

Public (1899) Department.

ORDINARY PRINTED.

G.O., No. 369 - 370

DATED 23 - 3 - 19

INDEXED.

[Despatch Abstract.]

Astronomical Solar Physics Observatories in Canada

Coming to the point astronomer
to the Meteorological Reporter to put letter from the
regarding the transfer of the control and
funds of the — to that point from the 1st April
1899, directing the latter officer to submit a formal
application to retire from the service from that
date, and addressing the point on the subject.

(Letter attached)
Stating that this point hopes that the point
will, when giving effect to the proposed transfer of the control &
funds of the — to that point, be able to protect the
rights of the present incumbents of the posts in the
Meteorological Office by permitting them to retain their
existing rates of pay until they retire or are promoted
and requesting to admit the subordinates of the Meteorological
Office to the increased — which they will receive under the
new scheme from the date of their arrival at Kodaikanal

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.
Cno	1952/226	2077	(67807/14.7.55)			
Cno	321/900	(5072)				

Government {1899} of Madras.
PUBLIC.

} 1899. *Enclosures*
 Spare copies

Letter, No. 370, 23rd March 1899.

MARCH.

Meteorological and Solar Physics Observatories in Madras.

Government hopes that the Government of India will, when giving effect to the control and funds of the — to that Government, be able to protect the incumbents of the posts in the Madras Meteorological office by permitting existing rates of pay until they retire or are promoted; and requesting that of Mr. Michie Smith to the increased pay which they will receive under the date of their arrival at Kodaikánal.

PUBLIC DEPARTMENT.

LETTER—from

THE CHIEF SECRETARY TO THE GOVERNMENT OF MADRAS

To

THE SECRETARY TO THE GOVERNMENT OF INDIA
DEPARTMENT OF REVENUE AND AGRI-
CULTURE

SIR,

In acknowledging the receipt of your letter No. 873, dated 1st April 1899, intimating that it is proposed to give effect, from the 1st April 1899, to the arrangements under which the control of the Madras Observatory and the work connected with it will be transferred to the Government of India, I am directed by the Government of India that the scale of establishment for the Madras Observatory, Mr. Eliot for the performance of meteorological work in the Madras Observatory, his letter No. 410-S., dated 29th May 1896, which formed an integral part of No. 2541—11—O., dated 19th October 1896, provides for reduced rates of pay for three senior subordinates in Miss Pogson's office, who will be transferred to the Observatory, and that nothing is said in the correspondence as to the rates of pay of incumbents against loss of emoluments. The existing rates of pay of the subordinates by Mr. Eliot are shown below:—

Present pay.				
1st Assistant	..	Rs. 60—80	plus Rs. 15 local allowance for publication of the daily weather report.	
2nd	..	40—55	" "	10
3rd	..	30—40	" "	5

2. The scale proposed for the Madras Astronomical department is as follows:—Computer on Rs. 100 and two Assistants on Rs. 60 and Rs. 40 per month respectively, while the establishment of the Kodaikānal Solar Physics department consists of four Assistants on Rs. 150 to Rs. 250, Rs. 100 to Rs. 150, Rs. 50 to Rs. 75. This Government has no information as to whether the Meteorological office are competent to do the work required in the other two branches, but I am to say that the Government of India will be able to protect the rights of individuals, either by a redistribution of the duties among individuals, or by the present holders of the posts in the Meteorological office to retire or are promoted.

3. I am further to refer to my letter No. 227, Public, dated 2nd April 1899, in which the Government of India was informed that Mr. Michelson was moving to Kodaikānal, and had applied to this Government for consideration of their subordinates of increased pay in consideration of their transfer. Pending a reply to my letter quoted above, this Government of

frances asked for. I am now to suggest that the compensation which it is necessary to allow the members of the establishment should be granted not as a special allowance, but by admitting them from the date of their arrival at Kodaikānal to the same rate of pay which they will receive under the new scheme. I am to request that the Government of India may be moved to pass orders accordingly.

I have the honour to be,

Sir,

Your most obedient servant,

G. STOKES,
Chief Secretary.ST. GEORGE,
23rd March 1899.

226-7 Pub-8 23-2-98
Public

801

FILE No. 9 OF 1898.

SERIAL No. 23.

1899.

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE AND AGRICULTURE.

METEOROLOGY.

To

THE CHIEF SECRETARY TO THE GOVERNMENT OF MADRAS.

No. 873-9-23.

Dated Calcutta, the 8th March 1899.

Receives }
Registers } 13. 3. 99
no. of Encls: 7.

SUBJECT.

TRANSFER of the control and funds of the Astronomical and Solar
Physics Observatories in Madras to the Government of India.

Government {1899} of Madras.
PUBLIC.

<i>Recd.</i>	}	<i>1899.</i>	<i>Enclosures</i>
<i>Regd.</i>		<i>Spare copies</i>	

G.O., No. 369, 23rd March 1899.

MARCH.

Astronomical and Solar Physics Observatories in Madras.

Communicating to the Government Astronomer and to the Meteorological Reporter to Government letter from the Government of India regarding the transfer of the control and funds of the — to that Government from the 1st April 1899, directing the latter officer to submit a formal application to retire from the service from that date, and addressing the Government of India on the subject.

GOVERNMENT OF MADRAS.

PUBLIC DEPARTMENT.

READ—the following paper :—

From T. W. HOLDERNESS, Esq., C.S.I., Secretary to the Government of India, Department of Revenue and Agriculture (Meteorology), to the Chief Secretary to the Government of Madras, dated Calcutta, the 8th March 1899, No. 873.

With reference to the correspondence ending with your letter, No. 227 (Public), dated the 23rd February 1899, I am

1. Despatch to Her Majesty's Secretary of State for India, No. 56, dated 1st September 1897.
2. Despatch from Her Majesty's Secretary of State for India, No. 173 (Revenue), dated 22nd September 1898, and enclosures.
3. Despatch to Her Majesty's Secretary of State for India, No. 14, dated 2nd February 1899, and enclosure.

directed to forward a copy of the papers noted in the margin regarding the re-organization of Indian observatories.

2. The Government of India were informed in Mr. Price's letter, No. 941

(Public), dated the 21st November 1893, that the Government of Madras had no objection to the transfer of the control of the Madras Observatory and the funds connected with it to the Government of India, or to placing the organization and management of the Solar Physics Observatory under the Meteorological Reporter to the Government of India. I am now to acquaint you that, in anticipation of the Secretary of State's approval of the scheme of re-organization, it is proposed to give effect to these arrangements from the 1st April 1899. The Meteorological Reporter to the Government of India has been informed accordingly, and the necessary budget provision has been made in the India estimates for 1899-1900.

ENCLOSURES.

DESPATCH from the Government of India, Department of Revenue and Agriculture (Meteorology), to Her Majesty's Secretary of State for India, dated Simla, the 1st September 1897, No. 56.

We have the honour again to address your Lordship on the subject of the proposed extension and re-organization of the Indian Scientific Observatories, and to forward copies of the correspondence on the subject noted in the margin.

1. Letter to the Government of Bombay, No. 794-14-1 of 9th March 1895.
2. Letter from the Meteorological Reporter to the Government of India, No. 410-S, dated 29th May 1896.
3. Letter to the Government of Madras, No. 2541-11-6, dated 19th October 1896.
4. Letter to the Government of Bombay, No. 2542-11-7, dated 19th October 1896.
5. Letter from the Government of Madras, No. 1343, Public, dated 21st December 1896.
6. Letter from the Government of Bombay, No. 696, dated 9th February 1897.
7. Note by the Surveyor-General, dated 13th July 1896.
8. Note by the Director, Geological Survey, dated 16th July 1896.

despatches, No. 9, dated 10th February 1892, and No. 37, dated 7th June 1892, was referred to the Solar Physics and Observatories Committees, who approved the proposals and recommended their adoption. In informing the Government of India of this fact, Lord Kimberley remarked in his despatch, No. 111, Revenue, dated 10th November 1892 :—

The Solar Physics Committee, it will be seen, suggest that if funds are not available for equipping a new complete observatory with two branches, the furtherance of solar physics in India would be the greater benefit to science, while astronomical requirements could for the time be met by the Madras Observatory. For solar physics observations costly buildings would not, it is added, be required. Your Government will, no doubt, consider carefully this view of the matter before you decide to recommend the establishment and equipment of a complete new observatory.

3. The financial position at the time did not admit of the establishment of the complete observatory referred to, and a partial scheme, in accordance with the suggestion of the Solar Physics Committee, was submitted to the Secretary of State in our despatch, No. 37, dated 20th June 1893. This scheme, which provided for the establishment of a Solar Physics Observatory at Kodaikānal and the continuance of the Madras Astronomical Observatory on a reduced scale, was sanctioned in Lord Kimberley's despatch, No. 117, Revenue, dated 31st August 1893. The necessary buildings at Kodaikānal are now under construction, and your Lordship has sanctioned the requisite equipment of instruments.

4. The scheme involved the transfer to Kodaikānal of part of the Madras Observatory staff and the whole of the Dehra Dun Solar Observatory staff, and it was proposed to transfer the control of the Madras Observatory and of the funds connected with it to the Imperial Government and to place the new Solar Physics Observatory immediately under the Government of India. To these proposals the Madras Government agreed. Further consideration led us to the conclusion that it would eventually be advisable to treat the Bombay Observatory in a similar manner, thus concentrating the higher physical work at a principal observatory at Kodaikānal, to which the Bombay and Madras Observatories would be subordinate, and bringing all three under the control of the Supreme Government. The grounds upon which we arrived at this conclusion are fully set forth in our letter to the Bombay Government, dated 9th March 1895, which forms one of our present enclosures. The Government of Bombay anticipated no insuperable difficulties in effecting the desired change, but the discussion of details was left for consideration until Mr. Chambers should have retired. That gentleman died shortly afterwards, and, pending a final settlement of the scheme, no permanent arrangements have been made for the working of the Colaba Observatory, and, as a purely temporary measure, Mr. Nanabhai Ardeser Moos, an officer of the Educational Department, has been appointed to officiate as Director.

