stations, but is larger to a moderate extent at Kodaikānal than Kottagiri. It is, however, noteworthy that during the greater part of this period (very notably in June and September) there is less cloud at Kottagiri in the morning up to 9 or 10 A.M., and again in the afternoon and evening after 5 P.M.

(4) During the months of October, November and December, the period of the retreating south-west monsoon currents, the cloud amount is nearly as large as during the preceding four months. It is also slightly larger on the average of the whole day at Kodaikānal than at Kottagiri; but, as in the preceding period, the excess at Kodaikānal occurs chiefly between 10 A.M. and 4 P.M. or 5 P.M. It is in all the months less cloudy at Kodaikānal up to 10 A.M. and also after 8 P.M.

Hence the general conclusion, that during the four months of least cloud there is much less cloud during nearly the whole day at Kodaikānal than at Kottagiri, and during the remainder of the year there is usually less cloud in the morning up to 10 A.M., and again in the evening after 5 or 6 P.M. Cloud forms more largely at Kodaikānal during the period of greatest convective action and air motion from about 10 A.M. to 4 P.M. As a rule, the photographic and probably the spectroscopic work would be done in the morning when the air would be most free from dust and least disturbed. It is hence apparent that the atmospheric conditions for the solar physics observations, so far as measured by the absence of cloud at the most important period of the day for the work, are more satisfactory at Kodaikānal than at Kottagiri.

A comparison of the cloud curves, Plate I, with those of the amount of sunshine, Plate II, show a close correspondence, the only difference being that the amount of sunshine at different hours of the day varies to a less extent than the amount of cloud. It is not necessary to endeavour to estimate to what extent the cloud estimates of the observatory at Kodaikānal would have to be reduced in order to represent fairly the cloud on the open plateau at a distance of 2 or 3 miles from the edge, as the data show sufficiently the superiority of Kodaikānal to Kottagiri.

(6) *Sunshine*.—The following statement of the results of the sunshine observations at the hill stations of Madras, Kodaikānal and Kottagiri was drawn up by Mr. Michie-Smith. It deals with the questions exhaustively, and is hence given in full. The data will be found in Tables XII, XIII, XIV, XV and XVI of the Appendix to the report, and all the more important results are charted on Plate II accompanying this report.

The following points have to be taken into account with reference to all that follows:—

(1) Solar time is used throughout, XII on the card having been placed at the meridian mark of the instrument, and no correction having been applied for equation of time. Neither has any correction been applied for scale errors at different times of the year.

(2) The observations made at Madras are not strictly comparable with those made at the two other stations. The Madras instrument is a Whipple-Casella recorder, of which the sphere is of remarkably clear white glass, while the metal card holder is moveable and only about one inch wide. The other two instruments are of the old pattern, with fixed broad card holder and glass spheres which are distinctly coloured. Until the instruments have been compared side by side, it is impossible to say to what extent they differ; but there can be little doubt that the Madras instrument will record somewhat fainter sunshine than the others.

Hourly amounts of sunshine.—Figures 1–10, Plate II, show graphically the amounts of sunshine recorded in each hour from sunrise to sunset for each month for March to December. The records for the first three months of the year are incomplete. Figures 11–13 show the sunshine for each hour for the periods March–April, May–September, and October–December. The first feature which calls for attention in these diagrams is the excess of sunshine at Madras over both the hill stations; and though part of this may be accounted for by the difference of instruments, it is evident that this explanation will not account for any large proportion of it. The excess is mainly in the afternoon, and is due to the well-known tendency for clouds to form on the hills in the afternoons. The total amount of sunshine recorded at Kodaikānal is considerably in excess (52 hours) of the total amount recorded at Kottagiri; and the hourly distribution at the two stations is very different. In that Kottagiri. From sunrise till about noon Kodaikānal is the clearer station; then from noon till about 5 P.M. Kottagiri is clearer, but after 5 P.M. Kodaikānal seems again to have more sunshine than Kottagiri between 5 and 6 P.M. This may be due to difference in the exposure of the instruments, but I think not, as the cloud observations at 20 hours and 22 hours show Kodaikānal to have a clearer atmosphere than Kottagiri at these hours. For the ten months the excess of forenoon sunshine at Kodaikānal over Kottagiri is 131 hours. This is a point of very great importance in favour of Kodaikānal, because it is in the forenoons that all the best solar work can be done at a hill station. For most months the early morning is brighter at Kodaikānal even than at Madras. In the diagrams 1 to 13 all sunshine has been treated alike so long as it was able to leave a burned trace on the card, but evidently this is not quite satisfactory; and an attempt has been made in figure 14 to take into account the intensity as well as the duration. In this diagram the difference between the two kinds of instruments need must not be forgotten. The table from which the diagram is drawn is prepared by multiplying the number of hours of sunshine for each day by a number (1–10) representing the mean intensity for the day, and dividing by 10 to get the equivalent "full sunshine." In March, September and December, Kodaikānal is the best of all the stations, but June and November, when it is slightly better. Kottagiri is below Kodaikānal in all months except May, the mean first and last recorded sunshine at each of the stations for each month. Figures 15 and 16 show the relative times of to note here are that, except in July, when it is the same, the sun appears much earlier at Kodaikānal than at Kottagiri, and that, except in May, it appears sooner than at Madras, indicating

probably clearer nights at Kodaikānal. As regards last sunshine, Kottagiri is better off than Kodaikānal, except in March, April and December. At first sight this seems contradictory to the statement made above, that there is more sunshine between 5 and 6 P.M. at Kodaikānal than at Kottagiri; but really it is not so, since the whole of the recorded sunshine between 5 and 6 P.M. was given on a few days in each month. Part of the inferiority of Kodaikānal over Kottagiri in the afternoons is due to the position of the observatory, which is so situated that it is frequently in mist, while the places farther west are quite clear. This statement is made from the results of actual observation and is not a mere surmise. Still, I have no doubt that Kottagiri is really somewhat clearer than Kodaikānal in the afternoons.

In concluding these remarks, it may not be amiss to point out that at Kodaikānal the weather was far from normal last year (1892). According to the unanimous opinion of those who know the place well, and with whom I have had an opportunity of speaking, the summer months were much more cloudy than usual, while, on the other hand, October and November were much brighter than usual.

The following are the Madras abnormalities for percentage of clear sky in 1892:—

January	February	March	April	May	June	July	August	September	October	November	December
+ 2	+ 7	+ 9	+ 3	+ 5	+ 6	— 4	— 5	— 4	+ 8	+ 13	+ 7

Number of days on which the sun could have been photographed.—An attempt has been made to determine from the sunshine recorder slips the number of days on which the sun could have been photographed at each station. The estimate is made by rejecting those days on which the sunshine did not reach an intensity of about 7 for not less than 20 minutes. The following is the result:—

TABLE showing number of days on which it would have been possible to photograph the sun.

	Madras.			Kottagiri.			Kodaikānal.		
	Neither forenoon nor afternoon.	Forenoon, but not afternoon.	Afternoon, but not forenoon.	Neither forenoon nor afternoon.	Forenoon, but not afternoon.	Afternoon, but not forenoon.	Neither forenoon nor afternoon.	Forenoon, but not afternoon.	Afternoon, but not forenoon.
Mar. and Apr.	1 + 2?	1 + 1?	1	1	2	1	2	3	3
May to Sept. . .	23 + 2?	11 + 1?	9 + 2?	23 + 5?	39 + 6?	20 + 3?	12 + 2?	40 + 4?	9 + 3?
Oct. to Dec. . .	5	4 + 1?	6 + 2?	8 + 3?	7 + 4?	3	6	12 + 4?	2 + 1?
Mar. to Dec. . .	29 + 4?	16 + 3?	16 + 4?	27 + 8?	48 + 10?	24 + 3?	20 + 2?	55 + 8?	14 + 4?

Nors.—4? means there were 4 days on which a photograph could probably, but not certainly, have been got.

The number of days on which a photograph could not have been got are few at all the places, but Kodaikānal is sensibly better than either of the other two.

The general result appears to me to be that, entirely apart from the special considerations which I have brought forward in my report on these stations (G.O., dated 16th September 1892, No. 648), Kodaikānal is for solar work decidedly superior to Kottagiri. Its superiority over Madras for this special work is less clear, but I believe that the much greater transparency of the air, especially in the forenoons, and the greater ease with which the work can be carried on, more than counterbalance the smaller total amount of sunshine. For actinometric work Madras is, of course, out of the question.

Relative merits of the stations as deduced from cloud observations at 20 hours and 22 hours.—This is shown graphically in figure 17. Unfortunately the data for November and December are incomplete. The estimate is got by giving a weight of 10 to all nights on which the cloud proportion did not exceed $\frac{1}{10}$, of 6 to nights with $\frac{1}{10}$ or $\frac{1}{15}$, and of 2 to nights with $\frac{1}{15}$ to $\frac{1}{20}$. From this diagram Madras appears best, except in March, July, September and November; but this is really far from being the case, as on very many of the nearly cloudless nights there is a thick haze which is not found at the hill stations. Kodaikānal is superior to Kottagiri, except in February and July.

(7) *Transparency of the atmosphere*.—With respect to the general clearness and purity of the atmosphere, conditions of great importance for photographing the details of the solar disc, and for actinometric work, it was not possible to obtain any observations from the observers.

Mr. Michie-Smith and Miss Pogson, who have both visited the stations of Kodaikānal and Kóttagiri, speak most favorably of the clearness and transparency of the atmosphere at these hill stations as compared with Madras. Kodaikānal appears also to be superior to Kóttagiri in this respect. Thus Mr. Michie-Smith in his report says:—

"The general results at which I have arrived from these observations as regards the relative merits of Kodaikānal and Kóttagiri as a site for an observatory is that Kodaikānal is by far the better situation of the two. Whether or not this has been absolutely proved by the observations detailed above depends to a certain extent on the further consideration of whether the atmospheric conditions at the time when I was observing were fairly characteristic of the Kóttagiri climate. Personally, I have not the least doubt that the conclusion is the correct one, for the general impression of the superiority of Kodaikānal very strongly forced itself upon me while I was observing at Kóttagiri; and I can affirm, without hesitation, that the best night while I was at Kóttagiri was inferior to the worst observing night at Kodaikānal. Having already expressed an opinion in favour of Kodaikānal, I took particular care that full justice was done to Kóttagiri, and took every possible opportunity of getting the most favorable observations. The inferiority was particularly marked in the solar observations and in the observations of the finer details of nebulae."

"In both of these researches the remarkable steadiness and transparency of the air at Kodaikānal would be an enormous advantage, and I believe that more good work could be done on a dozen clear nights there than on fifty clear nights at Madras. Solar observations could be carried on with at least equal success and with much greater comfort to the observer."

It is hardly necessary to state that Madras is, for various reasons, unfitted as a site for a Solar Physics Observatory.

The meteorological observations taken at Kodaikānal and Kóttagiri establish, I think, fully that Kodaikānal is superior in almost every respect to Kóttagiri.

- (1) Temperature is more uniform, whether the diurnal or annual changes be considered.
- (2) The mean temperature (58½°) is practically that best suited for the observational and laboratory work which would be carried on in Solar Physics Observatory, and is approximately that of the standard temperature assumed in much laboratory work in Europe (viz., 60° or 62°). It is about 7° above the mean temperature of London.
- (3) There is as a rule less cloud from sunrise up to 10 A.M. or 11 A.M., and also after 5 P.M. or 6 P.M., the most important periods of the day for astronomical and solar observations.
- (4) There is less cloud during nearly the whole day in the clearest and finest months of the year, i.e., during the season when probably the best work of the year would be done.
- (5) The atmosphere appears to be as a general rule purer, clearer, and less disturbed during the morning up to 10 A.M., the important period of the day for solar observation.
- (6) Finally, a far more satisfactory site for the observatory for the object in hand could be obtained in the neighbourhood of Kodaikānal than at Kóttagiri.

APPENDIX I.

TABLE I.

Mean daily temperature, mean of max. and min.

Month, 1892.	Madras.	Kodaikānal.	Kóttagiri.	Simla (mean of year).
January	75.7	64.5	55.3	43.8
February	77.5	67.9	59.2	44.2
March	81.2	69.9	61.9	45.8
April	85.1	61.9	64.8	51.3
May	89.0	62.3	64.1	57.0
June	85.5	60.3	63.3	59.4
July	84.2	58.9	61.1	58.2
August	81.7	58.0	..	56.1
September	83.1	58.4	..	54.2
October	80.8	57.3	..	50.4
November	77.4	57.5	..	52.1
December	75.4	54.1	57.5	48.3
Mean of year	82.5	62.6	..	52.4

TABLE II.

Mean daily range of temperature.

Month, 1892.	Madras.	Kodaikānal.	Kóttagiri.	Simla (mean of year).
January	17.1	15.6	16.8	14.8
February	19.1	16.8	18.9	16.3
March	19.7	16.7	21.2	17.4
April	16.1	16.3	18.8	19.2
May	18.2	15.0	16.8	19.3
June	17.2	13.4	13.6	17.7
July	15.4	12.2	12.4	11.6
August	14.5	11.5	..	10.6
September	15.2	13.8	..	14.1
October	14.7	12.0	..	16.7
November	16.1	12.6	..	16.8
December	16.1	14.9	17.8	16.4
Mean of year	16.5	14.2	..	15.9

TABLE III.

Mean humidity.

Month, 1892.	Madras.	Kodaikānal.	Kóttagiri.	Simla (normal).
January	76	72	69	60
February	78	64	62	56
March	75	47	52	52
April	76	67	69	47
May	61	70	73	48
June	72	79	82	63
July	72	80	80	89
August	80	83	..	91
September	76	71	..	78
October	62	81	..	62
November	78	80	..	48
December	80	68	72	45
Mean of year	75	72	..	61

TABLE IV.

Monthly rainfall.

Actual, 1892.

Month, 1892.	Madras.	Kodaikānal.	Kóttagiri.
January	0.13	0.15	0.01
February	NIL.	0.69	NIL.
March	NIL.	0.38	0.09
April	0.69	3.84	8.29
May	NIL.	4.33	8.38
June	4.02	8.71	6.11
July	7.82	3.65	4.90
August	10.79	7.01	6.41
September	6.29	1.75	2.40
October	6.60	9.64	14.68
November	0.96	0.64	2.80
December	4.74	1.84	2.25
Total of year	42.04	47.53	55.02

TABLE V.

Actual number of rainy days on which 0.01 inch or upwards fell.

Month, 1892.	Madras.	Kodáikanal.	Kóttagiri.
January	3	4	1
February	..	6	..
March	..	3	2
April	2	16	16
May	..	19	15
June	11	19	15
July	21	21	13
August	19	24	7
September	14	8	18
October	11	21	4
November	2	7	5
December	6	8	..
Total of year ..	88	155	115

TABLE VI.

Mean monthly rainfall.

Month, 1892.	Madras.	Kodáikanal.	Kóttagiri.
	INCHES.	INCHES.	INCHES.
January	0.94	0.55	0.53
February	0.29	0.63	0.20
March	0.41	3.02	1.63
April	0.63	6.14	3.36
May	2.21	4.86	7.41
June	2.07	3.90	2.43
July	3.78	4.92	4.58
August	4.48	6.39	4.33
September	4.75	6.76	6.99
October	10.99	10.87	10.22
November	13.75	5.59	6.93
December	5.24	7.39	4.16
Total of year ..	49.54	60.96	52.77

TABLE VII.

Mean number of rainy days.

(A rainy day being a day on which a tenth of an inch of rain or upwards falls.)

Month, 1892.	Madras.	Kodáikanal.	Kóttagiri.
January	1.4	1.0	1.6
February	0.1	0.5	0.6
March	0.6	3.3	2.3
April	0.8	5.9	4.8
May	1.5	10.8	10.5
June	4.7	9.0	7.8
July	6.9	8.5	9.8
August	8.2	12.0	8.8
September	7.1	13.8	11.0
October	10.0	15.0	16.3
November	11.0	10.5	9.8
December	5.2	8.5	6.3
Total of year ..	57.0	98.7	89.7

TABLE VIII.

Mean daily amount of wind.

Month, 1892.	Madras.	Kodáikanal.	Kóttagiri.
	MILES.	MILES.	MILES.
January	143	7	194
February	134	7	127
March	163	179	139
April	189	147	148
May	236	236	151
June	174	169	136
July	155	203	..
August	110	124	..
September	118	254	..
October	118	182	..
November	165	202	81
December	159	175	..
Mean of year ..	157	184	..

TABLE IX.

Mean cloud amount, Kodáikanal.

Month, 1892.	8 hours.	10 hours.	12 hours.	14 hours.	15 hours.	16 hours.	20 hours.	22 hours.	Mean.
January	4.4	3.3	5.7	6.3	6.7	7.0	6.0	4.3	5.8
February	1.1	1.3	3.3	4.1	5.7	3.9	3.2	3.3	3.4
March	0.0	0.8	3.6	3.4	2.9	1.8	0.7	0.7	1.7
April	9.7	8.0	6.6	6.4	5.9	5.3	5.3	4.9	4.7
May	4.9	4.4	4.7	6.2	7.5	6.1	4.7	4.3	5.3
June	5.5	5.9	9.9	8.9	8.5	8.3	8.6	5.3	7.3
July	7.2	4.7	6.9	9.6	9.3	9.4	8.1	8.1	8.8
August	7.6	8.0	9.2	9.2	9.2	8.6	8.2	7.8	8.5
September	8.3	6.7	8.1	9.0	8.8	7.2	5.1	4.3	7.1
October	5.1	6.8	8.1	8.6	8.4	7.4	7.1	6.5	7.4
November	3.5	6.3	7.4	7.8	8.4	7.5	7.1	5.1	6.8
December	6.0	4.2	5.0	8.8	6.1	6.6	4.6	4.3	6.2
Mean of year ..	4.4	5.1	6.6	7.0	7.3	6.6	5.2	4.9	6.0

TABLE X.

Mean cloud amount, Kóttagiri.

Month, 1892.	8 hours.	10 hours.	12 hours.	14 hours.	15 hours.	16 hours.	20 hours.	22 hours.	Mean.
January	3.2	3.6	3.5	3.6	4.0	5.0	4.8	3.2	3.9
February	3.0	3.0	2.8	3.6	4.0	4.8	4.8	3.1	3.7
March	2.2	2.9	3.0	3.4	5.0	4.4	5.1	1.9	3.2
April	4.0	4.4	4.6	5.0	6.7	7.3	6.9	6.4	5.7
May	5.7	5.5	5.4	5.8	6.7	7.0	6.7	6.1	6.1
June	8.7	8.2	6.9	7.0	7.5	8.1	7.8	6.5	7.6
July	7.5	7.3	7.2	7.5	7.8	8.2	7.8	6.8	7.5
August	..	..	7.5	7.7	..	8.1	8.0	7.4	..
September	..	..	6.7	7.2	..	7.4	6.2	6.7	..
October	..	..	6.8	6.6	..	8.1	7.2	6.4	..
November	..	..	..	..	..	..	..	..	..
December	5.1	4.7	4.4	4.9	5.2	5.2	4.5	3.6	4.7
Mean of year ..	..	..	..	..	..	..	..	..	..

TABLE XI.

Mean cloud amount, Madras.

Month, 1892.	8 hours.	10 hours.	12 hours.	14 hours.	16 hours.	18 hours.	20 hours.	22 hours.	Mean.
January	4.0	4.5	..	4.3	4.0	..	2.0	..	3.8
February	2.4	3.6	..	2.3	1.9	..	1.4	..	1.6
March	1.6	2.1	..	1.6	1.6	..	1.2	..	1.6
April	4.3	3.6	2.1	2.8	2.4	3.1	1.0	3.2	2.9
May	4.4	3.3	2.1	2.8	3.5	8.7	8.1	3.7	3.4
June	..	..	..	..	..	..	..	..	..
July	7.7	6.5	7.3	7.7	7.9	8.2	8.3	8.6	7.8
August	8.0	6.9	7.1	7.6	7.6	7.6	6.5	6.7	7.3
September	7.0	6.4	6.7	6.6	7.4	7.5	6.8	7.1	6.9
October	5.0	5.0	6.1	5.0	5.0	5.0	4.0	4.0	4.9
November	5.0	5.0	6.1	5.0	5.0	4.0	4.0	4.0	4.8
December	..	..	..	..	..	..	..	..	..
Mean of year	..	..	..	..	..	..	..	..	..

TABLE XII.

Hours of bright sunshine.

1892.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	March and April.	May to September.	October to December.	March to December.
Kottagiri—																
6 to 7	..	7.1	1.7	0.8	2.3	1.7	0.5	0.2	..	0.2	1.2	0.8	2.5	4.7	2.2	9.4
7-8	..	20.6	22.5	15.6	17.4	11.3	4.4	3.7	8.3	7.4	17.8	17.1	38.0	45.1	43.3	125.4
8-9	..	27.2	30.2	23.1	20.2	14.9	8.6	9.8	13.7	17.2	25.6	23.6	53.7	57.2	63.4	186.9
9-10	..	24.8	29.6	24.1	21.7	16.6	10.2	10.8	16.4	18.9	25.6	23.7	53.7	57.2	63.4	186.9
10-11	..	24.0	27.3	25.1	23.0	13.4	10.4	12.1	17.3	17.8	26.0	23.6	52.4	56.2	62.6	185.8
11-noon	..	24.1	25.9	24.9	24.8	13.0	9.3	10.1	15.2	15.7	22.4	24.5	50.8	52.4	58.6	188.9
12-13	..	23.9	24.7	22.8	22.9	9.9	3.4	7.2	13.1	10.8	18.9	20.8	48.1	50.1	56.5	187.7
13-14	..	24.0	26.9	21.2	22.8	9.9	3.4	7.2	13.1	10.8	18.9	20.8	48.1	50.1	56.5	187.7
14-15	..	22.0	25.4	18.6	20.0	10.2	7.4	6.8	12.4	10.7	16.6	20.9	44.0	46.8	47.1	147.9
15-16	..	21.1	24.1	16.0	14.8	6.0	4.1	5.7	11.9	5.0	13.3	19.8	40.1	42.8	37.6	120.6
16-17	..	17.7	19.3	9.1	13.2	4.3	3.1	2.9	8.6	1.3	8.7	11.9	28.4	29.0	22.4	79.8
17-18	..	6.1	2.1	1.0	1.9	0.3	..	0.0	0.2	..	..	..	3.1	3.3	..	3.4
18-19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	..	249.5	339.7	301.7	206.0	111.4	72.8	78.6	128.9	119.4	19.4	210.4	461.4	596.6	632.2	1,581.2
Kodai- kanal—																
6-7	..	..	10.3	6.8	8.3	5.7	2.6	2.6	3.2	2.6	5.5	5.0	17.0	22.4	13.1	52.5
7-8	..	..	29.2	20.6	21.1	13.2	7.9	9.3	13.6	17.6	21.1	21.7	49.8	64.0	60.4	174.2
8-9	..	..	29.8	24.4	20.9	15.4	13.0	13.8	17.4	20.6	25.3	23.6	54.2	60.6	69.5	204.2
9-10	..	..	30.0	24.3	20.8	17.8	13.4	14.6	21.6	20.1	27.0	23.8	54.3	67.2	70.9	213.4
10-11	..	..	30.4	23.6	23.5	15.6	12.1	13.4	21.1	18.2	23.8	23.0	54.0	65.6	64.3	203.9
11-noon	..	..	29.3	23.1	22.7	13.2	10.9	8.9	18.1	15.6	26.3	22.4	52.4	73.8	68.3	184.5
12-13	..	..	28.2	22.0	21.2	7.8	10.8	7.6	18.6	8.6	18.2	21.7	48.2	60.6	48.5	157.2
13-14	..	..	25.1	19.0	19.1	7.4	6.2	4.6	10.9	7.8	16.8	20.4	44.1	48.2	45.0	137.3
14-15	..	..	23.1	16.4	18.3	6.4	6.6	3.4	6.1	6.3	13.6	10.1	39.6	34.7	38.9	112.4
15-16	..	..	21.8	13.6	12.0	3.8	3.8	2.4	5.7	6.0	12.8	15.4	36.3	27.7	35.1	76.3
16-17	..	..	21.9	11.0	9.4	3.5	1.4	2.1	3.3	6.2	7.8	11.7	32.9	19.7	24.2	76.3
17-18	..	..	7.7	2.4	4.3	1.7	0.0	0.8	0.8	0.2	..	..	1.7	10.1	7.1	21.1
18-19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	..	..	284.7	207.1	196.6	111.4	68.1	83.0	134.3	129.7	190.8	209.6	491.8	611.4	530.3	1,635.6
Madras—																
6 to 7	..	2.3	1.6	0.8	5.1	9.2	6.6	2.9	2.6	4.3	3.2	0.6	5.0	25.5	5.0	35.4
7-8	..	20.8	22.6	19.9	18.8	23.8	14.0	6.4	7.0	9.6	13.8	15.0	16.1	39.7	60.8	44.9
8-9	..	25.5	27.6	29.1	24.3	27.9	16.4	8.9	12.2	12.7	20.7	21.7	22.8	53.4	73.1	65.2
9-10	..	29.1	26.2	30.0	25.6	27.8	17.0	13.6	14.8	14.4	22.1	23.7	23.6	55.6	87.5	69.2
10-11	..	26.7	28.5	30.5	26.6	27.8	17.0	13.6	14.8	14.4	22.1	23.7	23.6	55.6	87.5	69.2
11-12	..	26.4	28.5	30.5	26.6	27.8	17.0	13.6	14.8	14.4	22.1	23.7	23.6	55.6	87.5	69.2
12-13	..	27.0	28.9	30.7	26.0	27.7	20.4	16.8	18.8	19.6	21.1	22.5	24.1	57.0	101.9	87.7
13-14	..	28.8	28.9	31.0	27.0	27.9	20.4	16.8	18.8	19.6	21.1	22.5	24.1	57.0	101.9	87.7
14-15	..	27.4	28.6	31.0	26.7	28.4	21.4	12.8	13.3	10.6	18.6	22.8	24.7	57.7	86.5	68.1
15-16	..	26.0	28.0	29.9	27.3	26.6	19.8	10.2	11.4	11.3	18.5	21.0	23.9	57.2	79.3	64.7
16-17	..	18.0	27.0	25.0	23.2	16.3	6.9	9.6	9.6	17.5	18.2	19.0	45.9	65.6	54.7	166.2
17-18	..	1.5	18.4	9.3	5.6	8.9	8.2	0.7	4.0	8.5	6.7	3.0	0.3	14.8	25.8	3.9
Total	..	260.4	294.7	298.0	260.9	258.0	192.2	127.3	141.0	145.1	206.4	217.6	558.9	900.6	655.0	2,114.16

TABLE XIII.

Equivalent number of hours of full sunshine.

1892.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	March and April.	May to September.	October to December.	March to December.
Madras	200.1	204.7	163.6	171.3	246.0	151.7	94.3	91.4	89.9	128.9	144.3	142.7	334.9	674.7	411.9	1,421.5
Kodaikanal.	[171.9]	237.1	157.2	157.2	128.6	55.4	65.6	63.3	111.3	108.6	138.6	165.3	394.3	424.8	413.3	1,232.4
Kottagiri	[141.6]	154.6	164.9	150.8	141.4	60.1	48.1	53.4	88.7	62.3	145.8	142.4	315.7	391.9	370.5	1,078.1

TABLE XIV.

Mean time of first recorded sunshine.

Madras	7.2-h	7.1	7.3	7.3	6.6	7.5	8.8	8.1	7.8	7.6	7.8	7.4				
Kodaikanal.	[6.8]	6.7	6.9	6.9	6.8	7.3	8.2	7.1	7.5	7.3	7.1	7.1				
Kottagiri	[6.7]	7.0	7.1	7.5	7.5	7.7	8.2	8.2	7.8	8.0	7.2	7.4				

TABLE XV.

Mean time of last recorded sunshine.

Madras	16.7	17.7	17.1	16.9	17.3	17.1	15.7	15.7	15.3	16.6	15.5	16.7				
Kodaikanal.	[16.8]	16.8	17.0	16.3	17.3	14.5	13.0	14.8	14.8	14.6	15.4	16.3				
Kottagiri	[16.8]	16.8	16.8	16.9	16.1	14.8	14.7	14.9	16.1	15.2	16.0	16.1				

TABLE XVI.

Relative merits deduced from cloud observations at 20 hours and 92 hours.

(A weight of 10 is given to days having not more than of $\frac{1}{16}$ cloud, of 6 to days having from $\frac{1}{16}$ to $\frac{1}{8}$ and of 2 to days having from $\frac{1}{8}$ to $\frac{1}{4}$ of cloud.)

1892.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January to April.	May to September.	October to December.	Year.
Madras	254	258	294	284	195	107	28	100	72	168	193	195	1,090	502	556	2,148
Kodaikanal.	134	176	294	159	162	102	42	47	128	73	291	..	763	481	..	..
Kottagiri	196	182	230	68	91	65	67	37	72	55	..	160	676	322	..	..

* [Incomplete.]

This is derived from the following table:—

TABLE XVII.

1892.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January to April.	May to September.	October to December.	Year.
MADRAS.																	
No. of days on which cloud from	0-2 { 20 hours ..	22	24	27	37	16	11	1	3	7	13	12	17	100	43	42	185
	22 hours ..	..	..	..	..	11	9	1	8	4	11	14	13	..	33	33	..
3 and 4 { 20 hours ..	20 hours ..	6	3	4	2	7	4	2	2	1	5	10	4	14	16	19	49
	22 hours ..	..	..	..	..	11	4	2	3	2	8	9	8	..	22	25	..
5 and 6 { 20 hours ..	20 hours ..	2	0	0	1	2	2	2	2	3	6	3	3	3	13	12	39
	22 hours ..	..	..	..	..	4	3	3	2	5	3	3	6	..	17	12	..
7 and 8 { 20 hours ..	20 hours ..	1	2	0	0	6	12	4	2	3	2	3	5	3	17	10	39
	22 hours ..	..	..	..	..	2	3	0	1	4	4	0	3	..	10	7	..
9 and 10 { 20 hours ..	20 hours ..	1	0	0	0	0	11	21	16	16	6	2	2	1	64	9	74
	22 hours ..	..	..	..	..	3	11	26	17	16	6	4	1	..	71	10	(81)
KODAIKANAL.																	
0-2 { 20 hours ..	20 hours ..	9	14	30	30	13	7	2	2	11	6	16	..	63	35	..	..
	22 hours ..	12	13	22	12	17	11	3	4	10	7	18	..	66	45	..	..
3 and 4 { 20 hours ..	20 hours ..	3	7	0	4	2	1	2	2	3	1	3	..	14	10	..	..
	22 hours ..	1	4	1	3	0	1	2	2	3	0	3	..	9	8	..	..
5 and 6 { 20 hours ..	20 hours ..	1	3	0	2	4	3	4	3	3	3	3	..	8	17	..	..
	22 hours ..	4	5	1	0	2	3	1	2	2	2	3	..	10	10	..	..
7 and 8 { 20 hours ..	20 hours ..	7	2	0	4	2	6	2	3	3	2	2	..	13	15	..	..
	22 hours ..	6	2	0	2	1	7	3	1	3	9	0	..	9	15	..	..
9 and 10 { 20 hours ..	20 hours ..	11	3	1	19	10	14	21	21	10	19	6	..	30	76	..	..
	22 hours ..	9	6	1	12	11	8	23	22	12	13	7	..	27	75	..	..
KOTTAGIRI.																	
0-2 { 20 hours ..	20 hours ..	14	12	13	3	1	0	0	0	0	0	..	8	42	1	..	..
	22 hours ..	17	39	24	6	7	3	2	1	0	1	..	11	63	13	..	..
3 and 4 { 20 hours ..	20 hours ..	3	6	8	2	8	3	3	2	6	4	..	9	19	22	..	..
	22 hours ..	8	2	4	8	6	3	7	6	11	8	..	9	22	33	..	..
5 and 6 { 20 hours ..	20 hours ..	8	1	7	7	6	6	9	6	13	8	..	5	23	37	..	..
	22 hours ..	0	0	2	1	3	9	8	3	9	6	..	6	5	32	..	..
7 and 8 { 20 hours ..	20 hours ..	1	6	3	8	8	11	9	11	7	10	..	7	17	46	..	..
	22 hours ..	1	0	..	3	4	14	6	10	7	9	..	2	9	37	..	..
9 and 10 { 20 hours ..	20 hours ..	5	5	..	19	8	11	10	13	7	8	..	2	20	47	..	..
	22 hours ..	5	4	1	15	13	6	8	11	8	7	..	3	23	38	..	..

From the Meteorological Reporter to the Government of India, to the Secretary to the Government of India, Revenue and Agricultural Department, dated Simla, the 4th March 1893, No. 149-S.

I have the honour to acknowledge receipt of your letter No. 3576-1, dated 27th December 1892, forwarding a copy of a despatch from the Secretary of State, and requesting that after I have discussed the questions raised in that despatch with the Madras Government, I shall submit recommendations regarding them, with the report on the best site for the new Imperial Observatory, in which more especially I should state—

- (1) Whether I can recommend the establishment of a Solar Physics Observatory or the continuance of the Astronomical Observatory alone.

- (2) Whether in the former case I would recommend that Mr. Michie-Smith should have superintendence of the Solar Physics observations.
 (3) What part of the work hitherto conducted at the Madras Astronomical Observatory should be continued there, if only a Solar Physics Observatory be maintained in its entirety.

2. The original proposal made in my review on the subject was to establish a combined Astronomical and Solar Physics Observatory on the best site in the hills of Southern India. The carrying out of this scheme in a complete and satisfactory manner would necessarily involve a large expenditure; and the Secretary of State hence suggests that if funds are not available for establishing a new complete observatory with two branches, the furtherance of Solar Physics would be the greater benefit to science, while astronomical requirements could for the time be met by the Madras Observatory.

3. As it is very probable the Government of India may not be disposed to sanction large expenditure on a scheme chiefly for scientific object at the present time, I submit full proposals for the establishment of a Solar Physics Observatory and the continuance of the Madras Astronomical Observatory on a tentative footing.

4. If the Government of India are in a position to provide funds for the larger scheme, sketched in my memorandum, and which is apparently approved in its general outlines by the Solar Physics and Observatories Committees in England, full details can be easily prepared and submitted.

5. The following gives a brief statement of the work at present carried out in the Madras Observatory:—

Mr. Pogson during the period he was Government Astronomer (from 1861 to 1891), amassed an enormous number of observations, many of which were of great value. Little or nothing was done in the way of publishing the results of the observations until the last two or three years of his life. Before his death he gave full instructions and information respecting the unpublished observations to Mr. Michie-Smith, and also recommended to the Madras Government the appointment of that gentleman as his successor, with a view to the continuation of the publication of the accumulated observations in the form he wished. Mr. Michie-Smith was hence appointed temporarily, pending the settlement of the future of the Madras Observatory, and was specially instructed to devote himself to the publication of Mr. Pogson's series of observations. Hence, at the present time, the only systematic observational work carried on at the Madras Observatory is—

- 1st—Transit observations for the determination of time, and
 2nd—Meteorological observations.

It may be noted that no magnetical observations have been taken for many years. Satisfactory progress has been made during the past eighteen months in the work of publishing the series of observations.—

Mr. Michie-Smith has issued several volumes including the following:—

- (1) Meteorological and magnetical observations made at the Madras Observatory between the years 1861 and 1881.
 (2) Telegraphic determination of the difference of longitude between Madras and eight other stations.

The following volumes containing results of observations made by Mr. Pogson are in course of preparation, and will, I am informed, be completed in a few months:—

A.—Astronomical.

- (1) Separate results of 5,761 observations made with the new Meridian circle in 1862, 1863 and 1864; with the deduced catalogues for each year.
 (2) Separate results of 7,651 observations made with the Meridian circle in 1865, 1866 and 1867; with the deduced catalogues for each year.
 (3) Separate results of 5,867 observations made with the Meridian circle in 1868, 1869 and 1870; with the deduced catalogues for each year.
 (4) Separate results of 5,603 observations made with the Meridian circle in 1871, 1872, and 1873; with the deduced catalogues for each year.
 (5) Separate results of 4,639 observations made with the Meridian circle in 1874, 1875 and 1876; with the deduced catalogues for each year.
 (6) Separate results of 9,637 observations made with the Meridian circle in 1877, 1878 and 1879; with the deduced catalogues for each year.
 (7) Separate results of 9,267 observations made with the Meridian circle in 1880, 1881 and 1882; with the deduced catalogues for each year.
 (8) Separate results of 4,052 observations made with the Meridian circle, 1883 to 1887.
 (9) Catalogue of over 5,000 stars for the epoch 1875, from observations made with the Meridian circle, between the years 1862 and 1887; under the superintendence of N. R. Pogson, C.I.E.

B.—Magnetical.

- (10) Hourly Magnetical Observations made at the Madras Observatory between the years 1856 and 1860; under the superintendence of Majors W. S. Jacob, Bombay Engineers, W. K. Worster, Madras Artillery, and J. F. Tennant, Bengal Engineers.

C.—Meteorological.

- (11) Hourly Meteorological Observations made at the Madras Observatory between the years 1856 and 1860; under the superintendence of Majors W. S. Jacob, Bombay Engineers, W. K. Worster, Madras Artillery, and J. F. Tennant, Bengal Engineers.

It will require about a year to finish these volumes, and thus complete the publication of the series of Mr. Pogson's observations with the Meridian circle.

6. In addition to these, there are the following series of observations taken by Mr. Pogson and lying at the Madras Observatory, some of which, if not the whole, should almost certainly be taken in hand and prepared for publication:—

D.—(a) Observations of minor planets, comets and new variable stars and nebulae, furnishing 989 positions of 73 minor planets at 260 oppositions, 75 of 10 comets, those of such variable stars as are not observable with the Meridian circle, and of two new Nebulae in Ara and Phoenix, discovered by Miss E. Isis Pogson in 1876 and 1881.

(b) Observations of the transit of Mercury, November 12, 1861; transit of Venus, December 8, 1874; six eclipses of the Sun; seven eclipses of the Moon; five occultations of planets; and numerous star occultations between 1862 and 1880. Phenomena of Jupiter's satellites on 193 occasions between 1862 and 1880. Measures of Alpha Centauri, Gamma Virginis and a few other double stars. Spectroscopic measures of Gamma Argus.

(c) Determination of the constant of Solar Parallax, by means of 212 differential measurements of the planet Mars, in Right Ascension, from adjacent comparison stars, made with the Equatorials, on 104 evenings near the rising and 108 mornings near the setting of the planet, at its eight oppositions, in the years 1862, 1864, 1869, 1871, 1873, 1875, 1877 and 1879.