5. The acceptance by the Governments of Madras and Bombay of the principle that scientific observatories are properly national and not provincial institutions, and the change in the direction of the Colaba Observatory rendered it possible to give immediate effect to a complete scheme of re-organization. Such a scheme was elaborated by Mr. Eliot at our request, and will be found in his letter, dated 29th May 1896; and it is this scheme that we now submit for your Lordship's approval. The proposals made by Mr. Eliot contemplate the following distribution of work at the three observatories :—

(1) *Bombay*.—Magnetic and meteorological observations as hitherto (with any further improvements and extensions that may be suggested by the new Director and approved by the Observatories Committee) and the working of the local time-ball arrangements. The observatory to be under the immediate charge of a Superintendent and under the general control of the Director of the Magnetic Survey of India stationed at Kodaikānal.

(2) *Madras*.—Meteorological observations as at present, the working of the local time-ball arrangements, the distribution of time signals throughout India, and the preparation and issue of the Madras Daily Weather Report. The observatory to be placed under the immediate charge of a Superintendent and under the general charge of the Director of the Solar Physics Observatory at Kodaikānal.

(3) *Kodaikānal*.—(1) Observations in solar physics and the discussion of these observations and of any special astronomical observations that it may be considered desirable to take at Madras by the Director and staff of the Solar Physics Observatory; (2) the Magnetic Survey of India, meteorological observations and the discussion of the various series of magnetic observations made at Kodaikānal, Bombay, or in any part of the survey, by the Director and staff of the Magnetic Survey of India.

It will be seen that under this scheme, which is a further step towards the complete scheme originally proposed, provision is made for a survey of India instead of an extension of astronomical work; and, as at present, we are inclined to think that this is the preferable course. The notes of the Surveyor-General and our Director of the Geological Survey, which we enclose,

by

confirm us in our estimate of the importance of the proposed survey. But in such a matter we must depend largely upon the highest expert opinion obtainable; and therefore, while recommending the scheme generally to your Lordship's approval, we would suggest that it should be referred for examination and criticism to the Observatories Committee, the Solar Physics Committee of the Royal Society and the Admiralty or Board of Trade, or to any other authorities whose advice will, in your Lordship's opinion, be useful. We trust that the scheme as now formulated, subject to such modifications as may, on consulting the authorities referred to above, appear desirable, may receive your Lordship's approval.

7. The Governments of Madras and Bombay have expressed their general approval of the scheme, subject to certain observations on points of detail. The Bombay Government do not remark upon the criticisms offered by Mr. Moos, the officiating Director of the Colaba Observatory, and we do not find anything in them calling for special remark. They are merely the not unnatural protest of a Director against any reduction in the status of the institution which he directs. The required provision for peons has been added to the proposals.

8. The most important question raised by the Government of Madras is in regard to Miss Pogson's retirement and pension. The proposals of the Meteorological Reporter will be found in paragraphs 42 to 44 and 50 to 53 of his letter of 29th May 1896. The changes he suggests in the arrangement of work at Madras involve the retirement of Miss Pogson on a pension of Rs. 250 per mensem. In inviting the opinion of the Government of Madras upon the proposed arrangements, we specially referred to them the question whether a pension should be given to her. That Government, in reply, urge her claims very strongly indeed, and make their approval of the proposals contingent upon her being provided for, since "the Governor in Council finds himself altogether unable to agree to any arrangements which involve dispensing with Miss Pogson, the Meteorological Reporter to this Government, without a retiring allowance". The Meteorological Reporter to the Government of India also urges her claims most strongly. The Madras Government have shown themselves exceedingly ready to promote our aims in this matter, not only by relinquishing the control and consenting to the reduction in status of their own observatory, but also by agreeing to the Meteorological Reporter's proposals for the amalgamation of the Meteorological and Observatory establishments. We are unwilling therefore to insist upon the dismissal of Miss Pogson without a pension in the face of their opposition. But apart from this, we agree with the Madras Government in thinking that the case is an exceptional one and deserves exceptional treatment. Under a ruling of the 30th August 1876 (Finance Department Resolution No. 2430) the appointment of Meteorological *Observer*, if held by a person who has no other substantive appointment, is pensionable. The appointment of Meteorological *Reporter*, however, is held, in all provinces except Madras, in conjunction with other pensionable appointments, so that no general ruling has been necessary; and in the absence of special orders, Miss Pogson would come under the general rule that appointments paid by local allowances do not qualify for pension. Miss Pogson has done meritorious service for Government for nearly 24 years, of which over 11½ years were spent in a pensionable appointment which was, without any fault or shortcoming on her part, transferred by the Madras Government to another member of the family; and though her present appointment is a non-pensionable one, and she has therefore no claim on Government under the rules, we are unwilling, in carrying out our scheme, to deprive her of the means of livelihood. Mr. Eliot's proposals for amalgamation result in a saving of Rs. 519 per mensem upon the cost of the existing establishment and house-rent at Madras, so that, even if the proposed pension to Miss Pogson, upon which the Madras Government make their assent to the amalgamation conditional, is sanctioned, there will still be a net saving of Rs. 269 per mensem. We agree with that Government in thinking that, unless a pension is to be given to Miss Pogson, the amalgamation, with its consequent saving, should be postponed. Under the circumstances we have no hesitation in recommending very strongly for your Lordship's sanction the proposal to give Miss Pogson a pension of Rs. 250 per mensem with effect from the date on which the new scheme may be brought into operation. She is

at present in receipt of remuneration amounting in all to Rs. 550 per mensem; and will by that time have completed 25 years' service, as will appear from the statement of her services which we enclose.

9. The Government of Madras further raise the question of increasing the pay of Mr. Michie Smith, the Government Astronomer; but we are inclined to think that the consideration of this matter may be postponed for the present, although we recognise the fact that an increase will probably be advisable during the next few years.

10. In Lord Kimberley's despatch of the 31st August 1893 already referred to, he remarked that our proposals involved an initial outlay of Rs. 25,000 and a yearly increased charge of Rs. 1,619. The former figure was a rough estimate for the observatory only, and did not include the cost of accommodation for the astronomer and his establishment, or of an office building. It now appears that the cost of building in the Kodaikānal hills is unusually high; and the Solar Physics Observatory will cost Rs. 35,000, the Director's house Rs. 20,000 and quarters for his establishment Rs. 11,500. To this, under the present proposals, must be added another house for the Director of the Magnetic Survey at a cost of Rs. 20,000; while a joint office for the Observatory and the Survey, and the quarters for the establishment of the latter, will add Rs. 16,500 more. Thus the total cost of the buildings will amount to Rs. 1,03,000, of which, however, some Rs. 73,000 would necessarily be incurred under the original scheme. The additional capital outlay of Rs. 30,000 will enable us to secure from our annual outlay of Rs. 50,000 results which have been demanded by the best scientific opinion in England, supported by Your Lordship's predecessors, and which will rank with those obtained by other National or Imperial Observatories, and will ensure us a fuller return for our recurring expenditure than we obtain at present.

11. As regards the annual cost of establishment, the financial effect of the enlarged scheme may be thus compared with the cost under the original scheme:—

					RS.	A.	P.
Present Madras Observatory	..	..	..	..	380	0	0
Proposed Madras Observatory	..	..	..	..	332	0	0
	(a) Saving	..			48	0	0
Present Madras Meteorological Office	..	..	..	..	943	12	0
Proposed Madras Meteorological Office	..	..	..	..	524	12	0
	(b) Saving	..			419	0	0
Present Colaba Observatory	..	..	..	..	1,187	0	0
Proposed Colaba Observatory	..	..	..	..	507	0	0
	(c) Savings	..			680	0	0
Sanctioned by Secretary of State for Solar Physics establishment (d)	..	..	..	..	1,451	0	0
Available for Kodaikānal $a + b + c + d$	..	..	..	..	2,598	0	0
Proposed for Kodaikānal	..	..	..	..	2,529	0	0
	Saving	..			69	0	0
		..			250	0	0
Add Miss Pogson's pension	..	..	..	..	181	0	0 per mensem.
	Excess	..					

Rs. 100 per mensem on account of the rent of the Madras Meteorological Office will be saved by the amalgamation.

12. In conclusion we desire to suggest to Your Lordship that, in view of the extended scheme of operations now to be undertaken at the Kodaikānal Observatory, it might possibly be advisable to associate with the present Observatories Committee some gentlemen specially conversant with the subject of Solar Physics.

2429—11-10.

Copy forwarded to the Finance Department for information.

(By order.)

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

DESPATCH from the Government of India, Department of Revenue and Agriculture (Meteorology), to Her Majesty's Secretary of State for India, dated Calcutta, the 2nd February 1899, No. 14.

With Your Lordship's despatch No. 173 (Revenue), dated 22nd September 1898, we received a copy of reports by the Astronomer Royal and Sir J. Norman Lockyer and of a letter and enclosure from the Royal Society in reference to the proposed re-organization of Indian observatories. We would ask Your Lordship to communicate our acknowledgments to those gentlemen and to the Royal Society for the valuable assistance which they have given to our Government.

2. We now forward, for Your Lordship's information, a copy of a report by Mr. John Eliot, the head of our Meteorological Department and our principal scientific adviser, on the matters discussed in the papers under reference, and of the proceedings of a departmental committee to which we submitted them for further consideration.

3. Subject to Your Lordship's approval, we propose to accept and act on the recommendations (1) to (9) of the committee and on the first portion of recommendation (10). The second portion of the last recommendation is in accordance with our general views, but will not come under actual consideration until Mr. Eliot's retirement. The committee's recommendations provide for the carrying out through the agency of the Survey of India within two or three years of the fundamental magnetic survey of the Indian Continent recommended by Professor Rücker. This survey will be undertaken as part of the operations of the Survey Department, and will be controlled by an officer of that department. It may be necessary to arrange that the officer selected should undergo a short training in England before the survey is started; but on this point we await the recommendations of the Surveyor-General. We agree with the committee that until the completion of the fundamental survey, so much of the scheme submitted by us in 1897 to Your Lordship for organizing the Kodaikānal Observatory as provides for the appointment of a Director of Magnetic Surveys and appropriate staff should be held in abeyance.

4. We also agree with the committee that our work at Kodaikānal should for the present be restricted to the Solar Physics Observatory which is now in course of completion. We have authorized the officer (Mr. Michie Smith), who has hitherto held the post of Madras Astronomer, to assume the duties of Director of the Solar Physics Observatory at Kodaikānal, and we have decided to give immediate effect to the scheme of re-organization for the Madras Observatory and the Kodaikānal Solar Physics Observatory proposed in paragraph 48 of Mr. Eliot's letter No. 410 S., dated 29th May 1896, which formed an enclosure to our despatch No. 56, dated 1st September 1897. This scheme is identical in cost with that sanctioned in Lord Kimberley's despatch No. 117, dated 31st August 1893, and merely makes certain changes in the subordinate establishment. We also propose to grant from the 1st April next to Miss Pogson, the Meteorological Reporter to the Madras Government, the pension sanctioned in Your Lordship's Despatch No. 193, dated 4th November 1897, and to re-adjust the office hitherto held by her in the manner explained in paragraphs 52 and 53 of Mr. Eliot's letter above referred to.

5. With regard to the Colaba Observatory, we propose during the next two or three years to maintain its establishment as it is at present. The arrangement sanctioned in Your Lordship's Despatch No. 69, dated 6th May 1897, under which Mr. N. A. Moss receives a salary of Rs. 500 per mensem while holding the sub. *pro*

tem. appointment of Director, may be conveniently continued. But from the 1st April next we propose to bring the Colaba Observatory under the administrative control of the Meteorological Reporter to the Government of India.

6. The financial effect of our present proposals, as summarized in paragraphs 4 and 5 of this despatch, is shown in the tabular statement appended. The cost of the fundamental survey is excluded, as it is difficult to estimate apart from the regular operations of the Survey department.

7. We would request Your Lordship to obtain from the Royal Society the information which, in paragraph 4 of their proceedings, our departmental committee consider to be required in respect of the proposed astronomical observatory at Kodaikānal. The establishment of such an observatory two or three years hence will be dependent on financial considerations, and also on the cost of the arrangements which may be made for future maintenance of the magnetic survey.

8. We accept the conclusion recorded in paragraph 8 of the committee's proceedings that an annual inspection of the Indian observatories by a small board of visitors is not feasible in India. It would withdraw officers from other important work which fully occupies their time, and it would not, in our opinion, result in equivalent advantages. The observatories will from time to time be visited on convenient occasions by our Meteorological Reporter and by the Surveyor-General while these officers are on tour. We anticipate much benefit from the submission of the annual reports of the Kodaikānal Observatory and of the officer in charge of the Magnetic Survey to the Observatories Committee of the Royal Society, and from the assistance which we trust the Observatories Committee will give us in the settlement of definite programmes of work. We approve the recommendation made by Mr. Eliot in paragraph 8 of his letter that a programme for the Solar Physics Observatory be prepared and submitted to the Observatories Committee.

Minutes of Proceedings of the Committee, Calcutta, 19th December 1898.

PRESENT :

The Hon'ble Sir JAMES WESTLAND, K.C.S.I.

Mr. C. M. RIVAZ, C.S.I.

T. W. "HOLDERNESSE, Esq., C.S.I., Secy. to the Government of India, Department of Revenue and Agriculture.

Major-General C. STRAHAN, R.E., Surveyor-General of India.
J. ELIOT, Esq., C.I.E., F.R.S., Meteorological Reporter to the Government of India.

1. That the fundamental magnetic survey of the Indian Continent should be undertaken by the Survey of India, and that for the present, until the fundamental survey which is likely to last for two or three years is completed, the question of the appointment of a specialist from Europe as Director of Magnetic Survey is not one that presses for immediate decision. On the completion of the fundamental survey, the question of the future of the survey and of the discussion of the results will have to be considered.

2. That until the fundamental survey be completed the Colaba Observatory be maintained on the present scale.

3. That for the present the efforts of the Government of India be directed at Kodaikānal to the completion of the Solar Physics Observatory, and that the question of the establishment at Kodaikānal of an Astronomical Observatory be taken up hereafter along with the question of the appointment of the Director of Magnetic Surveys.

4. That meanwhile the Observatories Committee of the Royal Society be requested to advise as to the equipment, staff, organization and scheme of observations of the proposed Astronomical Observatory at Kodaikānal, and that when this information has been obtained, a site be selected and plans and estimates for the proposed buildings framed.

5. (a) That with reference to paragraph 3 of the Royal Society's letter the Director of Solar Physics (Mr. Michie Smith) be asked for an estimate of his requirements.

(b) That the Survey of India continue the daily photographs of the sun at Dehra at least for five years.

6. That with reference to paragraph 4 of the letter the Surveyor-General be asked to report on the proposal for the establishment of a permanent magnetic observatory for eye observations at Dehra.

7. That with reference to paragraph 5 the Surveyor-General be asked to report as to how he proposes to arrange for the superintendence of the fundamental survey.

8. That with reference to paragraph 6 it is agreed that the proposal for an annual inspection by a small board of visitors is not feasible in India.

9. That paragraph 7 be complied with by the Director of the Solar Physics Observatory and by the officer placed in charge of the proposed magnetic survey.

10. That the Director of the Solar Physics Observatory for the present be placed for administrative purposes under the Meteorological Reporter to the Government of India; and that eventually there should be a scientific adviser to the Government of India who should be a man of established European reputation and who should occupy the position of Director-General over the Meteorological, Solar Physics, Astronomical and Magnetic Branches of all Indian observatories.

STATEMENT showing the financial effect of the proposed re-organization of Indian Observatories.

		Sanctioned.	Proposed in 1897.	Now proposed.
		RS. A. P.	RS. A. P.	RS. A. P.
Solar Physics establishment		1,451 4 0	1,499 4 0	1,499 4 0
Madras Observatory		380 0 0	332 0 0	332 0 0
Madras Meteorological Office		1,043 12 0	524 12 0	524 12 0
Pension to Miss Pogson		Nil.	250 0 0	250 0 0
Colaba Observatory		987 0 0	507 0 0	987 0 0
Magnetic Survey		Nil.	1,030 0 0	Nil.
Total		3,862 0 0	4,143 0 0	3,593 0 0

No. 369, Public, dated 23rd March 1899.

Communicated to Government Astronomer and to the Meteorological Reporter to Government in continuation of G.O., No. 191, Public, dated 2nd February 1898.

2. In the despatch printed with the Government Order above quoted, the Secretary of State sanctioned the grant of a pension of Rs. 200 per mensem to Miss Pogson, and she should now submit a formal application to retire from the service from the 1st April 1899.

3. The following letter will be addressed to the Government of India:—

[Here enter letter No. 370, Public, dated 23rd March 1899.]

(True Extract.)

G. STOKES,
Chief Secretary.

- To the Government Astronomer.
- „ Meteorological Reporter to Government.
- „ Accountant-General.
- „ Revenue Department.
- „ Pension Department.

Exd. S. J. Pereira.

No. 873.

FROM

T. W. HOLDERNESS, Esq., C.S.I.,
Secretary to the Government of India,

To

THE CHIEF SECRETARY TO THE GOVERNMENT OF MADRAS.

Dept. of Rev. & Agri.
Meteorology.

Calcutta, the 8th March 1899.

SIR,

WITH reference to the correspondence ending with your letter

1. Despatch to Her Majesty's Secretary of State for India, No. 56, dated 1st September 1897.
2. Despatch from Her Majesty's Secretary of State for India, No. 173 (Revenue), dated 22nd September 1898, and enclosures.
3. Despatch to Her Majesty's Secretary of State for India, No. 14, dated 2nd February 1899, and enclosure.

organization of Indian observatories.

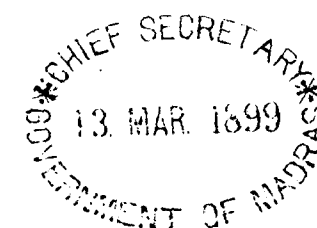
2. The Government of India were informed in Mr. Price's letter No. 941 (Public), dated the 21st November 1893, that the Government of Madras had no objection to the transfer of the control of the Madras Observatory and the funds connected with it to the Government of India or to placing the organization and management of the Solar Physics Observatory under the Meteorological Reporter to the Government of India. I am now to acquaint you that, in anticipation of the Secretary of State's approval of the scheme of reorganization, it is proposed to give effect to these arrangements from the 1st April 1899. The Meteorological Reporter to the Government of India has been informed accordingly, and the necessary budget provision has been made in the India estimates for 1899-1900.

I have the honour to be,

SIR,

Your most obedient Servant,

T. W. Holderness
Secretary to the Government of India.



80!

NO. 56 OF 1897.
GOVERNMENT OF INDIA.
DEPARTMENT OF REVENUE AND AGRICULTURE.
METEOROLOGY.

TO

THE RIGHT HONOURABLE LORD GEORGE F. HAMILTON,
Her Majesty's Secretary of State for India.

Simla, the 1st September 1897.

MY LORD,

WE have the honour again to address Your Lordship on the subject of the proposed extension and reorganisation of the Indian Scientific Observatories, and to forward copies of the correspondence on the subject noted in the margin.

1. Letter to the Government of Bombay, No. 1294 of 9th March 1895.
2. Letter from the Meteorological Reporter to the Government of India, No. 410-S., dated 29th May 1895.
3. Letter to the Government of Madras, No. 2541-11-6, dated 19th October 1895.
4. Letter to the Government of Bombay, No. 2542-11-7, dated 19th October 1895.
5. Letter from the Government of Madras, No. 1343-Public, dated 21st December 1895.
6. Letter from the Government of Bombay, No. 696, dated 9th February 1897.
7. Note by the Surveyor General, dated 13th July 1896.
8. Note by the Director, Geological Survey, dated 16th July 1896.

2. The original intention was to establish a complete Astronomical and Solar Physics Observatory in Southern India, and, while reducing the Madras Observatory to some extent, to leave the Bombay Magnetic Observatory untouched. This scheme which was set forth in our despatches No. 9, dated 10th February 1892, and No. 37, dated 7th June 1892, was referred to the Solar Physics and Observatories Committees, who approved the proposals and recommended their adoption. In informing the Government of India of this fact, Lord Kimberley remarked, in his Despatch No. 111-Rev., dated 10th November 1892:—

The Solar Physics Committee, it will be seen, suggest that if funds are not available for equipping a new complete observatory with two branches, the furtherance of solar physics in India would be the greater benefit to science, while astronomical requirements could for the time be met by the Madras Observatory. For solar physics observations costly buildings would not, it is added, be required. Your Government will, no doubt, consider carefully this view of the matter before you decide to recommend the establishment and equipment of a complete new observatory.