In addition to these observations of Mr. Pogson's, there are the following series of observations taken under previous Directors of the Madras Astronomical Observatory:—

E.—(a) A quarto volume of about 310 pages; containing observations made under the successive superintendence of T. G. Taylor Esq., Captain W. S. Jacob, Bombay Engineers, and Major W. K. Worster, Madras Artillery, all prior to 1861. These observations comprise 1,331 of the Sun, 315 of the Moon, 1,680 of the principal planets, 343 of minor planets and 25 of Donati's comet of 1858. Also a long list of occultations of planets and stars, and of the eclipses of Jupiter's satellites.

(b) Separate results of observations made with the Transit Instrument and the Mural Circle in 1853, 1854, 1855 and 1856; with the deduced catalogues for each year.

(c) Separate results of observations made with the Transit Instrument and the Mural Circle in 1857, 1858 and 1859; with the deduced catalogues for each year.

(d) Catalogue of about 2,200 stars, for the epoch 1855; from observations made with the Transit Instrument and Mural Circle between the years 1853 and 1858, under the superintendence of Captain W. S. Jacob, Bombay Engineers, and Major W. K. Worster, Madras Artillery.

7. It is doubtful how far it would be desirable to publish the last results in group E above; and before doing so the whole question of the errors of these old observations would have to be taken up fully, and this would probably require much time, and might result in the conclusion that the observations were not worth the labour that their preparation for publication might entail.

It would, I have the honour to suggest, be advisable that this matter should be referred to the Observatories Committee, in order that they might record their opinion as to which of the series of observations in groups D and E it would probably be advisable in the interests of astronomical science to publish.

8. It would appear to be very desirable that the publication of the Madras series of observations should be continued until the whole of these that are of value are placed in the hands of the scientific public before observational work on a large scale is resumed; and hence, further, that some arrangement be made by which Mr. Michie-Smith's services might be retained in order that he may complete this work which he has commenced so vigorously and successfully.

Mr. Michie-Smith's permanent appointment is Professor in the Christian College, Madras; and the arrangement by which he acts as Government Astronomer on leave without pay from that College ceases on the 30th June.

It will hence be necessary for Mr. Michie-Smith to determine some time before that date (probably not later than the beginning of April) whether he will resign or return to his appointment in the College; and this will depend upon whether the Government of India is prepared before that time to offer him a permanent appointment in the Madras or Southern India Imperial Observatory.

9. With respect to the question of the desirability of establishing a Solar Physics Observatory in India, the Famine Commission urged strongly the continuance and extension of the work of solar observation in India. Thus, it is stated in paragraph 7 of the Famine Commission's Report that "on the whole, it is not possible for us, in the present state of knowledge, to say more than that the subject of the periodicity of fluctuations in the rainfall, as determined by the spot variation, is one deserving of careful investigation, and that it does not seem contrary to reasonable expectation that some relation should be established between the variations of the rainfall from year to year and those of the conditions of the sun's surface, on the heat derived from which, unquestionably, all terrestrial meteorological phenomena closely depend. For various reasons India is a country in which the investigation of this matter may be carried out with especial facility, and for this reason (though other grounds are not wanting) we would urge that the expense of such researches would be small, the measures which have recently been taken by the Government of India to carry them out should be continued, and even extended in the future."

This recommendation was, I believe, fully approved not only by the Government of India but by the Secretary of State; and it is in consequence of this recommendation that the work of solar observations has been continued in India, and that these observations are directed by the Solar Physics Committee in England. Nothing has occurred during the period since the close of the Famine Commission to weaken the force of their recommendation; and it is extremely desirable not only from scientific considerations, but also from the practical and economic standpoint of the Famine Commissioners that these observations should be not only continued, but should be carried out in a more complete and systematic manner than hitherto.

10. Three classes of observations are necessary:—

1st, Photographic.

2nd, Spectroscopic.

3rd, Actinometric.

Photographic records are at present made at the Surveyor-General's office at Dehra Dun, but as this office will shortly be removed to Calcutta, it is necessary to find a new location for this work.

Spectroscopic observations have not yet been started, although the Secretary of State has requested they should be initiated. The delay is due to the difficulty in making arrangements for the proper performance of the work under present conditions.

Actinometric observations have been made at Leh and Mussoorie, and are at present taken at Simla. They have not been very satisfactory, partly in consequence of the very varying amount of dust haze in the atmosphere in Northern India during fine clear weather, and partly in consequence of imperfection in the instruments used for these observations.

11. The establishment of a Solar Physics Observatory at the most suitable hill station in Southern India, under a qualified Director, would enable the photographic and spectroscopic work to be carried out under probably the best and most suitable conditions obtainable in India. Actinometric observations should also be made under the same conditions.

12. It is probable that a much larger number of fairly satisfactory actinometric observations can be made on days fairly comparable with each other, so far as the atmospheric conditions affecting the absorption of the heat rays of sun are concerned at a hill station in Southern India (e.g., Kodaikanal) than at Simla. It is, however, doubtful whether the finest days at Kodaikanal for actinometric observations would be equal to those at Simla on clear days immediately after heavy snow or rain, when the atmosphere is remarkably transparent and clear and light north-easterly breezes oppose the transfer of dust from the plains to the hills. It would hence, on the one hand, be desirable to include actinometric observations in the range of work at the Solar Physics Observatory, and, on the other, to continue them at Simla, confining them at the latter place to the exceptionally fine days in the year described above, when such series of observations extending over the whole day should be made.

13. Hence the early establishment of a Solar Physics Observatory appears to be an urgent necessity—firstly, on account of the importance of the work, and secondly, on account of the imperfect and temporary nature of the present arrangements for the performance of the work. And, as has been established by the comparative observations taken during the past twelve months at the hill stations of Southern India (of which a full report accompanies this letter), the most suitable site for the Solar Physics Observatory would be on the Palni hills near Kodaikanal.

This conclusion it may be noted, though based on the results of the meteorological observations, is confirmed by the results of astronomical test observations taken by Mr. Michie-Smith at Kodaikānal and Kōttagiri (*vide* his report on this subject).

14. I have hence the honour to suggest that the consideration of the question of the permanent site of the Astronomical Observatory, its future work, equipment and establishment should be postponed for some time, say five years; and that a Solar Physics Observatory should be established on the Palni hills in such a manner as to secure—

- 1st—Photographic, spectroscopic and actinometric solar observations according to general methods, to be prescribed by the Solar Physics Committee, and hence probably in accordance with the methods in use at similar observatories in England, the United States and the Continent of Europe.
- 2nd—The completion of the publication of the Madras series of observations taken during the past 30 years, so far as they are likely to be of value for scientific purposes.
- 3rd—The continuation of the time determination and meteorological observations at Madras as during the past two years.

Five years' solar and other observations at Kodaikānal would afford ample data to secure finally, when the matter arose for discussion, whether that station or Madras would be best adapted for the future astronomical work of a fully equipped Astronomical Observatory in Southern India.

16. The preceding objects would be most satisfactorily and easily obtained by the following arrangements:—

- 1st—The early establishment of a Solar Physics Observatory on the Palni hills near Kodaikānal, and the appointment of Mr. Michie-Smith as the Director and also as Superintendent of the Madras Astronomical Observatory until the appointment of an Astronomer.
- 2nd—The appointment of an Assistant Superintendent at the Madras Observatory, who would live in the observatory and be in charge of the instruments, and superintend the performance of the ordinary transit and time-ball work and meteorological observations, subject to the orders of Mr. Michie-Smith.

17. The early appointment of Mr. Michie-Smith would secure several minor collateral advantages in addition to that of continuity in the publication of the Madras Astronomical Observations. His services might be utilised to assist in the preparation of plans for the new buildings, to select the most suitable site for the observatory on the Palnis, and to choose and train the native observers so far as is possible before the commencement of the work. His knowledge of the topography of the Palni hills would make his assistance in the selection of a site for the observatory invaluable.

18. As he would have probably to be frequently at Kodaikānal, if he were employed in choosing the site and superintending the erection of the building, it would be desirable that an Assistant Superintendent should be shortly appointed. It would necessarily be a temporary and a local appointment. I would suggest Miss Pogson for the appointment for the following reasons:—

- 1st—She was Assistant for many years to her father at the Madras Observatory and in the work of observation and reduction of the observations to an exact time, being time determination and time-ball work at Madras. Her father has reported very favorably on her work. It is also noted specially in these reports that she discovered two nebulae and reduced observations of 193 phenomena of the satellites of Jupiter between the years 1862 and 1881. There can be no doubt as to her qualifications for the work of superintending the time determination and meteorological observations, and she would be peculiarly fitted for the previous long connection with the observatory to look after the various astronomical telescopes, pending the final decision as to the future of the Madras Astronomical Observatory.

2nd—Miss Pogson was, after many years' service as Assistant to the Government Astronomer, deprived of the appointment; and although it was a pensionable appointment, she has not only received no compensation pension, but has been informed that she has lost all claims to pension. It is, I believe, generally felt that she has been somewhat hardly treated in this matter. The appointment, I suggest above, would in some respects be similar in character to that of which she was deprived. The Government may hence perhaps be disposed to take this fact into consideration as an additional reason why, if the appointment be created, it should be first offered to Miss Pogson.

19. When I was in Madras in January, I consulted with the Madras authorities as to views and wishes with respect to the observatory. I learnt that there would probably be objection to handing over the Madras Observatory (including the grant for its maintenance and buildings) to the Government of India, or to the control of the observatory being in future entirely

in the hands of the Government of India. The only point on which the Government of Madras expressed a strong opinion was with respect to the desirability of retaining Mr. Michie-Smith's services. They considered that he was, by his special scientific attainments and knowledge of the conditions of scientific work of India, peculiarly fitted for the appointment of Director of the Solar Physics Observatory, and that his services in carrying out the publication of the Madras Observations had been especially valuable, and deserved full recognition.

20. The cost of the Madras Observatory during the past two years has averaged about Rs. 18,000 per annum. The annual cost of the Solar Photographic branch at Dehra Dun is about Rs. 3,000; so that the present expenditure on the Madras and Dehra Dun observatories is about Rs. 21,000. Hence, a total yearly grant of about Rs. 21,000 is available for the new arrangements.

21. The following gives a rough estimate of the initial expenditure in starting the observatory at the Palnis:—

There would be required quarters for the Director, three domes (two of which would be sent from Dehra Dun), two office rooms (a small one for the Director and a large one for the observers, &c.), a photographic room and a small workshop, and also detached quarters for the observers and servants. Mr. Michie-Smith, whom I consulted, thought that the whole of the requisite buildings, if constructed in a somewhat temporary manner, would probably cost less than Rs. 20,000. So far as I can estimate, I think from Rs. 20,000 to Rs. 25,000 would be sufficient to provide buildings for the next five years, during which the question of the transfer of the Madras Astronomical Observatory would probably be in abeyance.

The apparatus in use at Dehra Dun would probably be ample for the requirements of the photographic work, whilst the telescope and the spectroscopic apparatus at present at the Poona College of Science, but which will be handed over to the Solar Physics Observatory as soon as it is required, will probably suffice, with some slight addition for the spectroscopic work. A list of the available apparatus is given in Appendix I, in order that the Solar Physics Committee may suggest whether it would suffice for present requirements or not.

A good astronomical clock, diffraction grating, heliostat, mean time chronometer and workshop tools including a lathe, would undoubtedly be required. The cost of the apparatus required would almost certainly be less than Rs. 7,500 and perhaps less than Rs. 6,000. The initial expenditure would hence probably be more than Rs. 25,000, but less than Rs. 32,500.

22. The following would be the staff that I should suggest for the combined reduced Madras Astronomical Observatory and the Solar Physics Observatory, including the arrangements:—

- 1st—For the Solar Physics Observatory.
- 2nd—For the Madras Observatory current work.
- 3rd—For the preparation of the unpublished Madras series of observations for publication.

I have already suggested that Mr. Michie-Smith should be appointed Director of the Solar Physics Observatory; his pay should not be less than Rs. 800 per mensem, his present pay, and it might perhaps be fixed at Rs. 800 rising to Rs. 1,200 by annual increments of Rs. 50 (as suggested in my first memorandum). Considering the character and importance of the work and the present value of the rupee, it would, I believe, hardly be possible to obtain from England a man of Mr. Michie-Smith's qualifications and experience for that salary.

There would be required for the observatory three observers, one for each branch of the work, and perhaps two menial assistants, a writer and the usual peons, &c.

Two clerks would probably suffice to assist Mr. Michie-Smith in the publication of the volumes of the Madras Observations. It would probably be found that this work could be done at Madras, and that two of the present staff could be selected for this work.

The Assistant Superintendent would require at least two clerks for the time-ball and meteorological work. If Miss Pogson were appointed, she would be provided with quarters in the observatory, and a small personal allowance of Rs. 100 would probably be sufficient to secure her services.

23. The following is an approximate statement of the annual cost of these arrangements:—

Director of Solar Physics Observatory and Superintendent, Madras Observatory, Rs. 800 to Rs. 1,200	Rs. 12,800
Assistant Superintendent, Madras Observatory, at Rs. 100 per mensem	1,200
Madras Observatory—	
For Time and Meteorological observations—	
1 Clerk on Rs. 60*	720
1 Do. on „ 40*	480
For preparation of volumes of Madras Observations for Press—	
1 Clerk on Rs. 100*	1,200
1 Do. on „ 80*	960

* These clerks are on the present establishment and paid at these rates.

	RS.
Solar Physics Observatory—	
First Observer, Rs. 200 to Rs. 300	3,300
Second Observer, Rs. 100 to Rs. 150	1,650
Third Observer, Rs. 50 to Rs. 75	825
Two menial assistants on Rs. 15 to Rs. 25	540
One writer, Rs. 30 to Rs. 50	540
Peons, &c.	500
Contingencies	1,000
Total	25,715

24. It would probably be advisable to have a European, for example, a Sergeant in the Royal Engineers, who has been trained at South Kensington as first or spectroscopic observer. If a competent native observer could be obtained, the pay of the first observer might be reduced. The photographic observer at Dehra Dun would probably be willing to go in that capacity to Kodaikānal. His present pay is Rs. 135 to Rs. 150.

25. If Miss Pogson were appointed Assistant Superintendent and her Meteorological office were located in the Observatory offices, there would be a saving of Rs. 50 per mensem for rent. The location of her office in the observatory building would probably give greater facilities for the preparation of Daily Weather Report for Madras, if it should be decided to commence it, than her present office.

26. It may also be noted that the continuation of the Solar Photographic Records during the transfer of the Photographic Observatory at present at Dehra Dun could be easily secured by removing one dome to Kodaikānal, and continuing the observations with the second instrument at Dehra Dun until the first instrument and its dome were placed in position at Kodaikānal.

APPENDIX I.

1. The following gives a brief description of the apparatus in use at Dehra Dun for photographing the sun, and which would be available for that work at Kodaikānal:—

I.—Smaller Photo-Heliograph—

Objective	4 inches diameter.
Length of telescope (including camera)	9 feet 3 inches.
Height of iron stand	6 feet 4 inches.
Size of solar picture	8 inches.
Masonry pillar, 5 feet 4 inches diameter. Height above plinth, 17 feet 7 inches. with a foundation of probably 5 feet. Estimated weight, 60 maunds. Cost of dome and observatory not known.	

II.—Larger Photo-Heliograph—

Objective	6½ inches diameter
Length of telescope (including camera)	15 feet 9 inches.
Height of iron stand	9 feet 6 inches.
Size of solar picture	12 inches.
Masonry pillar, 6 feet 1 inch diameter at plinth and 3 feet 9 inches at top. Height above plinth 12 feet 2 inches, probable foundation 5 feet. Weight, 100 maunds. Dome, cost Rs. 5,000 in addition to the cost of observatory, which was about Rs. 15,000.	

2. For the spectroscopic work there is available the telescope and adjuncts constructed, I believe, for the last transit of Venus observations in India, and at present lent to the Poona College of Science. The following gives a statement of the parts, &c.:—

- Telescope, 6 inches aperture, 7 feet focus.
- Cast iron pillar, universal adjustment in latitude and clock work.
- Finder, 1½ inches aperture.
- Six eye-pieces, ordinary Huyghenian, with dark glass caps.
- First surface reflection prism for viewing the sun and for use as star total reflection prism.
- Transit eye-piece.
- Large filar micrometer, with position circle.
- Iris Diaphragm for contracting the aperture of the lens.
- Prismatic illuminating arrangement.
- Level for determining the horizontality of the declination axis.
- Declination circle, 16 inches diameter, divided on silver. [This has been slightly damaged.]

Right ascension circle, 16 inches diameter, silver.
Clamping arrangements worked from eye-end.
Adjustable counterpoise for spectroscope.
Spectroscope by Hilger. Three prisms of 60°, 4 inches height, with arrangement to use dispersion of 2 to 18 prisms by reversion of the beam.
Collimator telescope, 1 inch aperture.
Large position circle and arrangement to observe the chromosphere and prominences both tangentially and radially, supplied with a long micrometer screw for taking rapid positions of lines, also for recording the same on smoked glass (not reliable); set of positive and negative eye-pieces and a filar micrometer eye-piece.

With a single reversal, i.e., employing "6 prisms" and a high power, all the lines in Vogel's large map of the solar spectrum can be recognized. The spectroscope is intended for all kinds of solar work; spectra of spots and faculae, chromospheric bright lines, and for observing and measuring prominences. It was constructed under the directions of the late Colonel Strange, and is the one with which Professor Lockyer made his observations of the widening of the lines in solar spots prior to 1885.

Probably all that is required to make this complete for the work desired is a diffraction grating, and a camera and a dome for its reception.

Telegram from the Revenue Secretary, Calcutta, to the Meteorological Reporter, India (Simla), dated the 15th March 1893, No. 925.

Your No. 149, dated 4th instant, Madras Observatory. Government of India presume that, if no new scheme is carried, Mr. Michie-Smith would still be kept on as Government Astronomer on pay not less than Rs. 800. Is not this so? Employment on this salary must be guaranteed to enable him resign Christian College.

Telegram from the Meteorological Reporter, India (Simla), to the Revenue Secretary, Calcutta, dated the 15th March 1893.

Printed copies of my No. 149 and of report on Kodaikānal and Kōttagiri sent off on Monday. I have no papers of conditions of appointment of Government Astronomer. Question before Government is, I understand, the permanent appointment of Mr. Michie-Smith, Government of India has sanctioned temporary appointment for indefinite period, that is, till settlement of present question. Secretary of State, I understand, either finally appoints or sanctions appointment and reference must be made to England. I doubt whether Observatories Committee would recommend or approve Michie-Smith's appointment as Astronomer, as I believe he has had no special training; he is editing Pogson's observations, but I doubt whether that would be considered as sufficient guarantee of his qualifications as an Astronomer. As reference must be made to England, it appears to me my suggestions are most satisfactory and economical that can be made unless it is determined to discontinue solar observations, and, if so, probably astronomical observatory might be temporarily reduced to half-time appointment as work in that direction less urgent than in direction of solar physics—vide despatch from England. In that case Michie-Smith might perhaps be willing to combine work of editing Pogson's observations and Time-Ball work with college duties; there is no necessity for great urgency in publication of Pogson's observations.

Telegram from the Revenue Secretary, Calcutta, to the Madras Secretary, Madras, dated the 21st March 1893, No. 981.