3. The financial position at the time did not admit of the establishment of the complete observatory referred to, and a partial scheme, in accordance with the suggestion of the Solar Physics Committee, was submitted to the Secretary of State in our despatch No. 37, dated 20th June 1893. This scheme, which provided for the establishment of a Solar Physics Observatory at Kodaikanal and the continuance of the Madras Astronomical Observatory on a reduced scale, was sanctioned in Lord Kimberley's Despatch No. 117-Rev., dated

31st August 1893. The necessary buildings at Kodaikanal are now under construction, and Your Lordship has sanctioned the requisite equipment of instruments.

4. The scheme involved the transfer to Kodaikanal of part of the Madras Observatory staff and the whole of the Dehra Dun Solar Observatory staff, and it was proposed to transfer the control of the Madras Observatory and of the funds connected with it to the Imperial Government, and to place the new Solar Physics Observatory immediately under the Government of India. To these proposals the Madras Government agreed. Further consideration led us to the conclusion that it would eventually be advisable to treat the Bombay Observatory in a similar manner, thus concentrating the higher physical work at a principal Observatory at Kodaikanal, to which the Bombay and Madras Observatories would be subordinate, and bringing all three under the control of the Supreme Government. The grounds upon which we arrived at this conclusion are fully set forth in our letter to the Bombay Government, dated 9th March 1895, which forms one of our present enclosures. The Government of Bombay anticipated no insuperable difficulties in effecting the desired change, but the discussion of details was left for consideration until Mr. Chambers should have retired. That gentleman died shortly afterwards, and pending a final settlement of the scheme, no permanent arrangements have been made for the working of the Colaba Observatory, and, as a purely temporary measure, Mr. Nanabhai Ardeser Moos, an officer of the Educational Department, has been appointed to officiate as Director.

5. The acceptance by the Governments of Madras and Bombay of the principle that scientific Observatories are properly national and not provincial institutions, and the change in the direction of the Colaba Observatory, rendered it possible to give immediate effect to a complete scheme of reorganisation. Such a scheme was elaborated by Mr. Eliot at our request, and will be found in his letter, dated 29th May 1896; and it is this scheme that we now submit for Your Lordship's approval. The proposals made by Mr. Eliot contemplate the following distribution of work at the three Observatories.

- (1) *Bombay*.—Magnetic and meteorological observations as hitherto (with any further improvements and extensions that may be suggested by the new Director and approved by the Observatories Committee), and the working of the local time-ball arrangements. The Observatory to be under the immediate charge of a Superintendent, and under the general control of the Director of the Magnetic Survey of India stationed at Kodaikanal.
- (2) *Madras*.—Meteorological observations as at present, the working of the local time-ball arrangements, the distribution of time-signals throughout India, and the preparation and issue of the Madras Daily Weather Report. The Observatory to be placed under the immediate charge of a Superintendent, and under the general charge of the Director of the Solar Physics Observatory at Kodaikanal.
- (3) *Kodaikanal*.—(1) Observations in solar physics, and the discussion of these observations and of any special astronomical observations that it may be considered desirable to take at Madras, by the Director and staff of the Solar Physics Observatory. (2) The

Magnetic Survey of India, meteorological observations, and the discussion of the various series of magnetic observations made at Kodaikanal, Bombay, or in the course of the survey, by the Director and staff of the Magnetic Survey of India.

6. It will be seen that under this scheme, which is a further step towards the realization of the complete scheme originally proposed, provision is made for a magnetic survey of India instead of an extension of astronomical work; and, as at present advised, we are inclined to think that this is the preferable course. The notes by our Surveyor-General and our Director of the Geological Survey which we enclose, confirm us in our estimate of the importance of the proposed survey. But in such a matter we must depend largely upon the highest expert opinion obtainable; and therefore, while recommending the scheme generally to Your Lordship's approval, we would suggest that it should be referred for examination and criticism to the Observatories Committee, the Solar Physics Committee of the Royal Society, and the Admiralty or Board of Trade, or to any other authorities whose advice will in Your Lordship's opinion be useful. We trust that the scheme as now formulated, subject to such modifications as may, on consulting the authorities referred to above, appear desirable, may receive your Lordship's approval.

7. The Governments of Madras and Bombay have expressed their general approval of the scheme, subject to certain observations on points of detail. The Bombay Government do not remark upon the criticisms offered by Mr. Moos, the officiating Director of the Colaba Observatory, and we do not find anything in them calling for special remark. They are merely the not unnatural protest of a Director against any reduction in the status of the institution which he directs. The required provision for peons has been added to the proposals.

8. The most important question raised by the Government of Madras is in regard to Miss Pogson's retirement and pension. The proposals of the Meteorological Reporter will be found in paragraphs 42 to 44 and 50 to 53 of his letter of 29th May 1896. The changes he suggests in the arrangement of work at Madras involve the retirement of Miss Pogson on a pension of Rs. 250 per mensem. In inviting the opinion of the Government of Madras upon the proposed arrangements, we specially referred to them the question whether a pension should be given to her. That Government in reply urge her claims very strongly indeed, and make their approval of the proposals contingent upon her being provided for, since "the Governor in Council finds himself altogether unable to agree to any arrangements which involve dispensing with Miss Pogson, the Meteorological Reporter to this Government, without a retiring allowance." The Meteorological Reporter to the Government of India also urges her claims most strongly. The Madras Government have shown themselves exceedingly ready to promote our aims in this matter, not only by relinquishing the control and consenting to the reduction in status of their own Observatory, but also by agreeing to the Meteorological Reporter's proposals for the amalgamation of the Meteorological and Observatory establishments. We are unwilling therefore to insist upon the dismissal of Miss Pogson without a pension in the face of their opposition. But apart from this, we agree with the Madras Government in thinking that the case is an exceptional one, and deserves exceptional treatment. Under a ruling of the 30th August 1876 (Finance Department Resolution No. 2430) the appointment of Meteorological Observer, if held by a person who has no other substantive appointment, is pensionable. The appointment of Meteorological Reporter, however,

is held, in all provinces except Madras, in conjunction with other pensionable appointments, so that no general ruling has been necessary; and in the absence of special orders, Miss Pogson would come under the general rule that appointments paid by local allowances do not qualify for pension. Miss Pogson has done meritorious service for Government for nearly 24 years, of which over 11½ years were spent in a pensionable appointment which was, without any fault or short coming on her part, transferred by the Madras Government to another member of the family; and though her present appointment is a non-pensionable one, and she has therefore no claim on Government under the rules, we are unwilling, in carrying out our scheme, to deprive her of the means of livelihood. Mr. Eliot's proposals for amalgamation result in a saving of Rs. 519 per mensem upon the cost of the existing establishment and house-rent at Madras; so that, even if the proposed pension to Miss Pogson, upon which the Madras Government make their assent to the amalgamation conditional, is sanctioned, there will still be a net saving of Rs. 269 per mensem. We agree with that Government in thinking that, unless a pension is to be given to Miss Pogson, the amalgamation, with its consequent saving, should be postponed. Under the circumstances we have no hesitation in recommending very strongly for Your Lordship's sanction the proposal to give Miss Pogson a pension of Rs. 250 per mensem with effect from the date on which the new scheme may be brought into operation. She is at present in receipt of remuneration amounting in all to Rs. 550 per mensem; and will by that time have completed 25 years' service, as will appear from the statement of her services which we enclose.

9. The Government of Madras further raise the question of increasing the pay of Mr. Michie Smith, the Government Astronomer; but we are inclined to think that the consideration of this matter may be postponed for the present, although we recognise the fact that an increase will probably be advisable during the next few years.

10. In Lord Kimberley's despatch of the 31st August 1893 already referred to, he remarked that our proposals involved an initial outlay of Rs. 25,000 and a yearly increased charge of Rs. 1,619. The former figure was a rough estimate, for the Observatory only, and did not include the cost of accommodation for the astronomer and his establishment, or of an office building. It now appears that the cost of building in the Kodaikanal hills is unusually high; and the Solar Physics Observatory will cost Rs. 35,000, the Director's house Rs. 20,000, and quarters for his establishment Rs. 11,500. To this, under the present proposals, must be added another house for the Director of the Magnetic Survey at a cost of Rs. 20,000; while a joint office for the Observatory and the Survey, and the quarters for the establishment of the latter, will add Rs. 16,500 more. Thus the total cost of the buildings will amount to Rs. 1,03,000, of which, however, some Rs. 73,000 would necessarily be incurred under the original scheme. The additional capital outlay of Rs. 30,000 will enable us to secure from our annual outlay of Rs. 50,000, results which have been demanded by the best scientific opinion in England, supported by Your Lordship's predecessors, and which will rank with those obtained by other National or Imperial Observatories, and will ensure us a fuller return for our recurring expenditure than we obtain at present.

11. As regards the annual cost of establishment, the financial effect of the enlarged scheme may be thus compared with the cost under the original scheme:—

			Rs.	A.	P.
Present Madras Observatory	...	...	380	0	0
Proposed Madras Observatory	...	...	332	0	0
(a) Saving	...	...	48	0	0

			Rs.	A.	P.
Present Madras Meteorological Office	...	...	943	12	0
Proposed Madras Meteorological Office	...	...	524	12	0
(b) Saving	...	...	419	0	0
Present Colaba Observatory	...	...	1,187	0	0
Proposed Colaba Observatory	...	...	507	0	0
(c) Saving	...	...	680	0	0
Sanctioned by Secretary of State for Solar Physics establishment (d)	...	...	1,451	0	0
Available for Kodaikanal a + b + c + d	...	...	2,598	0	0
Proposed for Kodaikanal	...	...	2,529	0	0
Saving	...	...	69	0	0
Add Miss Pogson's pension	...	...	250	0	0
Excess	...	...	181	0	0 per mensem.

Rs. 100 per mensem on account of the rent of the Madras Meteorological Office will be saved by the amalgamation.