Your telegram No. 96, dated 22nd February, Michie-Smith. Eliot's scheme, Madras and Kodaikānal observatories, only just received, will be disposed of as soon as possible. If Solar Physics Observatory is sanctioned, Michie-Smith will be permanently appointed, probable salary not less than Rs. 800. If not sanctioned, India cannot guarantee he will be accepted as permanent Astronomer. India suggests asking Christian College to allow present arrangement to continue six months longer. If Michie-Smith is obliged to rejoin college in June, it might be arranged to grant him a limited allowance for continuing the editing of Pogson's observations and looking after Time-Ball until Secretary of State's orders are received.

Telegram from the Secretary to the Government of Madras, Revenue Department, to the Secretary to the Government of India, dated 7th April 1893, No. 173.

Your telegram 21st March. Michie-Smith has applied Christian College extension leave six months, and failing grant offered resign professorship, as he considers second proposal in your telegram impossible.

From E. D. MACLAGAN, Esq., Officiating Under Secretary to the Government of India, to the Meteorological Reporter to the Government of India, dated Simla, the 17th April 1893, No. 1157.

With reference to your letter No. 149-S., dated the 4th March 1893, I am directed to request that you will be good enough to furnish a proposition statement in the prescribed form showing the cost of establishing the proposed new Imperial Observatory at Madras.

Telegram from the Secretary to the Government of Madras, to the Secretary to the Government of India, dated 15th May 1893, No. 252.

Your telegram April thirteenth. This Government accepts Eliot's proposals *in toto*, but desires suggest that Michie-Smith's appointment as permanent Director, Solar Physics, on the pay, eight rising to twelve hundred rupees, proposed by Eliot should be sanctioned at once in order remove difficulty in regard to Smith's engagement with Christian College Council. Have granted him six months' extension of leave, counting from about middle last month, on condition that he informs them at least two months before expiration term, whether or not he intends return. Any further concession their part improbable.

From Her Majesty's Secretary of State for India, to His Excellency the Most Honorable the Governor-General of India in Council, dated India Office, London, the 31st August 1893, No. 117 (Revenue).

With reference to your Excellency's letter, No. 37 (Meteorology), dated the 20th August 1893, I forward copy of papers marginally noted, containing the opinions of the Indian Observatories Committee and the Solar Physics Committee on the proposal for establishing a small scale a new observatory at Kodaikānal in the Palni hills.

2. I sanction your proposals, which involve an initial outlay of Rs. 25,000 and a yearly increased charge of Rs. 1,689.

3. The attention of your Government is invited to the suggestions of those Scientific Committees regarding—

- (1) the continued photographic registration of sun spots;
- (2) Mr. Michie-Smith's consulting the Astronomer Royal regarding the form of the catalogue of old observations now being printed.

Enclosure No. 1.

From W. H. M. CHRISTIE, Esq., Astronomer Royal, Royal Observatory, Greenwich, to Her Majesty's Under Secretary of State for India, dated Royal Observatory, Greenwich, the 21st July 1893.

With reference to your letters (1) R. and S. 1012 of the 18th instant, forwarding the report on the working of the Madras Observatory during the year 1892-93, and (2) R. and S. 1003 of the 13th instant, forwarding papers concerning the establishment of a Solar Physics Observatory at Kodaikānal in the Palni hills, under the direction of Mr. Michie-Smith, for the consideration of the Indian Observatories Committee, I have the honour to transmit, for the information of the Secretary of State for India in Council, a copy of the Resolutions of the Indian Observatories Committee passed at their meeting on 20th July 1893.

Enclosure in above.

Resolutions of the Indian Observatories Committee passed at their Meeting on 20th July 1893.

1. The Committee approve of the proposal to establish a Solar Physics Observatory at Kodaikānal, in Southern India, with Mr. Michie-Smith as Superintendent; he also *sanctioned* the temporary charge of the Madras Observatory.

2. That the Committee approve of deferring for the present the decision as to the permanent site of the Astronomical Observatory.

3. As regards the report on the Madras Observatory, the Committee are glad to note that satisfactory progress is being made in the reduction and publication of the old observations. With reference to paragraph 7, the Committee consider that the precise form the catalogue should take would be best settled by Mr. Michie-Smith placing himself in communication with the Astronomer Royal.

Enclosure No. 2.

From Colonel J. F. D. DONNELLY, Secretary, Solar Physics Committee, to Her Majesty's Under Secretary of State for India, dated South Kensington, S.W., 2nd August 1893, No. 2.

Adverting to your letter of the 18th ultimo, I have the honour to inform you that the Solar Physics Committee which met this day entirely concurs in the proposals of the Government of India with reference to the establishment of a Solar Physics Observatory at Kodaikānal under the direction of Mr. Michie-Smith, as contained in the letter of the 20th June last, and would recommend that effect should be given to those proposals at once.

At the same time, the Committee again venture to point out the importance of maintaining the continuity of the photographic registration, on the 8-inch scale of sun spots, and they have ascertained that it is probable that a second photo-heliograph, if necessary, can be lent by the Astronomer Royal in order that one may be in full working order before the other is dismantled.

Telegram from the Secretary, Government of India, Revenue and Agricultural Department, to the Secretary, Government of Madras, dated 30th September 1893, No. 3448.

Your telegram 252, dated 15th May last. Secretary of State sanctions appointment of Michie-Smith on 800 per mensem as Director, Solar Physics, and Superintendent, Madras Observatory. Letter follows.

No. 1955-14.

Copy of the correspondence forwarded to the financial Department for information.

(By order)

(Signed) E. D. MACLAGAN,
Offg. Under Secy. to the Govt. of India.

From E. D. MACLAGAN, Esq., Under Secretary to the Government of India, Revenue and Agricultural Department, to the Meteorological Reporter to the Government of India, dated Simla, the 14th July 1893, No. 2371.

I am directed to forward to you confidentially a copy of a despatch addressed to the Secretary of State, No. 37 (Meteorology), dated the 20th June 1893, submitting proposals regarding the establishment of a new observatory in the highlands in the South of India and to ask you to be good enough to report (1) what expenditure approximately would be incurred if the scheme were sanctioned and started from 1st October, and if the expenditure were confined to what could be met from the budget grant of the year, and (2) what extra amount would, if the scheme were sanctioned this summer, have to be budgeted for for 1894-95.

From JOHN ELIOT, Esq., Meteorological Reporter to the Government of India, to the Secretary to the Government of India, Revenue and Agricultural Department, dated Simla, the 27th July 1893, No. 533-S.

I have the honour to acknowledge the receipt of your No. 2371-14, dated the 14th July 1893, and to submit the following reply on the two points respecting which you ask me to report.

2. I assume that the grant of Rs. 25,000 for the initial cost of buildings and apparatus will not be made during the present official year and hence that it will not be possible to commence the actual work of building the new observatory at Kodaikānal until April 1894. It would be very desirable to commence as early as possible next year and hence I would suggest that the plans and estimates for the buildings should be prepared and approved before the end of the present official year. If Mr. Michie-Smith is appointed permanently in August, he should be then requested to take up this work. He should visit Kodaikānal, and, in consultation with the Public Works Department, select the most suitable site for the observatory and afterwards draw up plans for the buildings with the assistance of the Public Works Department, who would prepare the estimates. It is possible that Mr. Michie-Smith might be able to arrange to have the work done by contractors under his own supervision (and occasional inspection by the Public Works Department), and, if so, that would perhaps be the best arrangement. If these suggestions be adopted, observational work would go on during the remainder of the year at the Madras Astronomical and Dehra Dūn Solar Observatories as at present, and the only extra charge would be a small sum of a few hundred rupees for Mr. Michie-Smith's travelling allowance to Kodaikānal, which, of course, I am not able to estimate with any exactness.

3. The extra amount that would have to be budgeted for in 1894-95 would depend largely upon when the buildings would be finished. It would be very desirable to commence observational work on the 1st January 1895, but it is very doubtful whether the buildings could be erected in nine months (i.e., from April to December 1894). While the buildings are in progress, work would continue at the Madras and Dehra Dūn Observatories exactly as at present. Mr. Michie-Smith would have to be chiefly in Kodaikānal while the buildings are in course of erection, in order to advise and direct, and perhaps superintend the building, so that the various arrangements for the domes, &c., might be carried out to his satisfaction. As it would hence be almost indispensable for the proper progress of the work that Mr. Michie-Smith should spend the greater part of his time next year at Kodaikānal, it would be necessary to appoint Miss Pogson as Assistant Superintendent, with effect from the 1st of April 1894, and that she should be informed early, in order that she might arrange for giving up her present office and locating it next April in the observatory buildings, in which there is ample room for it.

4. Assuming that the new buildings would be ready for the commencement of work on the 1st January 1895, it would be necessary to provide for the observatories at Madras and Dehra Dūn, according to the present scale for the first nine months of the year, and for observatories at Madras and Kodaikānal, according to the new scale for these months from 1st January. As it would probably be necessary for Mr. Michie-Smith to visit Dehra Dūn as well as Kodaikānal, it would also be desirable to arrange for a grant on account of his travelling allowance and also that of the Solar Photographic Assistant if he were transferred from Dehra Dūn to Kodaikānal.

5. It would hence be necessary to arrange in next year's budget for the amount of Rupees 25,000 for cost of buildings, &c., and for the following amounts on account of observatories charges:—

	Rs.
Nine months, present scale, April to December	16,785
Miss Pogson's allowance for April to December	900
Three months, new scale	8,000
Travelling allowances (special)	1,200
Total	24,885

or about Rs. 2,500 in addition to the sanctioned amount of Rs. 22,380 for present year.

6. I have the honour to ask whether the amounts for the Madras and Kodaikānal Observatories are to be included from next year in the budget of the Meteorological Department, and, if not, if they are to be budgeted separately for by the Director of the Solar Physics Observatory.

ORDER—dated 21st November 1893, No. 940, Public.

Communicated to Mr. Michie-Smith, who will arrange for the preparation of the budget and estimates and plans required by the Government of India.

2. The following letter will be despatched.

(True Extract.)

J. F. PRICE,
Chief Secretary.

To the Government Astronomer.

LETTER—to the Secretary to the Government of India, Revenue and Agricultural Department, dated Fort St. George, 21st November 1893, No. 941, Public.

In reply to the 4th paragraph of your letter of the 4th instant, No. 3930—14, I am directed to state that there is no objection on the part of this Government to the transfer of the control of the Madras Observatory and the funds connected with it to the Government of India with effect from 1st April 1894, or to placing the organisation and management of the new Solar Physics Observatory under the Meteorological Reporter to the Government of India.

J. F. PRICE,
Chief Secretary.

Edw. C. M. Brisson.

Govt. of {1893} Madras.
PUBLIC.

Issued

Recd.

Encl.

G.O., &c., 21st November 1893,
Nos. 940, 941.

NOVEMBER.

**Solar Physics Observatory on the
Kodaikanal Hills.**

Communicating to Mr. Michie-Smith letter from the Government of India forwarding, with remarks, correspondence regarding the establishment of a —, for the preparation of the budget and estimates and plans required by the Government of India, and directing that that Government be informed that there is no objection to the transfer of the control of the Madras Observatory and the funds connected with it to the Government of India from 1st April 1894 or to placing the organisation and management of the new — under the Meteorological Reporter to the Government of India.

Telegram despatched to the
Govt. Astronomer, Madras Observatory
Madras

596. Secretary State has
sanctioned your appointment
on 800 Rs monthly as Director
Solar Physics and Supl.
Madras observatory.

True Copy signed by the A. S.

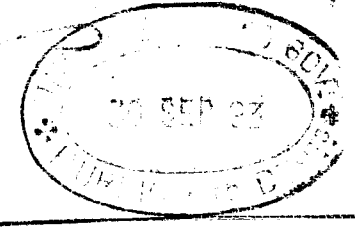
Coc. Clas. 3

INDIAN TELEGRAPHS. Monthly Number. 2/5

To (Office) Secy. to Government From (Office) Secy. to Govt

Wor. No. 3318 Day 30 Hour 14 Minute 32 Official Instructions. 10/10

To (Person) Mr. A. B. C. From (Person) Revenue



32 Word Form.
your telegram dated 15 was
last secretary state sanctioned
appointment of ~~Mr. A. B. C.~~ Mr.
Smith on Rs. 800 per month
as "Director Solar Physics and
Madras Observatory"
follows.

Read from LN. Sent to
At Recd. Ats. for At

O. S. P. Co. No 343 P-6-2-23-1000000
OOTACAM

Communicated into
revenue
instructions
on 10/10/22

Current No.

DEPARTMENT.

From

The Government of India
Revenue & Agri. Dept.

No.

Dated 30 — 9 — 93

Received — Do —
Red for registry 2nd October 1893.
Enclosures

SUBJECT.

Regarding the appointment of
Mr. Michie Smith as
Director, Solar Physics, and
Supt. Madras Observatory

Pul. 3908/15-6-90
286 27-4-93
241 24-3-93
240 24-3-93
150 22-2-93
3 24-1-93
H. M. K. P.

FROM

SIR E. C. BUCK, KT., C.S.I.,
Secretary to the Government of India,

TO

THE SECRETARY TO THE GOVERNMENT OF MADRAS.

Rev. & Agri. Dept.
Meteorology.

Simla, the 4th November 1893.

SIR,

IN continuation of my telegram of the 30th September, I am directed to forward, for information and guidance, a copy of the despatches marginally noted regarding the establishment of a Solar Physics Observatory on the Kodaikanal hills; together with a copy of some further correspondence with the Meteorological Reporter to the Government of India on the same subject.

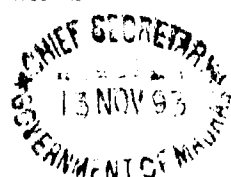
2. It will be observed from the Meteorological Reporter's letter of the 27th July that if the new buildings are commenced soon after April next and are ready for use by the 1st January 1895, the additional expenditure involved during the financial year 1894-95, will be approximately Rs. 27,500. The Government of India are ready to accept this as an Imperial charge, but will not be able to tell before February next whether the requisite funds will be forthcoming or not.

3. Meantime there will be no objection to the immediate preparation of plans and estimates, provided that the cost of these and of any small additional expenditure caused by Mr. Michie Smith's movements to and from the proposed site can be met from funds at the disposal of the Madras Government for the current year.

4. A provisional budget should also be prepared without delay for submission to the Government of India, with a view to obtaining provision for the anticipated expenditure of next year in case this can be met. I am in this connection to enquire whether His Excellency the Governor in Council would have any objection to the transfer of the control over the Madras Observatory and of

2

the funds connected with it to the Imperial Government from 1st April 1894, and to placing the organization and management of the new Solar Physics Observatory under the Meteorological Reporter to the Government of India. In anticipation of the expression of His Excellency's wishes on this point and in order to save time, the Meteorological Reporter to the Government of India has been asked to submit at once a supplementary Budget including the estimated expenditure on the Madras Observatory and on the new Observatory at Kodaikanal, and I am to request that Mr. Michie Smith may be instructed to supply him with such information as he may require for the due preparation of this budget.



I have the honour to be,

SIR,

Your most obedient Servant,

Malagan

Secretary to the Government of India.

19 gh

NO. 37 OF 1893.

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

METEOROLOGY.

To

THE RIGHT HONOURABLE

THE EARL OF KIMBERLEY, K.G.,

Her Majesty's Secretary of State for India.

Simla, the 20th June 1893.

MY LORD,

WITH reference to Your Lordship's despatch No. 111 (Revenue), dated 10th November 1892, we have now the honour to submit definite proposals concerning the establishment of a new observatory on the high country in the south of India, and we enclose a letter No. 147-S., dated 1st March 1893, from our Meteorological Reporter on the subject of the respective merits of the three sites at which observations have been taken.

2. We agree with Mr. Eliot that, for the reasons stated in his letter, Kodaikanal in the Palni hills affords the most suitable site for the proposed Solar Physics Observatory.

3. In a further letter of the 4th March 1893, No. 149-S., which is also appended, Mr. Eliot has recommended that the consideration of the question of the permanent site of the Astronomical Observatory be deferred for some five years; that a Solar Physics Observatory be established at Kodaikanal without delay; that Mr. Michie-Smith, now officiating as Government Astronomer, be placed in charge of the Solar Physics work with a staff of observers, assistants, &c.; and that Miss Pogson, the present Meteorological Reporter for Madras, be appointed Assistant Superintendent at the Madras Observatory to carry on the current astronomical work under the supervision of Mr. Michie-Smith. These proposals meet with the approval both of ourselves and of the Madras Government, and are now submitted for Your Lordship's sanction. They involve, as Mr. Eliot shows, the abandonment for the present of the original scheme which contemplated a complete observatory with two branches, but in view of the existing financial position we are constrained to adopt the suggestion of the Solar Physics Committee communicated in Your Lordship's Despatch No. 111, dated 10th November 1892, that partial effect should be given to the scheme by the establishment of a Solar Physics observatory only.

No. 3576, dated Calcutta, the 21st December 1892.

File No. 1 of
1892.

From—E. D. MACLAGAN, Esq., Officiating Under-Secretary to the Government of
India, Revenue and Agricultural Department,

Serial No. 16.

To—The Meteorological Reporter to the Government of India.

I am directed to forward copy of a despatch from Her Majesty's Secretary of State, No. 111, dated 10th November 1892, and of its enclosures, and to request that, during your visit to Madras, you will be good enough to discuss with the Madras Government the questions therein referred to, and submit your recommendation regarding them to the Government of India with your proposed report on the best site for the new Imperial Observatory. It will be advisable that among other matters you should state—

- (1) Whether you can recommend the establishment of a Solar Physics Observatory or continuance of the Astronomical Observatory alone;
- (2) Whether in the former case you would recommend that Mr. Michie Smith should have superintendence of the Solar Physics observations;
- (3) What part of the work hitherto conducted at the Madras Astronomical Observatory should be continued if only a Solar Physics Observatory be maintained in its entirety,

and that you should submit a rough estimate of the cost of your proposals.

3. I am to request that a copy of your report may be furnished at the same time to the Madras Government.

No. 3577, dated 21st December 1892.

Copy forwarded to the Government of Madras for information.

No. 3578, dated Calcutta, the 21st December 1892.

Serial No. 17.

From—E. D. MACLAGAN, Esq., Officiating Under-Secretary to the Government of
India, Revenue and Agricultural Department,

To—The Chief Secretary to the Government of Madras.

With reference to the correspondence ending with your letter No. 649, dated the 16th September last, I am directed to forward copy of a despatch from Her Majesty's Secretary of State, No. 111, dated 10th November 1892, and of its enclosures, and to request that, during the visit to Madras of the Meteorological Reporter to the Government of India, he may be fully consulted on the different points referred to therein. Mr. Eliot has been instructed to report on the correspondence and to submit a copy of his report to the Government of Madras. I am desired to ask that the Government of India may be favoured with the views of His Excellency the Governor in Council on any recommendations that may be made by Mr. Eliot.

2. I am to add that Mr. Michie Smith's services as Officiating Astronomer, Madras, may be retained till such time permanent arrangements are made for the new observatory.

No. 3579.

Copy forwarded to the Meteorological Reporter to the Government of India for information.

Telegram No. 96, dated the 22nd February 1893.

From—Madras,

To—Calcutta,

From—Chief Secretary,

To—Revenue Secretary.

File No. 14 of
1893.

Serial No. 1.

Your No. 3578, 21st December. Michie Smith represents he must return Christian College end June, or give reasonable notice of resignation from them. This Government urges steps may be taken to confirm him in present position, and also give him definite assurance that, whatever finally arranged, he will not be without emoluments at least equal to those of present Astronomership, namely, Rs. 800 per mensem. Importance of early decision was impressed on Mr. Eliot. Please wire early orders.

Telegram, dated the 3rd March 1893.

From—Calcutta,

To—Simla,

From—Revenue Secretary.

To—Meteorological Reporter.

Serial No. 2.

Madras Government wires that immediate orders are required regarding Michie Smith's future position, as he must give notice to Christian College. Please send your report on Madras Observatory at once, or at any rate sufficient to enable us to address Secretary of State immediately regarding permanent retention of Michie Smith, whose further employment does not involve consideration of all issues in which you may desire to write. Madras Government requires an assurance that he will receive not less than Rs. 800 a month, and you may recommend this.

Telegram, dated the 4th March 1893.

From—Simla,

To—Calcutta,

From—Meteorological Reporter.

To—Revenue Secretary.

Serial No. 3.

Report on relative merits of Kodaikanal and Kotagiri as sites for Solar Physics Observatory is being printed at Government Press here; also letter in reply to your No. 3576, dated 21st December, containing my proposals, has also been sent to Press, as I thought it would be best to send printed reply. Have asked Press to print them as quickly as possible. Meanwhile I send copy of letter by to-day's post in order you may take any immediate steps you consider best under circumstances.

No. 149-S.

FROM

THE METEOROLOGICAL REPORTER
TO THE GOVERNMENT OF INDIA,

TO

THE SECRETARY TO THE GOVERNMENT
OF INDIA, REVENUE AND AGRICULTURAL
DEPARTMENT.

Dated Simla, the 4th March 1893.

SIR,

I have the honor to acknowledge receipt of your letter No. ³⁵⁷⁶1, dated 27th December 1892, forwarding a copy of a despatch from the Secretary of State, and requesting that after I have discussed the questions raised in that despatch with the Madras Government, I shall submit recommendations regarding them, with the report on the best site for the new Imperial Observatory, in which more especially I should state—

- (1) Whether I can recommend the establishment of a Solar Physics Observatory or the continuance of the Astronomical Observatory alone.
- (2) Whether in the former case I would recommend that Mr. Michie Smith should have superintendence of the Solar Physics observations.
- (3) What part of the work hitherto conducted at the Madras Astronomical Observatory should be continued there, if only a Solar Physics Observatory be maintained in its entirety.

2. The original proposal made in my review on the subject was to establish a combined Astronomical and Solar Physics Observatory on the best site in the hills of Southern India. The carrying out of this scheme in a complete and satisfactory manner would necessarily involve a large expenditure; and the Secretary of State hence suggests that if funds are not available for establishing a new complete observatory with two branches, the furtherance of Solar Physics would be the greater benefit to science, while astronomical requirements could for the time be met by the Madras Observatory.

3. As it is very probable the Government of India may not be disposed to sanction large expenditure on a scheme chiefly for scientific objects at the

present time, I submit full proposals for the establishment of a Solar Physics Observatory and the continuance of the Madras Astronomical Observatory on a tentative footing.

4. If the Government of India are in a position to provide funds for the larger scheme, sketched in my memorandum, and which is apparently approved in its general outlines by the Solar Physics and Observatories Committees in England, full details can be easily prepared and submitted.

5. The following gives a brief statement of the work at present carried out in the Madras Observatory :—

Mr. Pogson during the period he was Government Astronomer (from 1861 to 1891, amassed an enormous number of observations, many of which were of great value. Little or nothing was done in the way of publishing the results of the observations until the last two or three years of his life. Before his death he gave full instructions and information respecting the unpublished observations to Mr. Michie Smith, and also recommended to the Madras Government the appointment of that gentleman as his successor, with a view to the continuation of the publication of the accumulated observations in the form he wished. Mr. Michie Smith was hence appointed temporarily, pending the settlement of the future of the Madras Observatory, and was specially instructed to devote himself to the publication of Mr. Pogson's series of observations. Hence, at the present time, the only systematic observational work carried on at the Madras Observatory is—

1st—Transit observations for the determination of time, and

2nd—Meteorological observations.

It may be noted that no magnetical observations have been taken for many years.

Satisfactory progress has been made during the past eighteen months in the work of publishing the series of observations.

Mr. Michie Smith has issued several volumes including the following :—

(1) Meteorological and Magnetical observations made at the Madras Observatory between the years 1861 and 1881.

(2) Telegraphic determination of the difference of longitude between Madras and eight other stations.

The following volumes containing results of observations made by Mr. Pogson are in course of preparation, and will, I am informed, be completed in a few months :—

A. Astronomical—

1. Separate results of 5,761 observations made with the new Meridian circle in 1862, 1863 and 1864; with the deduced catalogues for each year.

2. Separate Results of 7,651 observations made with the Meridian circle in 1865, 1866 and 1867; with the deduced catalogues for each year.

3. Separate Results of 5,867 observations made with the Meridian circle in 1868, 1869 and 1870; with the deduced catalogues for each year.

4. Separate Results of 5,603 observations made with the Meridian circle in 1871, 1872, and 1873; with the deduced catalogues for each year.

5. Separate Results of 4,639 observations made with the Meridian circle in 1874, 1875 and 1876; with the deduced catalogues for each year.

6. Separate Results of 9,637 observations made with the Meridian circle in 1877, 1878 and 1879; with the deduced catalogues for each year.

7. Separate Results of 9,267 observations made with the Meridian circle in 1880, 1881 and 1882; with the deduced catalogues for each year.

8. Separate Results of 4,052 observations made with the Meridian circle 1883 to 1887.

9. Catalogue of over 5,000 stars for the Epoch 1875, from observations made with the Meridian circle, between the years 1862 and 1887; under the superintendence of N. R. Pogson, C.I.E.

B. Magnetical—

10. Hourly Magnetical Observations made at the Madras Observatory between the years 1856 and 1860; under the superintendence of Majors W. S. Jacob, Bombay Engineers; W. K. Worster, Madras Artillery, and J. F. Tennant, Bengal Engineers.

C. Meteorological—

11. Hourly Meteorological Observations made at the Madras Observatory between the years 1856 and 1860; under the superintendence of Majors W. S. Jacob, Bombay Engineers; W. K. Worster, Madras Artillery, and J. F. Tennant, Bengal Engineers.

It will require about a year to finish these volumes, and thus complete the publication of the series of Mr. Pogson's observations with the Meridian circle.

6. In addition to these, there are the following series of observations taken by Mr. Pogson and lying at the Madras Observatory, some of which, if not the whole, should almost certainly be taken in hand and prepared for publication.

D. (a) Observations of minor planets, comets and new variable stars and nebulae, furnishing 989 positions of 73 minor planets at 260 oppositions, 75 of 10 comets, those of such variable stars as are not observable with the Meridian circle, and of two new Nebulae in Ara and Phoenix, discovered by Miss E. Isis Pogson in 1876 and 1881.

(b) Observations of the transit of Mercury, November 12, 1861; transit of Venus, December 8, 1874; six eclipses of the Sun; seven eclipses of the Moon; five occultations of planets; and numerous

star occultations between 1862 and 1880. Phenomena of Jupiter's Satellites on 193 occasions between 1862 and 1880. Measures of Alpha Centauri, Gamma Virginis and a few other double stars. Spectroscopic measures of Gamma Argus.

- (c) Determination of the constant of Solar Parallax, by means of 212 differential measurements of the planet Mars, in Right Ascension, from adjacent comparison stars, made with the Equatorials, on 104 evenings near the rising and 108 mornings near the setting of the planet, at its eight oppositions, in the years 1862, 1864, 1869, 1871, 1873, 1875, 1877 and 1879.

In addition to these observations of Mr. Pogson's, there are the following series of observations taken under previous Directors of the Madras Astronomical Observatory :—

- E. (a) A quarto volume of about 300 pages ; containing observations made under the successive superintendence of T. G. Taylor, Esq., Captain W. S. Jacob, Bombay Engineers, and Major W. K. Worster, Madras Artillery, all prior to 1860. These observations comprise 1,331 of the Sun, 345 of the Moon, 1,680 of the principal planets, 333 of minor planets and 25 of Donati's comet of 1858. Also a long list of occultations of planets and stars, and of the eclipses of Jupiter's Satellites.
- (b) Separate results of observations made with the Transit Instrument and the Mural Circle in 1853, 1854, 1855 and 1856 ; with the deduced catalogues for each year.
- (c) Separate results of observations made with the Transit Instrument and the Mural Circle in 1857, 1858 and 1859, with the deduced catalogues for each year.
- (d) Catalogue of about 2,200 stars, for the Epoch 1855 ; from observations made with the Transit Instrument and Mural Circle between the years 1853 and 1858, under the superintendence of Captain W. S. Jacob, Bombay Engineers, and Major W. K. Worster, Madras Artillery.

7. It is doubtful how far it would be desirable to publish the last results in group E above ; and before doing so the whole question of the errors of these old observations would have to be taken up fully, and this would probably require much time, and might result in the conclusion that the observations were not worth the labour that their preparation for publication might entail.

It would, I have the honor to suggest, be advisable that this matter should be referred to the Observatories Committee, in order that they might record their opinion as to which of the series of observations in groups D and E it would probably be advisable in the interests of astronomical science to publish.

8. It would appear to be very desirable that the publication of the Madras series of observations should be continued until the whole of these that are of value are placed in the hands of the scientific public before observational work on a large scale is resumed ; and hence, further, that some arrangement be made by which Mr. Michie Smith's services might be retained in order that he may complete this work which he has commenced so vigorously and successfully.

Mr. Michie Smith's permanent appointment is Professor in the Christian College, Madras ; and the arrangement by which he acts as Government Astronomer on leave without pay from that College ceases on the 30th June.

It will hence be necessary for Mr. Michie Smith to determine some time before that date (probably not later than the beginning of April) whether he will resign or return to his appointment in the College ; and this will depend upon whether the Government of India is prepared before that time to offer him a permanent appointment in the Madras or Southern India Imperial Observatory.

9. With respect to the question of the desirability of establishing a Solar Physics Observatory in India, the Famine Commission urged strongly the continuance and extension of the work of solar observation in India. Thus, it is stated in paragraph 7 of the Famine Commission's Report that "on the whole, it is not possible for us, in the present state of knowledge, to say more than that the subject of the periodicity of fluctuations in the rainfall, as determined by the sun spot variation, is one deserving of careful investigation, and that it does not seem contrary to reasonable expectation that some relation should be established between the variations of the rainfall from year to year and those of the conditions of the sun's surface, on the heat derived from which, unquestionably, all terrestrial meteorological phenomena closely depend. For various reasons India is a country in which the investigation of this matter may be carried out with especial facility, and for this reason (though other grounds are not wanting) we would urge that as the expense of such researches would be small, the measures which have recently been taken by the Government of India to carry them out should be continued, and even extended in the future."

This recommendation was, I believe, fully approved not only by the Government of India but by the Secretary of State ; and it is in consequence of this recommendation that the work of solar observations has been continued in India, and that these observations are directed by the Solar Physics Committee in England. Nothing has occurred during the period since the close of the Famine Commission to weaken the force of their recommendation ; and it is extremely desirable not only from scientific considerations, but also from the practical and economic standpoints of the Famine Commissioners that these observations should be not only continued, but should be carried out in a more complete and systematic manner than hitherto.

10. Three classes of observations are necessary—

- 1st, Photographic.
- 2nd, Spectroscopic.
- 3rd, Actinometric.

Photographic records are at present made at the Surveyor General's Office at Dehra Dun, but as that office will shortly be removed to Calcutta, it is necessary to find a new location for this work.

Spectroscopic observations have not yet been started, although the Secretary of State has requested they should be initiated. The delay is due to the difficulty in making arrangements for the proper performance of the work under present conditions.

Actinometric observations have been made at Leh and Mussoorie, and are at present taken at Simla. They have not been very satisfactory, partly in conse-

quence of the very varying amount of dust haze in the atmosphere in Northern India during fine clear weather, and partly in consequence of imperfection in the instruments used for these observations.

11. The establishment of a Solar Physics Observatory at the most suitable hill station in Southern India, under a qualified Director, would enable the photographic and spectroscopic work to be carried out under probably the best and most suitable conditions obtainable in India. Actinometric observations should also be made under the same conditions.

12. It is probable that a much larger number of fairly satisfactory actinometric observations can be made on days fairly comparable with each other, so far as the atmospheric conditions affecting the absorption of the heat rays of sun are concerned at a hill station in Southern India (e.g., Kodaikanal) than at Simla. It is, however, doubtful whether the finest days at Kodaikanal for actinometric observations would be equal to those at Simla on clear days immediately after heavy snow or rain, when the atmosphere is remarkably transparent and clear and light northerly breezes oppose the transfer of dust from the plains to the hills. It would hence, on the one hand, be desirable to include actinometric observations in the range of work at the Solar Physics Observatory, and on the other, to continue them at Simla, confining them at the latter place to the exceptionally fine days in the year described above, when such series of observations extending over the whole day should be made.

13. Hence the early establishment of a Solar Physics Observatory appears to be an urgent necessity—firstly, on account of the importance of the work, and secondly, on account of the imperfect and temporary nature of the present arrangements for the performance of the work. And, as has been established by the comparative observations taken during the past twelve months at the hill stations of Southern India (of which a full report accompanies this letter), the most suitable site for the Solar Physics Observatory would be on the Palni Hills near Kodaikanal. This conclusion it may be noted, though based on the results of the meteorological observations, is confirmed by the results of astronomical test observations taken by Mr. Michie Smith at Kodaikanal and Kotagiri (*vide* his report on this subject).

14. I have hence the honor to suggest that the consideration of the question of the permanent site of the Astronomical Observatory, its future work, equipment and establishment should be postponed for some time, say five years; and that a Solar Physics Observatory should be established on the Palni Hills in such a manner as to secure—

1st—Photographic, spectroscopic and actinometric solar observations according to general methods, to be prescribed by the Solar Physics Committee, and hence probably in accordance with the methods in use at similar observatories in England, the United States and the Continent of Europe.

2nd—The completion of the publication of the Madras series of observations taken during the past 30 years, so far as they are likely to be of value for scientific purposes.

3rd—The continuation of the time determination and meteorological observations at Madras as during the past two years.

Five years' solar and other observations at Kodaikanal would afford ample data to settle finally, when the matter arose for discussion, whether that

station or Madras would be best adapted for the future astronomical work of a fully equipped astronomical observatory in Southern India.

16. The preceding objects would be most satisfactorily and easily obtained by the following arrangements:—

1st—The early establishment of a Solar Physics Observatory on the Palni Hills near Kodaikanal, and the appointment of Mr. Michie Smith as the Director and also as Superintendent of the Madras Astronomical Observatory until the appointment of an Astronomer.

2nd—The appointment of an Assistant Superintendent at the Madras Observatory, who would live in the Observatory and be in charge of the instruments, and superintend the performance of the ordinary transit and time-ball work and meteorological observations, subject to the orders of Mr. Michie Smith.

17. The early appointment of Mr. Michie Smith would secure several minor collateral advantages in addition to that of continuity in the publication of the Madras Astronomical Observations. His services might be utilized to assist in the preparation of plans for the new buildings, to select the most suitable site for the observatory on the Palnis, and to choose and train the native observers so far as is possible before the commencement of the work. His knowledge of the topography of the Palni Hills would make his assistance in the selection of the site for the observatory invaluable.

18. As he would have probably to be frequently at Kodaikanal, if he were employed in choosing the site and superintending the erection of the building, it would be desirable that the Assistant Superintendent should be shortly appointed. It would necessarily be a temporary and a local appointment. I would suggest Miss Pogson for the appointment for the following reasons:—

1st—She was Assistant for many years to her father at the Madras Observatory and helped in the work of observation and reduction of the observations to an extent that would more than qualify her for the comparatively simple work of superintending time determination and time-ball work at Madras. Her father frequently reported very favourably on her work. It is also noted specially in these reports that she discovered two Nebulae and reduced observations of 193 phenomena of the Satellites of Jupiter between the years 1862 and 1881. There can hence be no doubt as to her qualifications for the work of superintending the time determination and meteorological observations, and she would be peculiarly fitted by her previous long connection with the observatory to look after the various astronomical telescopes, pending the final decision as to the future of the Madras Astronomical Observatory.

2nd—Miss Pogson was, after many years' service as Assistant to the Government Astronomer, deprived of the appointment; and although it was a pensionable appointment, she has not only received no compensation pension, but has been informed, that she has lost all

claims to pension. It is, I believe, generally felt that she has been somewhat hardly treated in this matter. The appointment, I suggest above, would in some respects be similar in character to that of which she was deprived. The Government may hence perhaps be disposed to take this fact into consideration as an additional reason why, if the appointment be created, it might be first offered to Miss Pogson.

19. When I was in Madras in January, I consulted with the Madras authorities as to their views and wishes with respect to the observatory. I learnt that there would probably be no objection to handing over the Madras Observatory (including the grant for its maintenance and buildings) to the Government of India, or to the control of the observatory being in future entirely in the hands of the Government of India. The only point on which the Government of Madras expressed a strong opinion was with respect to the desirability of retaining Mr. Michie Smith's services. They considered that he was, by his special scientific attainments and knowledge of the conditions of scientific work of India, peculiarly fitted for the appointment of Director of the Solar Physics Observatory, and that his services in carrying out the publication of the Madras Observations had been especially valuable, and deserved full recognition.

20. The cost of the Madras Observatory during the past two years has averaged about Rs. 18,000 per annum. The annual cost of the Solar Photographic branch at Dehra Dun is about Rs. 3,000; so that the present expenditure on the Madras and Dehra Dun Observatories is about Rs. 21,000. Hence, a total yearly grant of about Rs. 21,000 is available for the new arrangements.

21. The following gives a rough estimate of the initial expenditure in starting the observatory at the Palnis:—

There would be required quarters for the Director, three domes (two of which would be sent from Dehra Dun), two office rooms (a small one for the Director and a large one for the observers, &c.), a photographic room and a small workshop, and also detached quarters for the observers and servants. Mr. Michie Smith, whom I consulted, thought that the whole of the requisite buildings, if constructed in a somewhat temporary manner, would probably cost less than Rs. 20,000. So far as I can estimate, I think from Rs. 20,000 to Rs. 25,000 would be sufficient to provide buildings for the next five years, during which the question of the transfer of the Madras Astronomical Observatory would probably be in abeyance.

The apparatus in use at Dehra Dun would probably be ample for the requirements of the photographic work, while the telescope and the spectroscopic apparatus at present at the Poona College of Science, but which will be handed over to the Solar Physics Observatory as soon as it is required, will probably suffice, with some slight addition for the spectroscopic work. A list of the available apparatus is given in Appendix I, in order that the Solar Physics Committee may suggest whether it would suffice for present requirements or not.

A good astronomical clock, diffraction grating, heliostat, mean time chronometer and workshop tools including a lathe, would undoubtedly be required. The cost of the apparatus required would almost certainly be less than

Rs. 7,500 and perhaps less than Rs. 6,000. The initial expenditure would hence probably be more than Rs. 25,000, but less than Rs. 32,500.

22. The following would be the staff that I should suggest for the combined reduced Madras Astronomical Observatory and the Solar Physics Observatory, including the arrangements:—

1st—For the Solar Physics Observatory.