12. In conclusion we desire to suggest to Your Lordship that, in view of the extended scheme of operations now to be undertaken at the Kodaikanal Observatory, it might possibly be advisable to associate with the present Observatories Committee, some gentlemen specially conversant with the subject of Solar Physics.

We have the honour to be,

MY LORD,

Your Lordship's most obedient, humble Servants,

ELGIN.

G. S. WHITE.

J. WESTLAND.

J. WOODBURN.

M. D. CHALMERS.

E. H. H. COLLEN.

A. C. TREVOR.

No. 2429
11—10

Copy forwarded to the Finance Department for information.

By order,

E. MACONOCHIE,

Offg. Under Secretary to the Government of India.

LIST OF ENCLOSURES.

1. Letter to the Government of Bombay, No. 794 of 9th March 1895.
 2. Letter from the Meteorological Reporter to the Government of India, No. 410-S., dated 29th May 1895.
 3. Letter to the Government of Madras, No. 2541—11-6, dated 19th October 1896.
 4. Letter to the Government of Bombay, No. 2542—11-7, dated 19th October 1896.
 5. Letter from the Government of Madras, No. 1343-Public, dated 21st December 1896.
 6. Letter from the Government of Bombay, No. 696, dated 9th February 1897.
 7. Note by the Surveyor-General, dated 13th July 1896.
 8. Note by the Director, Geological Survey, dated 16th July 1896.
- Statement of Miss. Pogson's services.

Met. Act. 1897. 1898.

File No. 11 of
1896.

Serial No. 10.

No.

1897.

GOVERNMENT OF INDIA.
DEPARTMENT OF REVENUE AND
AGRICULTURE.
METEOROLOGY.

No. 56, DATED SIMLA, 1ST SEPTEMBER 1897.

(Copy.)

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

SUBJECT.

Reorganisation of the Indian Observatories

C. C. 11, 14, Simla—No. 567 R. & A. D.—31-6-97.

India Office,
London, 22nd September 1898.

Revenue,
No. 173.

To His Excellency The Right Honourable The Governor
General of India in Council.

MY LORD,

Reorganisation of Indian Observatories.

• Dated 27th July 1898, and enclosure.

In continuation of my Despatch No. 193,
dated 4th November 1897, I now forward, for the
consideration of your Excellency, a copy of Reports
by the Astronomer Royal and Sir J. Norman
Lockyer, and of a letter* from the Royal Society,
in reference to the proposed reorganisation of
Indian Observatories.

I have the honour to be,

My Lord,

Your Lordship's most obedient humble Servant,

(Signed) GEORGE HAMILTON.

ENCLOSURES.

The Royal Society, Burlington House, W.,
27th July 1898.

Sir,

With reference to your letter of the 24th March (R. & S. 676), I am directed to Inform you that the reports of the Astronomer Royal and Sir J. Norman Lockyer on Indian Observatories (which have been or will be laid before you by those gentlemen themselves) have been considered by the Observatories Committee of the Royal Society; and to submit to you, on behalf of the Committee, the following recommendations and remarks :—

1. The Committee consider that the work of the Indian Observatories should be directed to the following subjects (for some of which provision is already made) :—

- (a) Astronomical observations (positions of sun, moon, planets, and fundamental stars).
- (b) Solar physics, as laid down in the reports of the Astronomer Royal and Sir J. N. Lockyer.
- (c) Magnetic observations.
- (d) Meteorological observations.

2. With regard to the astronomical observations, the Committee are informed that the meridian circle now mounted at Madras would (with some alterations) be available for this purpose, and the Astronomer Royal and Sir J. N. Lockyer are agreed that a suitable site for the Astronomical Observatory can be found at Kodaikanal.

3. The Committee suggest that a new spectroscope, as recommended by the Astronomer Royal and Sir J. N. Lockyer, be purchased without delay for observations on solar physics, together with an instrument for obtaining photographs of the surface of the sun in monochromatic light. It is desirable that the daily photographs of the sun be continued at Dehra Dun, at any rate for five years.

4. In view of the suggested magnetic survey, referred to in the next paragraph, the Committee approve the proposal to establish a permanent magnetic observatory in the north of India, and they understand that special facilities exist for this purpose at Dehra Dun.

5. The Committee approve, and attach great importance to, the suggestion that a magnetic survey of India should be undertaken, and enclose a minute by Professor Rücker on the conditions which should, if possible, be fulfilled. The magnetic survey should be under the general direction of a superintendent having special knowledge of terrestrial magnetism.

The Committee also recommend :—

6. That a small board of visitors, composed of a few scientific officials selected by the Indian Government, make an annual inspection of the Indian Observatories, and report to the Indian Government on their condition and administration.

7. That an annual report by the Government Astronomer of India and by the Superintendent of Magnetic Surveys be submitted to the Observatories Committee of the Royal Society.

I am, &c.,
ARTHUR W. RÜCKER,
Secretary, R. S.

The Under Secretary of State
for India.

Enclosure in above.

Minute on the Indian Magnetic Survey; by Professor A. W. Rücker,
Secretary, Royal Society.

A magnetic survey of a large district may be conducted for one or both of two objects:—

- (1.) To determine the isomagnetic lines for some given date, *i.e.*, the distribution of the magnetic elements cleared as far as possible of all local disturbances.
- (2.) To determine the course of the principal loci of local magnetic disturbance.

The former operation is essential to the latter, as the undisturbed values of the elements must be known before the disturbances can be calculated; and I should recommend that, in the first instance, places where great local disturbances, due to basaltic rocks, are expected, should be avoided, and that the first object should be to determine the isomagnetic lines.

2. The number of stations at which observations are made for this purpose must depend so largely on what is financially possible that I offer no suggestions, beyond remarking that Dr. Neumayer and I have independently suggested that, where possible, the distance between the stations should not be greater than 40 to 50 kilometres. It is, I suppose, probable that this station-density would be impracticable in India, but whatever decision is arrived at the following conditions should be fulfilled:—

- (1.) The stations should be fairly uniformly distributed over the whole of the district under survey.
- (2.) The survey should be carried out in as short a time as possible, so that the corrections for secular change may be small.
- (3.) The secular change should not be determined from the Observatories only; but several small groups of stations (the members of each group being relatively near together) should be selected in districts relatively far apart, at which observations should be made at regular intervals, so as to determine the rate of secular change at distant points. The number of such observations must depend on the length of time during which the survey lasts, but if this exceeds five years the observations at these selected stations should be repeated more than once, and in no case should the interval between such repetitions exceed five years.

3. The question as to the instruments to be employed should be carefully considered. The Kew-pattern instruments have the advantage of being those which English magneticians know best, and they are used in the Indian Observatories. Those used by M. Moureaux in the survey of France are, however, much lighter and can be transported more easily, but if employed they should be compared with the Kew instrument at an observatory to determine any constant error. There is not much difference in cost.

In any case, it is very desirable that at least two magnets should be supplied with each instrument for the force and declination observations, and at least three dip needles. Three and four in the two cases respectively would be better. The results obtained with the needles ordinarily employed should be frequently checked by one of those held in reserve, in order to detect any error which may arise from the accidents of travel. The greatest care should be taken to prevent the rusting of the axes of the dip needles. The observer should himself calculate out his results before leaving the station, in order that if any uncertainty arises from any cause the observations may be repeated at once.

4. Corrections will have to be made for diurnal variation, especially in the case of the declination. I understand that this will be obtained from self-registering instruments at three permanent observatories. It may be desirable

to instal a set of absolute instruments at a fourth place (*e.g.*, in the extreme north-west), and to determine the diurnal variation by hourly eye readings, taken so many times a month during the progress of the survey.

5. The instruments used will differ among themselves, and should be carefully compared before the survey begins. These differences probably vary with time and travel, and the comparisons should be repeated directly or indirectly, if possible once a year. Probably a scheme could be arranged by which each instrument could be compared with one or two others annually, without making it necessary to convey any one instrument a very great distance for this purpose.

6. In the above observations I have purposely refrained from making specific recommendations, because much depends on the number of observers and sets of instruments employed, and on the conditions under which the work is carried out. I wish, however, to draw special attention to the fact that, if the magnetic survey is to be thoroughly satisfactory, it should be planned as an independent piece of work; and the questions of how the stations are to be distributed and how the corrections for secular change, diurnal variation, irregular magnetic disturbances (storms), and instrumental errors are to be determined and applied, should all be settled before the work is begun.

No doubt valuable information might be obtained under relatively inferior conditions, but if the experience which has been obtained in Europe is utilized the level attained will be raised. If desired, I should be glad to be of assistance to those to whom the responsibility of carrying on the survey is ultimately entrusted, as many details not referred to above are nevertheless not unimportant.

7. When the fundamental survey above contemplated is complete, I hope that it will be possible to pay some attention to the question of local disturbances. In India these might be of special interest.

ARTHUR W. RÜCKER.

REPORT

Serial 3

ON

INDIAN OBSERVATORIES,

WITH REFERENCE TO THE

PROPOSED SCHEME OF RE-ORGANIZATION,

BY

W. H. M. CHRISTIE.



CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1898.

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REPORT

ON

INDIAN OBSERVATORIES, WITH REFERENCE TO THE PROPOSED SCHEME OF RE-ORGANIZATION.

BY

W. H. M. CHRISTIE, C.B., M.A., F.R.S.,
ASTRONOMER ROYAL.

SECTION 1.—INTRODUCTORY.

In a letter from the India Office, R. & S. 2557, dated 29th October 1897, the Secretary of State for India expressed the hope that, as I was going to India to observe the eclipse of the sun, "if would be possible for me to visit Kodaikanal, where my presence would be of the highest advantage in initiating the new and important departure which is under consideration in regard to the observatories in India." After having obtained the necessary leave of absence from the Admiralty, I expressed my willingness to undertake the duty entrusted to me, and arranged to visit Bombay and Madras Observatories as well as Kodaikanal, in order that I might be in a better position, after inquiries on the spot, to report on the scheme for re-organization of the Indian Observatories proposed by the Government of India. As my duties in regard to the work of the Greenwich Observatory necessitated my return early in March, the time at disposal after the eclipse on 22nd January was very limited, and I found it impracticable to visit either Dehra Dûn (where daily photographs of the sun are now being taken satisfactorily) or Calcutta, communication between Calcutta and Madras by steamer being irregular, and slower than the railway route *via* Bombay. I had, however, the opportunity of discussing the question of Dehra Dûn Observatory and of the arrangements for the proposed magnetic survey with the principal officers of the Survey of India (General Strahan, R. E., Colonel Gore, R. E., and Major Burrard, R. E.), who were with me in the eclipse camp at Sahdol.