2nd—For the Madras Observatory current work.

3rd—For the preparation of the unpublished Madras series of observations for publication.

I have already suggested that Mr. Michie Smith should be appointed Director of the Solar Physics Observatory; his pay should not be less than Rs. 800 per mensem, his present pay, and it might perhaps be fixed at Rs. 800 rising to Rs. 1,200 by annual increments of Rs. 50 (as suggested in my first memorandum). Considering the character and importance of the work and the present value of the rupee, it would, I believe, hardly be possible to obtain from England a man of Mr. Michie Smith's qualifications and experience for that salary.

There would be required for the observatory three observers, one for each branch of the work, and perhaps two menial assistants, a writer and the usual peons, &c.

Two clerks would probably suffice to assist Mr. Michie Smith in the publication of the volumes of the Madras Observations. It would probably be found that this work could be done at Madras, and that two of the present staff could be selected for this work.

The Assistant Superintendent would require at least two clerks for the time-ball and meteorological work. If Miss Pogson were appointed, she would be provided with quarters in the Observatory, and a small personal allowance of Rs. 100 would probably be sufficient to secure her services.

23. The following is an approximate statement of the annual cost of these arrangements:—

	Rs.
Director of Solar Physics Observatory and Superintendent, Madras Observatory, Rs. 800 to Rs. 1,200	12,800
Assistant Superintendent, Madras Observatory, at Rs. 100 per mensem	1,200
Madras Observatory—	
For Time and Meteorological observations—	
1 Clerk on Rs. 60*	720
1 Do. „ 40*	480
For preparation of volumes of Madras Observations for Press—	
1 Clerk on Rs. 100*	1,200
1 Do. „ 80*	960

* These clerks are on the present establishment and paid at these rates.

Solar Physics Observatory—

First observer, Rs. 200 to Rs. 300	...	...	3,300
Second observer, Rs. 100 to Rs. 150	...	...	1,650
Third observer, Rs. 50 to Rs. 75	...	...	825
Two menial assistants on Rs. 15 to Rs. 25	...	...	540
One Writer, Rs. 30 to Rs. 50	...	...	540
Peons, &c.	...	...	500
Contingencies	...	...	1,000
TOTAL	...	...	25,715

24. It would probably be advisable to have a European, for example a Sergeant in the Royal Engineers, who has been trained at South Kensington as first or spectroscopic observer. If a competent native observer could be obtained, the pay of the first observer might be reduced. The photographic observer at Dehra Dun would probably be willing to go in that capacity to Kodaikanal. His present pay is Rs. 135 to Rs. 150.

25. If Miss Pogson were appointed Assistant Superintendent and her Meteorological Office were located in the observatory offices, there would be a saving of Rs. 50 per mensem for rent. The location of her office in the observatory building would probably give greater facilities for the preparation of Daily Weather Report for Madras, if it should be decided to commence it, than her present office.

26. It may also be noted that the continuation of the Solar Photographic Records during the transfer of the photographic observatory at present at Dehra Dun could be easily secured by removing one dome to Kodaikanal, and continuing the observations with the second instrument at Dehra Dun until the first instrument and its dome were placed in position at Kodaikanal.

I have the honor to be,

SIR,

Your most obedient Servant,

JOHN ELIOT,

Meteorological Reporter to the Government of India.

APPENDIX I.

1. The following gives a brief description of the apparatus in use at Dehra Dun for photographing the sun, and which would be available for that work at Kodaikanal:—

I.—Smaller Photo-Heliograph—

Objective	...	...	4 inches diameter.
Length of Telescope (including Camera)	...	...	9 feet 3 inches.
Height of iron stand	...	...	6 feet 4 inches.
Size of solar picture	...	...	8 inches.
Masonry Pillar, 5 feet 4 inches diameter.	Height above plinth, 17 feet 7 inches,		
with a foundation of probably 5 feet.	Estimated weight, 60 maunds. Cost of dome and observatory not known.		

II.—Larger Photo-Heliograph—

Objective	...	...	6½ inches diameter.
Length of Telescope (including Camera)	...	...	15 feet 9 inches.
Height of iron stand	...	...	9 feet 6 inches.
Size of solar picture	...	...	12 inches.
Masonry Pillar, 6 feet 1 inch diameter at plinth and 3 feet 9 inches at top.	Height above plinth 12 feet 2 inches, probable foundation 5 feet. Weight, 100 maunds. Dome, cost Rs. 5,000 in addition to the cost of observatory, which was about Rs. 15,000.		

2. For the spectroscopic work there is available the telescope and adjuncts constructed, I believe, for the last transit of Venus observations in India, and at present lent to the Poona College of Science. The following gives a statement of the parts, &c. :—

Telescope, 6 inches aperture, 7 feet focus.

Cast iron pillar, universal adjustment in latitude and clock work.

Finder, 1½ inches aperture.

Six eye-pieces, ordinary Huyghenian, with dark glass caps.

First surface reflection prism for viewing the sun and for use as star total reflection prism.

Transit eye-piece.

Large filar micrometer, with position circle.

Iris Diaphragm for contracting the aperture of the lens.

Prismatic illuminating arrangement.

Level for determining the horizontality of the declination axis.

Declination circle, 16 inches diameter, divided on silver. [This has been slightly damaged.]

Right ascension circle, 16 inches diameter, silver.

Clamping arrangements worked from eye-end.

Adjustable counterpoise for spectroscope.

Spectroscope by Hilger. Three prisms of 60°, 4 inches height, with arrangement to use dispersion of 2 to 18 prisms by reversion of the beam.

Collimator telescope, 1 inch aperture.

Large position circle and arrangement to observe the chromosphere and prominences both tangentially and radially, supplied with a long micrometer screw for taking rapid

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positions of lines, also for recording the same on smoked glass (not reliable) ; set of positive and negative eye-pieces and a filar micrometer eye-piece.

With a single reversal, *i.e.*, employing "6 prisms" and a high power, all the lines in *Vogel's large map* of the solar spectrum can be recognized. The spectroscope is intended for all kinds of solar work ; spectra of spots and faculae, chromospheric bright lines, and for observing and measuring prominences. It was constructed under the directions of the late Colonel Strange, and is the one with which Professor Lockyer made his observations of the widening of the lines in solar spots prior to 1885.

Probably all that is required to make this complete for the work desired is a diffraction grating, and a camera and a dome for its reception.

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No. 147-S.

FROM

THE METEOROLOGICAL REPORTER
TO THE GOVERNMENT OF INDIA,

TO

THE SECRETARY TO THE GOVERNMENT OF INDIA, REVENUE AND AGRICULTURAL DEPARTMENT.

Simla, the 1st March 1893.

SIR,

I HAVE the honor to submit the following report on the comparative observations taken at Madras, Kodaikanal, and Kotagiri during the past year with the view of determining the most suitable locality for the Solar Physics Observatory which it is proposed to establish.

A summary of the observations is given in an appendix to the report. They are also plotted out for ready examination in Plates I and II accompanying the report.

The following gives a verbal summary of the observations :—

(1) *Brief description of the hill stations.*—Kodaikanal is the hill station on the Palni hills, a nearly isolated group of mountains in the Madura district.

The Palnis are divided into two groups—an eastern and a western portion, of which the latter is considerably more elevated than the former, averaging about 7,000 feet. Kodaikanal is in the western portion at an elevation of about 7,200 feet. The ascent to it (from the south) is steep. The summit may almost be described as a rolling plateau. There is in the neighbourhood of Kodaikanal very little forest, and the hill country to the north, east, and west resembles the downs in the south of England. To the south lies the upper valley of the Vaigai, at present slightly cultivated, but which will, when the Periyar scheme has been accomplished, be speedily brought into a state of high cultivation by the system of irrigation which will then be opened.

Kotagiri is a small hill station in the Nilgiris. These hills form a mountain plateau which is united by a narrow and precipitous range of granitic peaks at the western extremity to the West Ghâts. Kotagiri is situated at the north-east end of the plateau, at an average height of about 6,500 feet above the sea. The plateau consists chiefly of grassy undulating hills, divided by narrow valleys. A large portion of the land near Kotagiri is taken up with tea and coffee plantations. The ground is much more broken up and uneven than at Kodaikanal.

It would hence be much easier to find an almost perfect location for a Solar Physics Observatory at Kodaikanal than at Kotagiri. Mr. Michie Smith in his report (paragraph 5) discusses this point, and he is fully qualified to speak on it from his acquaintance with the topography of both districts. He says the formation of the hills at Kotagiri is much less favourable for observational work than the formation about Kodaikanal. Kotagiri lies in a basin, surrounded by hills rising to a moderate height on all sides. At Kodaikanal, on the other hand, there is a large plateau rising in the centre, and this situation seems to be exactly what would be desired on general principles as the site of an observatory. He also adds that he endeavoured to find an equally favourable site in the Nilgiris hills, but failed.

It may hence be fairly concluded that Kodaikanal offers an admirably exposed site for such an observatory, and that Kotagiri does not.

In order to test the atmospheric conditions of these two hill stations, and determine which would be most suitable for the Solar Physics Observatory, temporary meteorological observatories were established, and regular observations taken from January 1892 up to March 1893. The following observations were taken daily:—

- (1) Temperature at 8, 10 and 16 hrs.
- (2) Humidity at 8, 10 and 16 hrs.
- (3) Wind direction and amount at 8, 10 and 16 hrs.
- (4) Cloud amount and kind at two-hourly intervals from 8 A.M. to 10 P.M.
- (5) Amount of sunshine as measured by sunshine recorders.
- (6) Special mist observations.
- (7) Solar and terrestrial radiation observations.

The monthly means of these observations and the corresponding means for Madras are given in the tables in the appendix to this letter. They are also charted in Plates I and II in such a manner as to show the relative merits of the stations for the more important elements of observation. The following gives a verbal summary of the more important features for a comparison of the relative merits of the stations:—

(2) *Temperature*.—Table I, Appendix I, gives the mean temperature of each month of 1892 at Madras, Kodaikanal, and Kotagiri, and the normal monthly temperature of Simla for comparison with the southern hill stations. The mean monthly temperature of Kodaikanal in 1892 ranged between 54.1° in December and 62.2° in May, thus giving an annual variation of only 8.1° . The mean monthly temperature at Kotagiri varied from 55.3° (in January) to 64.8° (in April), thus giving an annual range of 9.5° . The mean temperature of the year at Kodaikanal was 58.5° , agreeing almost exactly with that of Simla (58.0°). The range of the mean monthly temperature at Kodaikanal (*viz.* 8.1°) was, however, less than a third of the normal range at Simla (25.6°). Another important feature of the temperature conditions is the diurnal range. Table II gives comparative data for the same stations. It may be noted that the annual range of temperature in India depends chiefly upon the varying intensity of solar radiation at the earth's surface, and hence is small in Southern India and large in Upper India.

On the other hand, the diurnal range, especially at the hill stations, depends largely upon the convective actions and currents set up by the changes in that intensity during the day with the varying altitude of the sun; and hence the differences in this feature are comparatively small between hill stations in Southern and Northern India. The mean monthly diurnal range of temperature in 1892 at Kodaikanal varied from 11.5° to 16.8° , and averaged 14.2° ; at Kotagiri it varied from 12.4° to 21.2° , and averaged 17.0° ; whilst at Simla it ranges normally between 10.6° and 19.3° , and averages 15.9° . Hence the diurnal mean range of temperature is slightly less at Kodaikanal than at Simla and also at Kotagiri. The mean daily range of temperature at Madras is somewhat less than at the hill stations. Hence the characteristic features of the air temperature at the southern hill stations are:—

- (1) Moderate temperature.
- (2) Very small range or variation of temperature during the year.
- (3) Moderate diurnal range of temperature.

In each of these respects Kodaikanal is superior to Kotagiri, its temperature being on the average of the year about 2° lower, and the annual range about 1° less, and the diurnal range about 2° less.

Hence, so far as uniform and moderate temperature conditions are concerned, Kodaikanal is superior to Kotagiri.

(3) *Solar and Terrestrial Radiation Observations*.—Means of these observations have not been included in the tables, Appendix I, as they show practically no difference between the hill stations. The observations for the months May to October give a mean difference of 62.4° between the corrected mean maximum and the corrected mean maximum of a solar radiation thermometer. The corresponding mean difference of the same period for Kotagiri was 62.5° , practically identical with the former. Similarly, the difference between the grass radiation thermometer and minimum in shade for the same period at Kodaikanal was 5.5° and at Kotagiri 5.8° .

These observations were not taken at Madras. Normal means for three stations similarly situated to Madras are given below for the same period of the year:—

Stations.				Difference solar thermometer and maximum.	Difference grass radiation thermometer and minimum.
Port Blair	...	...	...	51.4	3.7
Bombay	...	...	...	52.8	3.6
Negapatam	...	...	...	53.3	4.0

It may hence be assumed that at Madras the corresponding means would be very approximately 52.0° and 4° , or $\frac{1}{4}$ th and $\frac{1}{4}$ th respectively less than the means for the hill stations. These differences measure roughly the superiority of the hill stations as compared with Madras for all solar physics work, but

more especially actinometric work. With respect to the latter, it should also be kept in mind that it involves much exposure to the sun, and, as Mr. Michie Smith points out—"Solar observations at Madras in the hot weather are carried on with great difficulty, if not with actual danger, to the health of the observer; whereas at a hill station, though the direct solar radiation may be more intense, the coolness of the air renders the work comparatively pleasant as soon as the observer has once got thoroughly sunburnt."

Rainfall.—The actual monthly rainfall and the number of rainy days of the three stations, Madras, Kotagiri, and Kodaikanal, are given in Tables IV and V. Normal rainfall data for these stations are also available, and are given in Tables VI and VII. (A comparison of the actuals of 1892 with the normals show that the rainfall at the hill stations in 1892 was very abnormal, the number of rainy days being very largely in excess at Kodaikanal as compared with the excess at Kotagiri. This was apparently not due to larger rainfall than usual, as the total rainfall of the year was considerably below the normal at Kodaikanal, whilst it was slightly in excess at Kotagiri. This may be possibly due to the position of the observatory at Kodaikanal, which is close to the edge of the precipice facing the plains to the south, whilst the normals are for the revenue rain gauge station which is at some distance from the cliff. This exaggeration of the number of rainy days due to the peculiar position of the observatory is of importance, as it is almost certain that the same condition would exaggerate the cloud amount; and hence it is very probable that the cloud amounts obtained for the observatory are larger than would have been obtained if the observatory had been located on the open rolling ground, away from the edge of the plateau on which Kotagiri is situated, and where, for various reasons, it was not possible to locate the temporary observatory.

The chief facts of the normal rainfall data are the following:—

Kodaikanal receives slightly more rain than Kotagiri (about twelve per cent. more). This distribution is dependent on the fact that the Nilgiris are some distance to the north of the Palnis, and hence slightly differently situated relative to the rain-bearing currents of the south-west monsoon from the West Coast, and those from the Coromandel Coast during the retreating south-west monsoon. Kodaikanal obtains more rain in March and April and less in May and November, and more in August and December. The differences in the remaining months are small and of little importance.

Table VII of the mean number of rainy days furnishes similar evidence. The number of rainy days at Kodaikanal is 98.7, or 9.0 in excess of Kotagiri, and hence almost exactly 10 per cent. in excess. Kodaikanal has more rainy days in March, April, June, August, September, and December, and less in July and October, than Kotagiri.

The number of rainy days is, as might be expected, considerably greater at these hill stations than at Madras. The mean daily rainfall per rainy day at Kodaikanal is .618 inch and at Kotagiri .588 inch.

(4) **Humidity.**—The observations indicate that there is no marked difference between the humidity conditions of Kodaikanal and Kotagiri. Kodaikanal appears to be slightly drier than Kotagiri, but the difference is too small to be of

any importance. Both stations appear to be much subject to mists and fogs. Hence an attempt was made to measure the amount of mist; but the observations appear to be of little value, as in many instances they conflict with the evidence of the sunshine recorder. The fogs are chiefly due to the forced ascensional movement of the air, and hence form most largely during the period when convective action is most vigorous, i.e., from about 10 A.M. to 4 P.M.

(5) **Cloud.**—In order to test this important factor in the value of a station for astronomical purposes, observations of the amount and kind of cloud were taken every two hours between 8 A.M. and 10 P.M. The observers at Kotagiri and Kodaikanal were both trained by Miss Pogson, and no attempt was made to alter the standards of their eye estimates during the year. The observations appear on the whole to have been carefully taken, and may be accepted as fairly representing the cloud conditions of the two observatories. As already noted in the rainfall section, it is probable the cloud amount of Kodaikanal is exaggerated to some extent from the position of the observatory.

The monthly means of amount of cloud are given in Tables IX, X and XI of the Appendix and are plotted in Fig. 1 to 13 of Plate I. The monthly means show that there is less cloud at Kodaikanal from February to June, and that there is more cloud during the remainder of the year. On the average of the whole year, there is practically no difference.

The curves, Figure 1 to 12, Plate I, present the following features:—

- (1) The cloud curves of January are almost identical in form, and show that there is more cloud throughout the whole day at Kodaikanal than at Kotagiri.
- (2) During the dry and hot weather months from February to May the amount of cloud is considerably less at Kodaikanal. March is especially free from cloud at that station. In all these months, but more especially in February and May, cloud forms to a much larger extent in the hottest part of the day at Kodaikanal than at Kotagiri. Hence, although the cloud amount is much less at the former station during the morning up to 10 or 11 A.M., and again in the afternoon from about 3 or 4 P.M., it is frequently greater during the intervening interval from 10 A.M. to 3 P.M.
- (3) During the south-west monsoon period from June to September the cloud amount is large at both stations, but is larger to a moderate extent at Kodaikanal than Kotagiri. It is, however, noteworthy that during the greater part of this period (very notably in June and September) there is less cloud at Kotagiri in the morning up to 9 or 10 A.M., and again in the afternoon and evening after 5 P.M.
- (4) During the months of October, November, and December, the period of the retreating south-west monsoon currents, the cloud amount is nearly as large as during the preceding four months. It is also slightly larger on the average of the whole day at Kodaikanal than at Kotagiri; but, as in the preceding period, the excess at Kodaikanal occurs chiefly between 10 A.M. and 4 P.M. or 5 P.M. It is in all the months less cloudy at Kodaikanal up to 10 A.M. and also after 5 P.M.

Hence the general conclusion, that during the four months of least cloud there is much less cloud during nearly the whole day at Kodaikanal than at Kotagiri, and during the remainder of the year there is usually less cloud in the morning up to 10 A.M., and again in the evening after 5 or 6 P.M. Cloud forms more largely at Kodaikanal during the period of greatest convective action and air motion from about 10 A.M. to 4 P.M. As a rule, the photographic and probably the spectroscopic work would be done in the morning when the air would be most free from dust and least disturbed. It is hence apparent that the atmospheric conditions for the solar physics observations, so far as measured by the absence of cloud at the most important period of the day for the work, are more satisfactory at Kodaikanal than at Kotagiri.

A comparison of the cloud curves, Plate I, with those of the amount of sunshine, Plate II, show a close correspondence, the only difference being that the amount of sunshine at different hours of the day varies to a less extent than the amount of cloud. It is not necessary to endeavour to estimate to what extent the cloud estimates of the observatory at Kodaikanal would have to be reduced in order to represent fairly the cloud on the open plateau at a distance of 2 or 3 miles from the edge, as the data show sufficiently the superiority of Kodaikanal to Kotagiri.

(6) *Sunshine*.—The following statement of the results of the sunshine observations at the hill stations of Madras, Kodaikanal, and Kotagiri was drawn up by Mr. Michie Smith. It deals with the questions exhaustively, and is hence given in full. The data will be found in Tables XII, XIII, XIV, XV and XVI of the Appendix to the report, and all the more important results are charted on Plate II accompanying this report.

"The following points have to be taken into account with reference to all that follows:—

(1) Solar time is used throughout, XII on the card having been placed at the meridian mark of the instrument, and no correction having been applied for equation of time. Neither has any correction been applied for scale errors at different times of the year.

(2) The observations made at Madras are not strictly comparable with those made at the two other stations. The Madras instrument is a Whipple-Casella recorder, of which the sphere is of remarkably clear white glass, while the metal card holder is moveable and only about one inch wide. The other two instruments are of the old pattern, with fixed broad card holder and glass spheres which are distinctly coloured. Until the instruments have been compared side by side, it is impossible to say to what extent they differ; but there can be little doubt that the Madras instrument will record somewhat fainter sunshine than the others.

Hourly amounts of sunshine.

Figures 1—10, Plate II, show graphically the amounts of sunshine recorded in each hour from sunrise to sunset for each month from March to December. The records for the first three months of the year are incomplete. Figures 11—13 show the sunshine for each hour for the periods March—April, May—September,

and October—December. The first feature which calls for attention in these diagrams is the excess of sunshine at Madras over both the hill stations; and though part of this may be accounted for by the difference of instruments, it is evident that this explanation will not account for any large proportion of it. The excess is mainly in the afternoon, and is due to the well-known tendency for clouds to form on the hills in the afternoons. The total amount of sunshine recorded at Kodaikanal is considerably in excess (52 hours) of the total amount recorded at Kotagiri; and the hourly distribution at the two stations is very different. In every month Kodaikanal has more sunshine in the forenoon and less in the afternoon than Kotagiri. From sunrise till about noon Kodaikanal is the clearer station; then from noon till about 5 P.M. Kotagiri is clearer, but after 5 P.M. Kodaikanal seems again to clear, and has more sunshine than Kotagiri between 5 and 6 P.M. This may be due to difference in the exposure of the instruments; but I think not, as the cloud observations at 20 hours and 22 hours show Kodaikanal to have a clearer atmosphere than Kotagiri at these hours. For the ten months the excess of forenoon sunshine at Kodaikanal over Kotagiri is 131 hours. This is a point of very great importance in favour of Kodaikanal, because it is in the forenoons that all the best solar work can be done at a hill station. For most months the early morning is brighter at Kodaikanal even than at Madras. In the diagrams 1 to 13 all sunshine has been treated alike so long as it was able to leave a burned trace on the card, but evidently this is not quite satisfactory; and an attempt has been made in Figure 14 to take into account the intensity as well as the duration. In this diagram the difference between the two kinds of instruments used must not be forgotten. The table from which the diagram is drawn is prepared by multiplying the number of hours of sunshine for each day by a number (1—10) representing the mean intensity for the day, and dividing by 10 to get the equivalent "full sunshine". In March, September, and December, Kodaikanal is the best of all the stations, but for the other months Madras leads. Kotagiri is below Kodaikanal in all months except May, June, and November, when it is slightly better. Figures 15 and 16 show the relative times of the mean first and last recorded sunshine at each of the stations for each month. The chief points to note here are that, except in July, when it is the same, the sun appears much earlier at Kodaikanal than at Kotagiri, and that, except in May, it appears sooner than at Madras, indicating probably clearer nights at Kodaikanal. As regards last sunshine, Kotagiri is better off than Kodaikanal, except in March, April, and December. At first sight this seems contradictory to the statement made above, that there is more sunshine between 5 and 6 P.M. at Kodaikanal than at Kotagiri; but really it is not so, since the whole of the recorded sunshine between 5 and 6 P.M. was given on a few days in each month. Part of the inferiority of Kodaikanal over Kotagiri in the afternoons is due to the position of the observatory, which is so situated that it is frequently in mist, while the places farther west are quite clear. This statement is made from the results of actual observation and is not a mere surmise. Still, I have no doubt that Kotagiri is really somewhat clearer than Kodaikanal in the afternoons.

In concluding these remarks, it may not be amiss to point out that at Kodaikanal the weather was far from normal last year (1892). According to the unanimous opinion of those who know the place well, and with whom I have had an opportunity of speaking, the summer months were much more cloudy than usual, while, on the other hand, October and November were much brighter than usual.

The following are the Madras abnormals for *percentage of clear sky* in 1892:—

January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
+2	+7	+9	+3	+5	+6	-4	-5	-4	+6	+13	+7

Number of days on which the sun could have been photographed.

An attempt has been made to determine from the sunshine recorder slips the number of days on which the sun could have been photographed at each station. The estimate is made by rejecting those days on which the sunshine did not reach an intensity of about 7 for not less than 20 minutes. The following is the result:—

Table showing number of days on which it would have been possible to photograph the sun.

	MADRAS.			KOTAGIRI.			KODAIKANAL.		
	Neither forenoon nor afternoon.	Forenoon, but not afternoon.	Afternoon, but not forenoon.	Neither forenoon nor afternoon.	Forenoon, but not afternoon.	Afternoon, but not forenoon.	Neither forenoon nor afternoon.	Forenoon, but not afternoon.	Afternoon, but not forenoon.
March and April ...	1 + 2?	1 + 1?	1	1	2	1	2	3	3
May to September ...	23 + 2?	11 + 1?	9 + 2?	23 + 5?	39 + 6?	20 + 3?	12 + 2?	40 + 4?	9 + 3?
October to December	5	4 + 1?	6 + 2?	3 + 3?	7 + 4?	3	6	12 + 4?	3 + 1?
March to December...	29 + 4?	16 + 3?	16 + 4?	27 + 8?	48 + 10?	24 + 3?	20 + 2?	55 + 8?	14 + 4?

NOTE.—? means there were 4 days on which a photograph could probably, but not certainly, have been got.

The number of days on which a photograph could not have been got are few at all the places, but Kodaikanal is sensibly better than either of the other two.

The general result appears to me to be that, entirely apart from the special considerations which I have brought forward in my report on these stations (G. O. 16th September 1892, No. 648), Kodaikanal is for solar work decidedly superior to Kotagiri. Its superiority over Madras for this special work is less clear, but I believe that the much greater transparency of the air, especially in the forenoons, and the greater ease with which the work can be carried on, more than counterbalance the smaller total amount of sunshine. For actinometric work Madras is, of course, out of the question.

Relative merits of the stations as deduced from cloud observations at 20 hrs. and 22 hrs.

This is shown graphically in Figure 17. Unfortunately the data for November and December are incomplete. The estimate is got by giving a weight of 10 to all nights on which the cloud proportion did not exceed $\frac{3}{10}$, of 6 to nights with $\frac{3}{10}$ or $\frac{4}{10}$, and of 2 to nights with $\frac{5}{10}$ to $\frac{6}{10}$. From this diagram

Madras appears best, except in March, July, September, and November; but this is really far from being the case, as on very many of the nearly cloudless nights there is a thick haze which is not found at the hill stations. Kodaikanal is superior to Kotagiri, except in February and July."

(7) *Transparency of the atmosphere.*—With respect to the general clearness and purity of the atmosphere, conditions of great importance for photographing the details of the solar disc, and for actinometric work, it was not possible to obtain any observations from the observers. Mr. Michie Smith and Miss Pogson, who have both visited the stations of Kodaikanal and Kotagiri, speak most favourably of the clearness and transparency of the atmosphere at these hill stations as compared with Madras. Kodaikanal appears also to be superior to Kotagiri in this respect. Thus Mr. Michie Smith in his report says:—

"The general results at which I have arrived from these observations as regards the relative merits of Kodaikanal and Kotagiri as a site for an observatory is that Kodaikanal is by far the better situation of the two. Whether or not this has been absolutely proved by the observations detailed above depends to a certain extent on the further consideration of whether the atmospheric conditions at the time when I was observing were fairly characteristic of the Kotagiri climate. Personally, I have not the least doubt that the conclusion is the correct one, for the general impression of the superiority of Kodaikanal very strongly forced itself upon me while I was observing at Kotagiri; and I can affirm without hesitation that the best night while I was at Kotagiri, was inferior to the worst observing night at Kodaikanal. Having already expressed an opinion in favour of Kodaikanal, I took particular care that full justice was done to Kotagiri, and took every possible opportunity of getting the most favourable observations. The inferiority was particularly marked in the solar observations and in the observations of the finer details of nebulae."

* * * * *

"In both of these researches the remarkable steadiness and transparency of the air at Kodaikanal would be an enormous advantage, and I believe that more good work could be done on a dozen clear nights there than on fifty clear nights at Madras. Solar observations could be carried on with at least equal success and with much greater comfort to the observer."

It is hardly necessary to state that Madras is for various reasons unfitted as a site for a Solar Physics Observatory.

The meteorological observations taken at Kodaikanal and Kotagiri establish, I think, fully that Kodaikanal is superior in almost every respect to Kotagiri.

- (1) Temperature is more uniform, whether the diurnal or annual changes be considered.
- (2) The mean temperature ($58\frac{1}{2}^{\circ}$) is practically that best suited for the observational and laboratory work which would be carried on in Solar Physics Observatory, and is approximately that of the standard temperature assumed in much laboratory work in Europe (*vis.*, 60° or 62°). It is about 7° above the mean temperature of London.

- (3) There is as a rule less cloud from sunrise up to 10 A.M. or 11 A.M., and also after 5 P.M. or 6 P.M., the most important periods of the day for astronomical and solar observations.
- (4) There is less cloud during nearly the whole day in the clearest and finest months of the year, i.e., during the season when probably the best work of the year would be done.
- (5) The atmosphere appears to be as a general rule purer, clearer, and less disturbed during the morning up to 10 A.M., the important period of the day for solar observation.
- (6) Finally, a far more satisfactory site for the observatory for the object in hand could be obtained in the neighbourhood of Kodaikanal than at Kotagiri.

I have the honor to be,

SIR,

Your most obedient Servant,

JOHN ELIOT,

Meteorological Reporter to the Government of India.

APPENDIX I.

TABLE I.

Mean daily Temperature, Mean of Max. and Min.

Month, 1892.	Madras.	Kodaikanal.	Kotagiri.	Simla (mean of year.)
January	75.7	54.5	55.3	43.8
February	77.5	57.9	59.3	44.3
March	81.2	60.9	64.0	53.6
April	85.1	61.9	64.8	61.8
May	89.0	62.2	64.1	67.0
June	85.5	60.3	62.3	69.4
July	84.2	58.9	61.1	66.4
August	81.7	58.0	...	65.1
September	82.1	58.4	...	64.3
October	80.6	57.2	...	59.5
November	77.5	57.5	...	52.1
December	75.4	54.1	57.5	48.2
Mean of year	81.4	58.5	...	58.0

TABLE II.

Mean daily range of Temperature.

Month, 1892.	Madras.	Kodaikanal.	Kotagiri.	Simla (mean of year.)
January	17.1	15.6	16.6	14.8
February	19.1	16.8	18.9	16.3
March	19.2	16.7	21.2	17.4
April	15.1	16.3	18.8	19.2
May	18.2	15.0	16.6	19.3
June	17.2	13.4	13.6	17.7
July	15.4	12.2	12.4	11.5
August	14.5	11.5	...	10.6
September	15.2	13.8	...	14.1
October	14.7	12.0	...	16.7
November	16.2	12.5	...	16.8
December	16.1	14.9	17.8	16.4
Mean of year	16.5	14.2	...	15.9

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TABLE III.

Mean Humidity.

Month, 1892.	Madras.	Kodaikanal.	Kotagiri.	Simla (normal).
January ...	%	%	%	%
February ...	76	72	69	60
March ...	76	64	62	56
April ...	75	47	52	52
May ...	76	67	69	47
June ...	61	70	73	48
July ...	72	79	82	63
August ...	72	80	80	89
September ...	80	83	...	91
October ...	76	71	...	78
November ...	82	81	...	52
December ...	78	80	...	48
Mean of year ...	80	68	72	45
	75	72	...	61

TABLE IV.

Monthly Rainfall.

Actual, 1892.

Month, 1892.	Madras.	Kodaikanal.	Kotagiri.
	Inches.	Inches.	Inches.
January ...	0.13	0.15	0.01
February ...	Nil.	0.69	Nil.
March ...	Nil.	0.38	0.09
April ...	0.69	8.81	8.29
May ...	Nil.	4.33	5.38
June ...	4.02	8.71	6.11
July ...	7.82	3.65	4.90
August ...	10.79	7.01	6.41
September ...	6.29	1.75	3.40
October ...	6.60	9.54	14.58
November ...	0.96	0.64	2.60
December ...	4.74	1.84	3.25
Total of year ...	42.04	47.53	55.02

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TABLE V.

Actual number of rainy days on which 0.01 inch or upwards fell.

Month, 1892.	Madras.	Kodaikanal.	Kotagiri.
January ...	2	4	1
February ...	0	5	0
March ...	0	3	2
April ...	2	16	16
May ...	0	19	15
June ...	11	19	19
July ...	21	21	15
August ...	19	24	13
September ...	14	8	7
October ...	11	21	18
November ...	2	7	4
December ...	6	8	5
Total of year ...	88	155	115

TABLE VI.

Mean Monthly Rainfall.

Month.	Madras.	Kodaikanal.	Kotagiri.
	Inches.	Inches.	Inches.
January ...	0.94	0.55	0.53
February ...	0.29	0.63	0.20
March ...	0.41	3.02	1.63
April ...	0.63	6.14	3.36
May ...	2.21	4.86	7.41
June ...	2.07	3.90	2.43
July ...	3.78	4.92	4.58
August ...	4.48	6.39	4.33
September ...	4.75	6.70	6.99
October ...	10.99	10.87	10.22
November ...	13.75	5.59	6.93
December ...	5.24	7.39	4.16
Total of year ...	49.54	60.96	52.77

TABLE VII.

Mean number of rainy days

(A rainy day being a day on which a tenth of an inch of rain or upwards falls).

Month.	Madras.	Kodaikanal.	Kotagiri.
January ...	1'4	1'0	1'8
February ...	0'1	0'5	0'5
March ...	0'6	3'5	2'3
April ...	0'3	5'8	4'8
May ...	1'5	10'8	10'5
June ...	4'7	9'0	7'8
July ...	6'9	8'5	0'8
August ...	8'2	12'0	8'8
September ...	7'1	13'8	11'0
October ...	10'0	15'0	16'3
November ...	11'0	10'5	9'8
December ...	5'2	8'5	6'3
Total of year	57'0	98'7	89'7

TABLE VIII.

Mean daily amount of wind.

Month, 1892.	Madras.	Kodaikanal.	Kotagiri.
	Miles.	Miles.	Miles.
January ...	163	P	134
February ...	138	P	127
March ...	163	179	129
April ...	189	147	148
May ...	226	236	155
June ...	176	160	152
July ...	155	203	125
August ...	110	124	...
September ...	118	234	...
October ...	110	182	...
November ...	165	202	...
December...	159	175	...
Mean of year	157	184	...

TABLE IX.

Mean cloud amount, Kodaikanal.

Month, 1892.					8 hours.	10 hours.	12 hours.	14 hours.	16 hours.	18 hours.	20 hours.	22 hours.	Mean.
January	...	...	...	...	4.4	5.3	5.7	6.3	6.7	7.0	6.0	4.8	5.8
February	...	...	...	...	1.1	1.8	3.3	4.1	5.7	3.9	3.2	3.8	3.4
March	...	...	...	...	0.6	0.8	2.6	3.4	2.9	1.8	0.7	0.7	1.7
April	...	...	...	...	2.7	3.0	4.5	5.4	5.9	5.6	5.3	4.9	4.7
May	...	...	...	...	4.2	4.4	4.7	6.2	7.5	6.1	4.7	4.3	5.3
June	...	...	...	...	5.5	6.2	9.0	8.9	8.5	8.2	6.6	5.2	7.3
July	...	...	...	...	7.9	8.7	8.9	9.6	9.3	9.4	8.1	8.1	8.8
August	...	...	...	...	7.6	8.0	9.2	9.2	9.2	8.6	8.2	7.8	8.5
September	...	...	...	...	6.3	6.7	8.1	9.0	8.8	7.2	5.1	5.3	7.1
October	...	...	...	...	5.1	6.6	8.1	8.6	8.4	8.4	7.1	6.5	7.4
November	...	...	...	...	3.5	5.3	7.4	7.3	8.4	7.5	3.5	3.1	5.8
December	...	...	...	...	4.0	5.1	6.5	7.0	7.3	6.6	5.2	5.0	5.9
Mean of year	...	...	...	...	4.4	5.1	6.5	7.0	7.3	6.6	5.2	5.0	5.9

TABLE X.

Mean cloud amount, Kotagiri.

[illegible]

TABLE XI.
Mean Cloud amount, Madras.

Month, 1892.	8 hours.	10 hours.	12 hours.	14 hours.	16 hours.	18 hours.	20 hours.	22 hours.	Mean.
January	4.0	4.5	...	4.3	4.0	...	2.0	...	3.8
February	2.4	3.6	...	2.3	1.9	...	1.4	...	2.3
March	1.6	2.1	...	1.6	1.6	...	1.2	...	1.6
April	4.3	3.6	2.9	2.8	2.4	3.1	1.0	3.2	2.9
May	4.4	3.3	2.5	2.8	3.5	3.7	3.1	3.7	3.4
June	...	...	...	...	...	...	...	...	...
July	7.7	6.5	7.4	7.7	7.0	8.2	8.3	8.6	7.8
August	8.0	6.9	7.1	7.0	7.6	7.6	6.5	6.7	7.3
September	7.0	6.4	5.5	6.0	7.4	7.5	5.8	7.1	6.9
October	5.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.5
November	5.0	5.0	6.0	5.0	5.0	4.0	4.0	4.0	4.8
December	...	...	...	...	...	...	...	...	...
Mean of year	...	...	...	...	...	...	...	...	...

TABLE XII.
Hours of Bright Sunshine.

1892.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.	May to September.	October to December.
KODAIKANAL 6 to 7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7-8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8-9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9-10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10-11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11-noon	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12-13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13-14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14-15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15-16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16-17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17-18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18-19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
KODAIKANAL 6-7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7-8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8-9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9-10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10-11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11-noon	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12-13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13-14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14-15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15-16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16-17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17-18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18-19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
MADRAS 6 to 7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7-8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8-9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE XII—contd.
Hours of Bright Sunshine.

1892.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.	May to September.	October to December.
9-10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10-11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11-12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12-13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13-14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14-15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15-16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16-17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17-18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE XIII.

Equivalent number of hours of full sunshine.

Madras	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kodaikanal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kotagiri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE XIV.

Mean Time of first recorded sunshine.

Madras	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kodaikanal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kotagiri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE XV.

Mean Time of last recorded sunshine.

Madras	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kodaikanal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kotagiri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE XVI.

Relative merits deduced from Cloud Observations at 20 hours and 22 hours.
(A weight of 10 is given to days having not more than $\frac{2}{10}$ of cloud, of 6 to days having from $\frac{2}{10}$ to $\frac{4}{10}$ and of 2 to days having from $\frac{4}{10}$ to $\frac{6}{10}$ of cloud.)