SECTION 2.—BOMBAY OBSERVATORY.

The Bombay Observatory was established by the East India Company in 1826 at Colaba, its present site, but there is no record of observations prior to 1842, when the magnetic and meteorological department of the Observatory was established. It was not, however, till the year 1846 that the system of observation was put on a proper basis, and trustworthy magnetic and meteorological observations have been regularly made and published from that date to the present time, a period of more than 50 years.

In 1864 a Committee was appointed to inquire into the working of the Observatory, which was then in an unsatisfactory state, and as the result of their recommendations the late Mr. Charles Chambers was appointed Superintendent. New magnetic instruments (self-registering and for absolute determinations) were also obtained, and have been in use continuously since. On the death of Mr. Chambers in February 1896, Mr. N. A. F. Moos was appointed Officiating Director.

I visited the Observatory at Colaba on 5th January and received full information from Mr. Moos as to the instruments and methods of work. Mr. Moos furnished me with a list of the instruments in use,* and of the new instruments which he considered desirable. Of the instruments in use, the transit instrument by Gilbert is very old, dating from 1826, and its pivots are in a bad state. It is possible that if it were thoroughly overhauled and repaired it might be made serviceable, but I feel very doubtful whether it is worth the expense, and I would recommend that a new transit instrument be provided at a cost of about 80%. The sidereal clock is also very old and untrustworthy, and I would recommend that a new clock should be provided at a cost of about 80%. Also an electro-magnetic corrector should be provided for the mean solar clock. These improvements appear to be absolutely necessary to give accurate time for the shipping at Bombay.

* This list is printed in Sir Norman Lockyer's Report.

It is advisable that arrangements should be made for periodical repair of the instruments, which should be sent to England for the purpose, and an annual inspection of the Observatory and report on the condition of the instruments would be very useful in this connection.

The work appears to be carried on very satisfactorily, but several of the instruments are now quite out of date. The wax-paper process is still in use for the photographic registration, and though the results obtained with it are good, it involves much unnecessary labour for the photographers. Mr. Moos proposes to substitute the bromide-paper process now in general use, and I would urge that this should be done as soon as practicable.

The site of the Observatory at Colaba is very unfavourable as regards both magnetic and meteorological conditions, as was pointed out in 1865 by the Committee, who urged that it should be moved to a better locality. This, however, was not done, and since that time the establishment (in the year 1888) of two 38-ton guns in the neighbourhood of the Observatory has introduced a new disturbing element for the magnets. Owing to the magnetic character of the rock (basaltic trap) which crops up through the soil, it is hardly practicable to ascertain the disturbing effect of the guns, with store of shells and accessories, on the magnets, a trial magnetic survey of the Observatory compound showing considerable local variations due to the soil. Notwithstanding these difficulties, natural and artificial, of the site, Mr. Moos has been able to deduce with considerable accuracy the secular change of the magnetic declination for the 50 years 1846 to 1895, a valuable contribution to terrestrial magnetism.

While I feel that the site selected for the Observatory is peculiarly unfortunate, and that it is advisable that the Observatory should be moved, as recommended by the Committee in 1865, the great interest attaching to the determination of the secular change of magnetism at Bombay through a long series of years makes it essential that, when the Observatory is moved, great care should be taken to preserve, as far as possible, the continuity of the magnetic determinations by means of simultaneous observations made at the new and old sites.

SECTION 3.—MADRAS OBSERVATORY.

This Observatory was established in 1792, and valuable astronomical observations have been made, especially under Taylor and Pogson. But astronomical observations (except time-determinations) have been entirely suspended since 1887, the whole strength of the establishment being devoted to working up and publishing the observations which Mr. Pogson had accumulated.

I stayed at the Observatory with Mr. Michie Smith on 6th and 7th February, on my way to Kodaikanal. Mr. Michie Smith gave me full information respecting arrangements made or proposed at Madras and Kodaikanal, and furnished me with a list of the instruments available for use at either observatory.*

The meridian or transit circle, though 40 years old, appears to be a good instrument, but it should be sent to England to be repaired and made thoroughly serviceable, advantage being taken of the opportunity to introduce such modern improvements as may seem advisable. But the growth of trees in the neighbourhood of the Observatory has, in course of years, greatly obstructed the view, so that stars near the horizon can no longer be observed. I would recommend, therefore, that for this reason, as well as for others, the transit circle should be re-erected at Kodaikanal after thorough repair and renovation. A small transit instrument, which is, I believe, available, would suffice for time-determinations at Madras.

SECTION 4.—KODAIKANAL OBSERVATORY.

In company with Mr. Michie Smith I visited Kodaikanal, where this Observatory is now being erected, on 9th February, remaining there four days. Kodaikanal is on a hilly plateau in the south of India, rising very steeply from the plain to a height varying from about 6,000 to 8,000 feet above the sea. The climate is remarkable for moderate temperature, with very small diurnal and annual variation. Mr. Eliot gives the mean temperature of the year 1892 as 58°·5, with an annual variation of only 8°·1 (from 54°·1 for December to 62°·2 for May). The mean diurnal range was 14°·2, with very small variation through the year. On the occasion of my visit the weather throughout Southern and Central India was very unfavourable for the time of year, being characterized by cyclones and thunderstorms, and at Kodaikanal there was much mist and cloud. Notwithstanding these abnormal conditions, the sun could have been photographed each morning, and the air was very steady, the definition with Mr. Michie Smith's telescope 3½ inches diameter being very good. At night cloud or mist prevented observation, except on one night, when the definition was found to be very good, stars being remarkably steady close down to the horizon. I was particularly struck with the brilliancy of the Orion nebula as seen in such a small telescope.

The site of the Observatory is on hilly ground near the centre of the plateau, the height being about 7,700 feet above the sea. It appears to be well chosen, commanding a clear horizon all round, with distant hills of about the same height round it; and the conditions for observing would presumably be more favourable than at the station near the edge of the plateau where the meteorological observations were made, or at the hotel where I observed. The Solar Physics Observatory is on the summit of the hill, a somewhat restricted site, and there is a somewhat lower secondary summit to the south-west which would be well suited for the Astronomical Observatory, having a clear horizon, except to the north-west, where a small portion of the sky is cut off by the higher summit.

* This list is printed in Sir Norman Lockyer's Report.

The foundations of the Solar Physics Observatory and of the Astronomer's residence were being laid at the time of my visit, and I discussed the plans on the spot with Mr. Michie Smith on two occasions. The plan provided for three domes or drums of 15 feet diameter at the north, south and east ends of the building, and these, with the polar siderostat on the west, would practically take up the whole available site. In order to provide more room for the equatorials and to allow for possible future expansion, I proposed to make the north and south domes of 18 feet diameter instead of 15 feet, and to omit the east dome and the eastern portion of the building for the present. It also seemed to me that the building was higher than necessary. The suggested modifications have been approved, and are being carried out.

No provision appears to have been made as yet for photographing the sun in monochromatic light by the new Hale-Dealanders method, and I would recommend that, a small addition should be made to the building on the south side to allow of this important work being taken up with as little delay as possible.

SECTION 5.—OBJECTS FOR WHICH THE INDIAN OBSERVATORIES SHOULD BE MAINTAINED.

These were stated by me in the year 1883 in the following letter to the Secretary of State for India, as representing the contribution which, in my view, India should make towards the advancement of Astronomy:—

Dated 14th April 1883.

From—W. H. CHRISTIE, Royal Observatory, Greenwich,

To—The Under Secretary of State for India.

"In reply to your letter No. R. S. C. 132 of 3rd February, enclosing correspondence on the subject of the maintenance of the Madras Observatory, and requesting my opinion on the question, I have the honour to offer the following remarks, as the result of a full consideration of these papers, and of the information I have been able to gather respecting the observatories at Madras and Bombay.

"2. Since the matter was discussed in the year 1867, the requirements of astronomical science have changed in several important respects. At that date the pressing need in astronomy was an extensive catalogue of southern stars, and for this work an observatory in the latitude of Madras was not suited. But this want has now been supplied by observatories in the southern hemisphere, and what appears to be most needed at the present time is to link together observations of fundamental stars at northern and southern stations. The comparison which has recently been made of the positions of stars determined at observatories in the two hemispheres, shows discordances, which may arise partly from uncertainty in refraction and partly from errors peculiar to the location and the instrument at each observatory. It would therefore be, in my opinion, very desirable to make accurate observations of a limited number of stars at such an observatory as that of Madras, occupying an intermediate position between those of Europe on the one hand, and those of the Cape of Good Hope and Australia on the other.

"3. Independently of their scientific value, such observations of stars at Madras might be made of direct practical benefit to the Indian Trigonometrical Survey, as has been pointed out by Colonel Walker in his letters of 4th February and 23rd July 1867. To secure this object it might perhaps be desirable to affiliate the observatory to the Trigonometrical Survey, or at any rate to bring it into closer relations with the Surveyor-General.

"4. In addition to observations of fundamental stars, observations of the sun, moon, and planets might be made with great advantage at Madras, where the results would not be subject to uncertainty from refraction. In particular, the determination of the position of the ecliptic from observations of the sun is a matter of great importance in connection with accurate determinations of the positions of fundamental stars.

"5. Again, a new branch of astronomy, *viz.*, astronomical physics, has come into existence since 1867, and this has developed to such an extent that observatories have been established in several countries specially for observations of this class, whilst in England and other countries means have been provided for carrying on spectroscopic and photographic observations at the national observatory. India appears peculiarly suited for such observations, especially those which bear on solar physics.

"6. Taking, then, a general view of the requirements of astronomy at the present day, it would, I think, be desirable to maintain an astronomical observatory in India for the following definite objects:—

- "(a) Determination of accurate positions of the sun and of a limited number of fundamental stars, and, as far as practicable, of the moon and planets.
- "(b) Daily observations of the solar prominences, and of other solar phenomena, with the spectroscope.
- "(c) Daily photographs of the sun. (These are now satisfactorily provided for at Dehra Dun under the superintendence of the Surveyor-General.)