1892.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.	January to April.	May to September.	October to December.	Year.
Madras	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kodaikanal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kotagiri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

* [] incomplete.

*This is derived from the following table:—

TABLE XVI.

1892.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January to April.	May to September.	October to December.	Year.
MADRAS.																
No. of days on which cloud from																
0-2 { 20 hours ...	22	24	27	27	15	11	1	8	2	13	12	17	13	41	42	185
3 and 4 { 22 hours ...	...	...	...	...	11	9	1	8	4	11	14	13	...	33	38	...
5 and 6 { 20 hours ...	5	3	4	2	7	4	2	2	1	5	10	4	14	16	17	40
7 and 8 { 22 hours ...	...	...	...	...	11	4	2	3	2	8	9	8	...	22	25	...
9 and 10 { 20 hours ...	...	...	...	...	4	3	3	3	1	3	3	3	...	17	13	...
11 { 22 hours ...	...	...	...	...	6	3	4	2	3	2	3	5	...	17	10	30
12 { 20 hours ...	...	...	...	...	2	3	0	1	4	4	0	3	...	10	7	...
13 { 22 hours ...	...	...	...	...	3	11	25	17	15	5	4	1	...	71	10	74
KODAIKANAL.																
No. of days on which cloud from																
0-2 { 20 hours ...	9	14	30	10	13	7	2	2	11	6	16	...	63	35	...	...
3 and 4 { 22 hours ...	12	13	28	13	17	11	3	4	10	7	18	...	66	45	...	...
5 and 6 { 20 hours ...	3	7	0	4	2	1	2	2	3	1	3	...	14	10	...	...
7 and 8 { 22 hours ...	1	4	1	3	0	1	2	2	3	0	2	...	9	8	...	...
9 and 10 { 20 hours ...	1	3	0	2	4	3	4	3	3	3	3	...	6	17	...	...
11 { 22 hours ...	4	5	1	0	2	3	1	2	2	3	3	...	10	10	...	...
12 { 20 hours ...	7	2	0	4	2	5	2	3	3	3	2	...	13	15	...	...
13 { 22 hours ...	5	2	0	2	1	7	3	1	3	9	0	...	9	15	...	...
14 { 20 hours ...	11	3	1	10	10	14	21	21	10	16	6	...	25	76	...	...
15 { 22 hours ...	9	5	1	18	11	8	22	22	12	13	7	...	27	75	...	...
KOTAGIRI.																
No. of days on which cloud from																
0-2 { 20 hours ...	14	12	12	3	1	0	0	0	0	0	...	8	42	1	...	...
3 and 4 { 22 hours ...	17	10	24	3	7	3	2	7	0	1	...	11	63	13	...	...
5 and 6 { 20 hours ...	3	6	2	2	8	3	3	2	6	4	...	9	19	22	...	...
7 and 8 { 22 hours ...	8	2	4	8	6	3	7	6	11	8	...	9	21	32	...	...
9 and 10 { 20 hours ...	8	1	7	7	6	5	9	5	12	8	...	5	23	37	...	...
11 { 22 hours ...	0	2	2	1	3	9	8	3	9	6	...	6	6	32	...	...
12 { 20 hours ...	1	5	3	8	8	11	9	12	7	10	...	7	17	48	...	...
13 { 22 hours ...	1	0	...	...	4	10	6	10	7	9	...	2	9	37	...	...
14 { 20 hours ...	5	5	10	18	11	10	12	5	9	...	2	20	47	...	...	...
15 { 22 hours ...	5	6	1	10	13	8	8	11	3	7	...	3	22	38	...	...

MADRAS OBSERVATORY

The 22nd January 1893

C. MICHIE SMITH.

Telegram No. 925, dated the 15th March 1893.

From—Calcutta,
From—Revenue Secretary,

To—Simla.

To—Meteorological Reporter, India.

File No. 14.
Serial No. 6.

YOUR No.-149, dated 4th instant, Madras Observatory. Government of India presume that, even if no new scheme is carried, Mr. Michie Smith would still be kept on as Government Astronomer on pay not less than R800. Is not this so? Employment on this salary must be guaranteed to enable him resign Christian College.

Telegram dated the 15th March 1893.

From—Simla,
From—Meteo. Reporter, India,

To—Calcutta.

To—Revenue Secretary.

Serial No. 7.

PRINTED copies of my No. 149 and of report on Kodaikanal and Kotagiri sent off on Monday. I have no papers of conditions of appointment of Government Astronomer. Question before Government is, I understand, the permanent appointment of Mr. Michie Smith, Government of India has sanctioned temporary appointment for indefinite period, that is, till settlement of present question. Secretary of State, I understand, either finally appoints or sanctions appointment and reference must be made to England. I doubt whether Observatories Committee would recommend or approve Michie Smith's appointment as Astronomer, as I believe he has had no special training; he is editing Pogson's observations, but I doubt whether that would be considered as sufficient guarantee of his qualifications as an Astronomer. As reference must be made to England, it appears to me my suggestions are most satisfactory and economical that can be made unless it is determined to discontinue solar observations, and, if so, probably astronomical observatory might be temporarily reduced to half-time appointment as work in that direction less urgent than in direction of solar physics—vide despatch from England. In that case Michie Smith might perhaps be willing to combine work of editing Pogson's observations and Time-Ball work with college duties; there is no necessity for great urgency in publication of Pogson's observations.

Telegram No. 181, dated the 21st March 1893.

From—Calcutta,
From—Revenue Secretary,

To—Madras.

To—Madras Secretary.

Serial No. 8.

YOUR telegram No. 96, dated 22nd February, Michie Smith. Eliot's scheme, Madras and Kodaikanal Observatories, only just received, will be disposed of as soon as possible. If Solar Physics Observatory is sanctioned, Michie Smith will be permanently appointed, probable salary not less than R800. If not sanctioned, India cannot guarantee he will be accepted as permanent Astronomer. India suggests asking Christian College to allow present arrangement continue six months longer. If Michie Smith is obliged to rejoin college in June, it might be arranged to grant him a limited allowance for continuing the editing of Pogson's observations and looking after Time-Ball until Secretary of State's orders are received.

Telegram No. 173, dated 7th April 1893.

From—The Secretary to the Government of Madras, Revenue Department,
To—The Secretary to the Government of India.

YOUR telegram 21st March. Michie-Smith has applied Christian College extension leave six months, and failing grant offered resign professorship, as he considers second proposal in your telegram impossible.

No. 1157, dated Simla, the 17th April 1893.

From—E. D. MACLAGAN, Esq., Officiating Under-Secretary to the Government of India, SERIAL NO. 10.
To—The Meteorological Reporter to the Government of India.

WITH reference to your letter No. 149-S., dated the 4th March 1893, I am directed to request that you will be good enough to furnish a proposition statement in the prescribed form showing the cost of establishing the proposed new Imperial Observatory at Madras.

39
Telegram No. 252, dated 15th May 1893.

File No. 14.

From—The Secretary to the Government of Madras,

SERIAL NO. 11. •

To—The Secretary to the Government of India.

Your telegram April thirteenth. This Government accepts Eliot's proposals *en bloc*, but desires suggest that Michie-Smith's appointment as permanent Director, Solar Physics, on the pay, eight rising to twelve hundred rupees, proposed by Eliot should be sanctioned at once in order remove difficulty in regard to Smith's engagement with Christian College Council. Have granted him six months' extension of leave, counting from about middle last month, on condition that he informs them at least two months before expiration term, whether or not he intends return. Any further concession their part improbable.

No. 2371, dated Simla, the 14th July 1893.

From—E. D. MACLAGAN, Esq., Under-Secretary to the Government of India, Revenue and Agricultural Department.

To—The Meteorological Reporter to the Government of India.

File No. 14.

Serial No. 16.

I AM directed to forward to you confidentially a copy of a despatch addressed to the Secretary of State, No. 37 (Meteorology), dated the 20th June 1893, submitting proposals regarding the establishment of a new observatory in the highlands in the South of India and to ask you to be good enough to report (1) what expenditure approximately would be incurred if the scheme were sanctioned and started from 1st October, and if the expenditure were confined to what could be met from the budget grant of the year, and (2) what extra amount would, if the scheme were sanctioned this summer, have to be budgetted for for 1894-95.

No. 533-S., dated Simla, the 27th July 1893.

From—JOHN ELIOT, Esq., Meteorological Reporter to the Government of India, Revenue and Agricultural Department.

File No. 14.

Serial No. 17.

I HAVE the honor to acknowledge the receipt of your No. 2371, dated the 14th July 1893, and to submit the following reply on the two points respecting which you ask me to report.

2. I assume that the grant of Rs. 25,000 for the initial cost of buildings and apparatus will not be made during the present official year and hence that it will not be possible to commence the actual work of building the new observatory at Kodaikanal until April 1894. It would be very desirable to commence as early as possible next year and hence I would suggest that the plans and estimates for the buildings should be prepared and approved before the end of the present official year. If Mr. Michie-Smith is appointed permanently in August, he should be then requested to take up this work. He should visit Kodaikanal, and, in consultation with the Public Works Department, select the most suitable site for the observatory and afterwards draw up plans for the buildings with the assistance of the Public Works Department, who would prepare the estimates. It is possible that Mr. Michie-Smith might be able to arrange to have the work done by contractors under his own supervision (and occasional inspection by the Public Works Department), and, if so, that would perhaps be the best arrangement. If these suggestions be adopted, observational work would go on during the remainder of the year at the Madras Astronomical and Dehra Dun Solar Observatories as at present, and the only extra charge would be a small sum of a few hundred rupees for Mr. Michie-Smith's travelling allowance to Kodaikanal, which, of course, I am not able to estimate with any exactness.

3. The extra amount that would have to be budgetted for in 1894-95 would depend largely upon when the buildings would be finished. It would be very desirable to commence observational work on the 1st January 1895, but it is very doubtful whether the buildings could be erected in nine months (i.e., from April to December 1894). While the buildings are in progress, work would continue at the Madras and Dehra Dun Observatories exactly as at present. Mr. Michie-Smith would have to be chiefly in Kodaikanal while the buildings are in course of erection, in order to advise and direct, and perhaps superintend the building, so that the various arrangements for the domes etc., might be carried out to his satisfaction. As it would hence be almost indispensable for the proper progress of the work that Mr. Michie-Smith should spend the greater part of his time next year at Kodaikanal, it would be necessary to appoint Miss Pogson as Assistant Superintendent, with effect from the 1st of April 1894, and that she should be informed early, in order that she might arrange for giving up her present office and locating it next April in the observatory buildings in which there is ample room for it.

4. Assuming that the new buildings would be ready for the commencement of work on the 1st January 1895, it would be necessary to provide for the observatories at Madras and Dehra Dun, according to the present scale for the first nine months of the year, and for observatories at Madras and Kodaikanal, according to the new scale for these months from 1st January. As it would probably be necessary for Mr. Michie-Smith to visit Dehra Dun as well as Kodaikanal, it would also be desirable to arrange for a grant on account of his travelling allowance and also that of the Solar Photographic Assistant if he were transferred from Dehra Dun to Kodaikanal.

5. It would hence be necessary to arrange in next year's budget for the amount of Rs. 25,000 for cost of buildings, &c., and for the following amounts on account of observatories charges:—

	Rs.
Nine months, present scale, April to December	18,785
Miss Pogson's allowance for April to December	900
Three months, new scale	6,000
Travelling allowances (special)	1,200
TOTAL.	21,845

Or about Rs. 2,500 in addition to the sanctioned amount of Rs. 22,340 for present year.

6. I have the honor to ask whether the amounts for the Madras and Kodaikanal Observatories are to be included from next year in the budget of the Meteorological Department, and, if not, if they are to be budgetted separately for by the Director of the Solar Physics Observatory.

Serial No. 18.

No. 117 (Revenue), dated India Office, London, the 31st August 1893.

From—Her Majesty's Secretary of State for India.

To—His Excellency the Most Honourable the Governor General of India in Council.

WITH reference to Your Excellency's letter No. 37 (Meteorology) dated the 20th June 1893, I forward copy of papers marginally noted, containing the opinions of the Indian Observatories Committee and the Solar Physics Committee, on the proposal for establishing on a small scale a new observatory at Kodaikanal, in the Pulni hills.

* Astronomer Royal's letter, dated 21st July, with enclosure
Colonel Donnelly's letter, dated 2nd August 1893.

vatory at Kodaikanal, in the Pulni hills.

2. I sanction your proposals, which involve an initial outlay of Rs. 25,000, and a yearly increased charge of Rs. 1,649.

3. The attention of your Government is invited to the suggestions of those Scientific Committees regarding—

- (1) the continued photographic registration of sun spots.—
- (2) Mr. Michie-Smith's consulting the Astronomer Royal regarding the form of the catalogue of old observations now being printed.

Enclosure No. 1.

Dated Royal Observatory, Greenwich, the 21st July 1893.

From—W. H. M. CHRISTIE, Esq., Astronomer Royal, Royal Observatory, Greenwich.

To—Her Majesty's Under-Secretary of State for India.

With reference to your letters (1) R. and S. 1012 of the 3rd instant, forwarding the report on the working of the Madras Observatory during the

year 1892-93, and (2) R. and S. 1086 of the 13th instant, forwarding papers concerning the establishment of a Solar Physics Observatory at Kodaikanal in the Pulni hills, under the direction of Mr. Michie-Smith, for the consideration of the Indian Observatories Committee, I have the honour to transmit, for the information of the Secretary of State for India in Council, a copy of the Resolutions of the Indian Observatories Committee passed at their meeting on 20th July 1893.

Enclosure in above.

Resolutions of the Indian Observatories Committee passed at their Meeting on 20th July 1893.

1. The Committee approve of the proposal to establish a Solar Physics Observatory at Kodaikanal, in Southern India, with Mr. Michie-Smith as Superintendent, he also remaining in temporary charge of the Madras Observatory.

2. That the Committee approve of deferring for the present the decision as to the permanent site of the Astronomical Observatory.

3. As regards the report on the Madras Observatory, the Committee are glad to note that satisfactory progress is being made in the reduction and publication of the old observations. With reference to paragraph 7, the Committee consider that the precise form the catalogue should take would be best settled by Mr. Michie-Smith placing himself in communication with the Astronomer Royal.

Enclosure No. 2.

No. 2, dated South Kensington, S. W., 2nd August 1893.

From—Colonel J. F. D. DONNELLY, Secretary, Solar Physics Committee,
To—Her Majesty's Under-Secretary of State for India.

Adverting to your letter of the 18th ultimo, I have the honour to inform you that the Solar Physics Committee which met this day entirely concurs in the proposals of the Government of India with reference to the establishment of a Solar Physics Observatory at Kodaikanal under the direction of Mr. Michie-Smith, as contained in the letter of the 20th June last, and would recommend that effect should be given to those proposals at once.

At the same time, the Committee again venture to point out the importance of maintaining the continuity of the photographic registration, on the 8-inch scale of sun spots, and they have ascertained that it is probable that a second photo-heliograph, if necessary, can be lent by the Astronomer Royal in order that one may be in full working order before the other is dismantled.

Telegram No. 3448, dated 30th September 1893.

From—The Secretary, Government of India, Revenue and Agricultural Department,
To—The Secretary, Government of Madras.

Your telegram 252, dated 15th May last. Secretary of State sanctions appointment of Michie-Smith on 800 per mensem as Director, Solar Physics and Superintendent, Madras Observatory. Letter follows.

52

LIST OF ENCLOSURES.

1. Letter from Government of Madras, No. 649, dated 16th September 1892, and 2 enclosures.
2. Letter to the Meteorological Reporter to the Government of India, No. 3576, dated 21st December 1892.
3. Letter to the Government of Madras, No. 3578, dated 21st December 1892.
4. Telegram from the Government of Madras, No. 96, dated 22nd February 1893.
5. Telegram to Meteorological Reporter to the Government of India, dated 3rd March 1893.
6. Telegram from Meteorological Reporter to the Government of India, dated 4th March 1893.
7. Letter from Meteorological Reporter to the Government of India, No. 149-S., dated 4th March 1893.
8. Letter from Meteorological Reporter to the Government of India, No. 147-S., dated 1st March 1893.
9. Telegram to Meteorological Reporter, No. 925, dated 15th March 1893.
10. Telegram from Meteorological Reporter, dated 15th March 1893.
11. Telegram to Government of Madras, No. 981, dated 21st March 1893.
12. Telegram from Government of Madras, No. 173, dated 7th April 1893.
13. Letter to Meteorological Reporter, No. 1157, dated 17th April 1893.
14. Telegram from the Government of Madras, No. 252, dated 15th May 1893.

File No. 14.
Serial No. 15.

No. 1893.

GOVERNMENT OF INDIA.
REVENUE AND AGRICULTURAL
DEPARTMENT.

METEOROLOGY.

NO. 37, DATED SIMLA, THE 20TH JUNE 1893.

(COPY.)

Letter to Her Majesty's Secretary of
State for India.

SUBJECT.

Submits proposals concerning the establish-
ment of a new observatory in the highlands
in the south of India.

200 R. & A. D. 1893. - 108.

Public 149

Telegram from "Kewant"

30 Sept^r 1893

Circulated.

It is proposed to
reprint the telegram
to Mr. Michie Smith.

2. Apparently the simple
& short designation
of Government Astronomer
Madras & Astronomer
to be replaced by
of Sir Edmund Dwyer
Long. The names
are really becoming
perfect nonsense in
official correspondence.

3. The telegram seems
to show that the
creation of a separate
appointment, ~~and~~
holder of which is
to denote himself
Solar physicist, is
desired for the present.

* Telegram leaf?
6/10

N

W. H. D.

20th

7 0/10/93

[Faint, illegible handwritten notes]

[Faint, illegible handwritten notes]

Whether such a
nomenclature is
better.

W. H. D.
20th

2/10

2/11

File No. 14.

Serial No. 22.

GOVERNMENT OF INDIA.
DEPARTMENT OF REVENUE AND AGRICULTURE.

METEOROLOGY.

To

THE SECRETARY TO THE GOVERNMENT OF MADRAS.

No. 39

Dated Simla, the 4th November 1893.

Recd. 13th Morning
June 2

SUBJECT.

Forwards for information and guidance copy of correspondence regarding the Establishment of a Solar Physics Observatory on the Kodaikanal Hills.

Gort. C. Press, Simla, -No. 843 R. & A. D. -7-11-93. -102.

2.17/11
 1917/11
 28-7-15

state that there is
 objection on the
 part of the Govt.
 to the transfer of
 the control of the
 Madras Observatory
 & the funds connected
 with it to the Govt.
 of India with effect
 from 1st April 1894,
 as to placing the organi-
 sation & management
 of the new Solar
 Physics Observatory
 under the Meteor.
 logical Department to
 Govt of India -

15/11/93
 16.11.93

state.
 It is understood that
 the Govt. desire to make
 this transfer, & to relieve
 itself of all responsibility
 as to the working of the
 new scheme.

As this is a purely Imperial
 question - in which centralization
 is most important.

giving 3
 17/11/93
 16/11/93
 Smith, who will answer
 for the preparation
 of the budget
 estimates & plan
 required by the Govt.
 of India.
 The following
 letter will be sent

1894
 15/11
 16/11/93
 the 4th para of the
 letter of the 4th inst
 or 29/10/93 I am directed

RECEIVED
 A. KIANI
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John A. Smith

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[Document Abstract.]

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