"7. In regard to the question of where such an astronomical observatory should be located, it is to be remarked that the reasons which were urged in 1867 for preferring Bombay

"6. I would therefore submit that the Madras Observatory should be maintained on an improved footing for the astronomical observations specified in Section 8, with magnetic and meteorological observations strictly subordinate, and that the Bombay Observatory should be maintained as at present for magnetic and meteorological observations. Though the Madras Observatory should, in my opinion, preserve its distinctive astronomical character, I think it desirable that magnetic observations, to a limited extent, should be made there, as valuable results may be expected from a comparison of magnetic fluctuations at two observatories on opposite sides of the Indian Peninsula. I may remark that systematic observations of the magnetic instruments have been made at Madras continuously, I believe, since the year 1841, though no results have, as far as I am aware, been published.

"9. But while I would strongly recommend the maintenance of the Madras Observatory, it appears to me highly desirable, in view of the past history of observatories in India, that some system of control should be provided with a view to securing their continued efficiency, and that speedy publication of the results of observations on which the value of an observatory almost entirely depends.

" 10. Remarking that there is no scientific public in India which could bring the pressure of opinion to bear on the conduct of an observatory, two modes of securing the continued efficiency of the observatories of Madras and Bombay suggest themselves to me :—

- " (1) An annual inspection of the observatories by the Surveyor-General, who should report to the Indian Government on their condition and administration.
- " (2) An annual report by the directors of the two observatories which should be submitted to a committee to be appointed by the President of the Royal Society as representing the scientific opinion of this country, the President Royal Society, President Royal Astronomical Society, and Astronomer Royal might be *ex-officio* members of the committee, with three or four nominated members.

It appears from the Note by the Meteorological Reporter on the future organization of the Madras Observatory (18th October 1891), that the Secretary of State has decided that it is desirable, if not necessary, that an astronomical observatory should be maintained in India for the objects defined in this letter, and they should therefore be taken as the basis of any scheme of re-organization. The requirements of astronomy as regards India remain substantially the same as in 1883, and the need for the observations I have specified has only been emphasized by the advances which have since been made in other countries.

The determination of the recently discovered variation of latitude, implying a small movement of the earth's pole, is a matter of great interest to astronomers, which is closely connected with the scientific work of the Indian Survey. This should now be taken up at the Indian Observatory in connection with the determination of the accurate positions of stars under (a).

In solar physics a method has recently been devised and perfected for photographing the sun's surface and chromosphere in mono-chromatic light, thus showing the relation of sun-spots and prominences. This method could be applied with great success in India, and it is very desirable that this work, which falls under the head (b) in my letter, should be taken up at the Indian Observatory.

But though the programme of work which I indicated in 1883 was apparently accepted by the Secretary of State, the unfortunate accumulation of arrears left by Mr. Pogson led to the suspension of all astronomical observations at Madras, in order that the whole strength of the establishment might be devoted to the computations. The working up and publication of Mr. Pogson's observations are now practically completed. Mr. Michie Smith informs me in a letter dated 12th May 1898 that the original MS. of the catalogue of 5,000 stars (which summarises and completes the whole work from 1862 to 1887) will be complete in another month, and the press copy soon after.

The time has therefore now come when the programme of observation which I formulated in 1985 should be carried out.

SECTION 6.—THE PROPOSED MAGNETIC SURVEY.

The proposal to make a magnetic survey of India appears to have been brought forward by the Meteorological Reporter and by the Surveyor-General at practically the same time. The following note by the Surveyor-General summarizes the matter:—

"Note on the proposed Magnetic Survey of India, by the Surveyor-General of India."

"The subject of a magnetic survey of India has been in my mind for some years, as hitherto no attempt has been made in this Department to take any scientific magnetic observations, which I think is greatly to be regretted. It is true orders have been issued to traverse surveys to record the reading of the magnetic needle when taking astronomical azimuths and to plane tables to note the variation as determined by their plane tables, but that is all. Under the most favourable circumstances, in the hands of the most careful observers, these would have given only approximate results, but taken as they were by conversers, these would have given only approximate results, but taken as they were by comparatively untrained and wholly unscientific men, the results have proved to be of no scientific value and of but little use even for survey purposes where great accuracy is not required. When in charge of the Drawing Office in Calcutta, it was a common thing to have inquiries made as to the variation of the needle in such and such a district, and it was very rarely that the question could be answered satisfactorily; in some cases there was no record at all, in others it had been determined so long ago that it was impossible to give a correct answer as the annual alteration was not known. I determined to try and do something to rectify this state of

"In these circumstances I determined to try and do something to rectify this state of affairs, and had already entered into correspondence with the Superintendent, Trigonometrical Surveys, as to the best way of utilising the four instruments for determining the magnetic elements which we possess, when I heard that Mr. Eliot was suggesting a systematic magnetic survey, and a few days ago I had an interview with him, at which he sketched out a rough programme by which we could make the best use of our four instruments, so as to supplement the work that he has proposed to undertake in his Department. It was proposed that two permanent stations, the one at Calcutta and the other at Dehra, should be started by the Survey Department, and that one instrument should be given to the officer who is to conduct the triangulation in Mekran and another to one of the officers working in Burma. These observatories will, so far as I can see, cost the Government absolutely nothing. Mr. Eliot is considering that an accurate knowledge of the magnetic

"I quite agree with Mr. Eliot in considering that an accurate knowledge of the magnetic elements all over India is of great practical importance, and a chart showing the lines of equal magnetic variation would be most interesting from a scientific point of view and of great value for survey purposes.

"C. STRAHAN"

"C. STRAHAN."

13th July 1896.

It will be seen that it was proposed that a systematic magnetic survey should be made by the Surveyor-General's Department, and in June 1896 Captain Burrard, R.E., Superintendent, Trigonometrical Surveys, informed Mr. Moos, the Director of the Bombay Observatory, of the decision of the Surveyor-General to include magnetic observations in the survey operations of his department, and arranged with Mr. Moos to make the Bombay Observatory the base station of the magnetic survey.

SECTION 7.—MR. ELIOT'S SCHEME FOR RE-ORGANIZATION OF THE INDIAN OBSERVATORIES.

Mr. Eliot proposes that the work carried on at the Indian Observatories of Madras and Bombay should be under the general direction of two European officers of high scientific attainments—a Director of Solar Physics and a Director of Magnetic Surveys—stationed at Kodaikanal, but absolutely independent of each other. Each of these would have a staff of native assistants, principally for calculations and scientific investigations. The observatories at Madras and Bombay would be placed under the immediate charge of half-time officers (Professors in the Educational service), who would reside at the observatories, see that the observers carried out their work fully and satisfactorily. The native staff at each of the two observatories would be reduced, provision being made only for time signals and meteorological observations at Madras, and for magnetical and meteorological observations and time signals at Bombay. At Bombay it is proposed to carry on the whole work of observations and tabulation of observations as hitherto, leaving the ulterior discussions to be made by the Director of Magnetic Surveys at Kodaikanal. But at Madras the astronomical work would be entirely dropped, and no provision is made for taking it up at Kodaikanal.

In the programme of work formulated by Mr. Eliot astronomical (meridian and extra-meridian) observations occupy the first place, but somehow, in the working out of his scheme, these have been altogether eliminated, and the astronomical observatory is replaced by a solar physics department and a magnetic survey. I do not think that such an arrangement can be accepted as satisfactory, and the statement made in the letter from the Government of India to the Government of Madras, under date 19th October 1896, that, "if conditions are satisfactory, and funds are available, a third Director may eventually be appointed to carry on the astronomical work," does not seem to me to recognize the position which the astronomical work should occupy.

But the fundamental principle of Mr. Eliot's scheme, that the native staff at Madras and Bombay should carry out the work, which must necessarily be done there, under the immediate supervision of half-time officers, residing at the observatories, the scientific officers who undertake the general direction of these observatories (including the responsibility for and discussion of results) being transferred to a more suitable station, seems to me to be well adapted to the conditions of India, and, from the inquiries that I have made, I gather that it would work well both at Madras and Bombay.

I consider, therefore, that Mr. Eliot's scheme, which has been carefully thought out, so as to utilize the money now apportioned to the observatories, may be accepted as a sound basis for the re-organization of the Indian Observatories, subject to provision for the astronomical observations required, and for the carrying out of the proposed magnetic survey under economical conditions.

SECTION 8.—PROPOSED MODIFICATION OF MR. ELIOT'S SCHEME.

Mr. Eliot's scheme does not make any provision either at Madras or Kodaikanal for the astronomical observations (positions of sun, moon, planets, and fundamental stars) which have been recognised as desirable by the Secretary of State. Further, it proposes to create a new permanent scientific department for the magnetic survey, a work which is not permanent in its nature, and which should be completed as rapidly as practicable by the temporary employment of a sufficient staff of trained observers. In the Survey of India Department we have a well-organised scientific staff, which, with a little special training, would be fully capable of carrying out a magnetic survey, as it has already carried out most successfully surveys of cognate nature.

In these two respects Mr. Eliot's scheme seems to need modification. I would propose that the magnetic survey should be undertaken by the Survey of India Department (which can carry it out at little additional expense), and that the two European officers at Kodaikanal should direct the whole of the work at Kodaikanal and Madras, this work to include astronomical observations of position and solar physics observations. Thus, in place of two independent Directors of Solar Physics and Magnetic Surveys, I would propose that there should be the Government Astronomer of India (a post which is abolished by Mr. Eliot's scheme) and a Deputy Astronomer. This would not affect the financial aspect of the scheme, and it would make better provision for the absence on furlough of the Astronomer.

A slight modification might also be made with advantage in the native staff, but this is a minor point.

The following is the modified scheme which I would propose, Mr. Eliot's original scheme being given also for comparison:—

Re-organization of Indian Observatories, Kodaikanal.

MR. ELIOT'S SCHEME.	PROPOSED SCHEME.
<i>Solar Physics Department.</i>	<i>Astronomical and Magnetic Observatory. (including Solar Physics).</i>
R	R
Director 800	Astronomer [R1,000—1,500] 800
First Assistant, R150—250 225	First Assistant 225
Second Assistant, R100—150 137½	Second Assistant 137½
Third Assistant, R65—85 80	Third Assistant 80
Fourth Assistant, R50—75 68½	Fourth Assistant 68½
Mechanic 40	Mechanic 40
Two Menial Assistants, R15—25 45	Two Menial Assistants 45
Writer, R30—50 45	Writer 45
Head Peon 12	Head Peon 12
Three Peons 20	Three Peons 20
Two Lascars 17	Two Lascars 17
<u>1,499½</u>	<u>1,499½</u>
<i>Magnetic Survey Department.</i>	
Director, R600—800 733½	Deputy Astronomer, [R500—1,000] 800
First Assistant, R120—180 165	Second Assistant, R100—150 137½
Second Assistant, R50—70 65	Second Assistant, R100—150 137½
Third Assistant, R30—50 45	Third Assistant 45
Two Peons 22	
<u>1,030½</u>	<u>1,120</u>
GRAND TOTAL 2,529½	2,619

It is proposed that the posts of Astronomer and Deputy Astronomer should be on a scale of salary similar to those of Professors in the Educational Service, but the scale would not necessarily apply to the present Astronomer, who accepted the appointment at a salary of Rs. 800, and whose claims to an increase of salary might be considered independently of future appointments. In my letter of 22nd July 1891 to the Secretary of State, I pointed out the importance of fixing such a scale of salary as would induce a properly qualified man to go out to India and Mr. Eliot originally proposed that the salary should be progressive, a proposal which was strongly supported by the Government of Madras. The men appointed to the posts of Astronomer and Deputy Astronomer should be of the same calibre as Professors in the Educational Service, and to secure such men a similar scale of salary is required. This should be fixed before any new appointment is made.

In the scheme as thus modified the astronomical observations of position might be made at Madras with the existing transit circle, but they could be carried out under more favourable conditions at Kodaikanal, and I would recommend that the transit circle should be moved there after having been sent to England to be thoroughly overhauled and repaired.

As regards the solar physics observations provision should be made for them at Kodaikanal with the least possible delay. They should include photographs of the sun in monochromatic light by the new method, as well as solar spectroscopic observations, both visual and photographic.

The daily photographs of the sun should be continued at Dehra Dun, where they are now being taken satisfactorily under the Surveyor-General's direction, at little or no expense beyond that of the plates and chemicals.

The magnetic survey of India would, in the proposed scheme, be undertaken by the Survey of India Department, and, as will be seen by the Surveyor-General's note, it could be carried out at a little or no additional expense, as it would form part of the survey operations. It is essential, however, that the Superintendent in charge of the magnetic survey should have a special knowledge of Terrestrial Magnetism.

As regards the Bombay Observatory, it seems advisable that it should be placed (at any rate while the Magnetic Survey is in progress) under the general direction of the Superintendent of the Magnetic Survey, and serve as a base station for the Survey. I agree with Mr. Eliot's proposal that it should be under the immediate supervision of a half-time officer and that the staff should be constituted as in his scheme.

SECTION 9.—CONTROL.

In my letter of 14th April 1893 I indicated a system of control for the Indian Observatories with a view to securing their continued efficiency. This comprised,—

1. An annual inspection.
2. An annual report to be submitted to a Committee in England.

The second part has been carried out; the reports being duly submitted to the Observatories Committee of the Royal Society.

As regards the annual inspection (which, I suggested, should be made by the Surveyor-General), I would now propose that a Small Board of Visitors, composed of the Surveyor-General, the Meteorological Reporter, and one or two other officials selected by the Indian Government, should make an annual inspection of the Indian Observatories (Kodaikanal, Madras, and Bombay), and report to the Indian Government on their condition and administration.

But, while it seems to me advisable that there should be this general control, I think it of great importance that nothing should be done to weaken the sense of responsibility of the Government Astronomer, and that he should not be placed under the direction of any other official. He alone should be responsible for the making of the observations considered advisable and for their discussion and publication.

SECTION 10.—SUMMARY OF RECOMMENDATIONS.

1. Provision to be made for astronomical observations (positions of sun, moon, planets, and fundamental stars) and solar physics observations at Kodaikanal, under the Government Astronomer of India, with a Deputy Astronomer and a staff of native assistants.

2. The daily photographs of the sun to be continued at Dehra Dun under the Surveyor-General of India, at any rate for the next five years.

3. The proposed magnetic survey of India to be carried out by the Survey of India Department under a Superintendent, who should have a special knowledge of terrestrial magnetism.

4. The Madras Observatory for time and meteorological observations to be placed under a half-time officer as Superintendent, with a reduced staff (as in Mr. Eliot's scheme), the whole work being under the direction of the Government Astronomer of India.

5. The Bombay Observatory for magnetical and meteorological and time observations to be also under a half-time officer as Superintendent, with a somewhat reduced staff (as in Mr. Eliot's scheme), the whole work being under the direction of the Superintendent of the Magnetic Survey.

6. A small Board of Visitors, composed of the Surveyor-General, the Meteorological Reporter, and one or two other officials selected by the Indian Government, to make an annual inspection of the Indian Observatories, and report to the Indian Government on their condition and administration.

7. An annual report by the Government Astronomer of India, and by the Superintendent of the Magnetic Survey (through the Surveyor-General), to be submitted to the observatories Committee of the Royal Society.

8. Other recommendations on details of arrangements will be found in the body of the Report.

W. H. M. CHRISTIE.

ROYAL OBSERVATORY ;
Greenwich, 15th July 1898.

REPORT

ON

INDIAN OBSERVATORIES AND THEIR ORGANIZATION,

BY

SIR NOR. N LOCKYER, K.C.B., F.R.S.



CALCUTTA:

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REPORT

ON

INDIAN OBSERVATORIES AND THEIR ORGANIZATION.

SECTION 1.—NUMBER OF OBSERVATORIES INSPECTED AND DISCUSSED.

Dealing with the existing observatories, we have in India six institutions in which work other than meteorological is carried on.
Starting from the north these observatories are as follows :—

Simla.—Actinometry.
Dehra.—Solar Physics.
Calcutta (Alipore).—Meteorology (including local forecasts).
Astronomy (time).
Magnetic.
Bombay.—Magnetic.
Meteorology (including local forecasts).
Astronomy (time).
Poona.—Solar Physics.
Madras.—Meteorology (including local forecasts).
Astronomy (time and general).

In addition to these observatories the Government of India many years ago proposed the erection of a hill observatory in Southern India, and the prosecution of solar physics inquiries in addition to the daily photographs of the sun taken at Dehra.
When effect is given to this project, which was locally studied in the Palni Hills in 1885 and finally approved by the Secretary of State in 1893, Calcutta, Bombay, and Madras will each be furnished with a group of two observatories supplying local and general astronomical needs.

In the inspection, the result of which forms the subject-matter of this Report, I visited all the above-named observatories with the exception of Simla.

SECTION 2.—HISTORY OF THESE OBSERVATORIES.

1. Colaba Observatory.
2. Poona Observatory.
3. Dehra Observatory.
4. Madras Observatory.
5. Alipore (no data received).

THE COLABA OBSERVATORY.

The important services rendered to the Indian Marine by the then purely astronomical observatory of Madras induced the East India Company in 1822 to establish another observatory at Bombay on the opposite coast of the peninsula. The site—the present one—was enclosed in 1823. The building was erected in 1826 by Mr. Curwin, the first astronomer. The instruments originally sent out were returned as unserviceable by Mr. Curwin, who seems to have resigned. The empty building was then assigned as a dwelling house to the Elphinstone Professor of Astronomy, and eventually, in 1840, he was furnished with the transit instrument and clocks at present in use for the purpose of giving time to the shipping and facilitate the rating of chronometers.

In the year 1841 meteorological and magnetic work was added to the programme, Mr. Orlebar being then director. The magnetic instruments had been intended for use at Aden in connection with similar sets at Simla and Madras, but they were finally set up at Bombay with the help of Mr. Caldecott, the Superintendent of the Trevandrum Observatory. With regard to the magnetic instruments, a Joint Committee of the Royal Society and British Association recommended that a magnetic survey of the "neighbouring country" should be undertaken.

In 1845 the programme of work was again expanded. The Geographical Society of Bombay proposed, and the Court of Directors and the Lords of the Admiralty provided, tide gauges for the West Coast, but they do not seem to have ever been effectively used; by 1865 the one at Colaba was the only one in operation. In the same year meteorological observations on the West Coast and at Aden were proposed by the same society.

After Mr. Orlebar, the work of the observatory was subsequently controlled by Commanders Montrion, Mitchison, Ferguson, Robinson and others. During this period the reports seem to have been published regularly year by year and they were submitted to the Astronomer Royal, chiefly "to make the state and proceedings of the observatories known." In 1867 the Astronomer Royal disclaimed the view that "power should be given to any person in England for the direction of the Indian observatories." A change was made in 1885 by the appointment of a Committee of Advice which had some relation to the Royal Society. I know nothing concerning the action of this Committee.

In 1864 the Bombay Government appointed a Committee to inquire into the operations of the observatory, Captain W. C. Barker, I.N., being President.

The following points were those on which the Government required special information:—

1. "The purposes intended by the present operations of the observatory."
2. "The degree of accuracy with which the present purposes are fulfilled."
3. "The improvements which are needed, and the extension of the observatory operations which is desirable, both generally and also with due regard to the class of this observatory and the resources of the Government."

This Committee presented a very valuable report from which most of the previous references to the history of this observatory have been derived, and they commence by stating "the purposes intended by the present operations of the observatory" which are given as follows:—

- (1) To keep and give the exact mean time to the extensive shipping in the harbour
Purposes of the present operations in the different to rate ships' chronometers, and to departments. make such extra observations of special astronomical phenomena as may be of use to science.
- (2) To register the indications of all the instruments measuring the different elements of the weather and climate, for the purposes of science generally, and with special reference to the bearings of meteorology on sanitary science; and to trace the propagation of the changes in the atmosphere from place to place, and the modifications they undergo in transit, with the special object of ultimately giving warning of sudden and violent changes of weather.
- (3) To keep a record of the observed times and heights of tide and to deduce therefrom the formulae representing their elements at this port, in order to predict these times and heights in future for the use of the shipping.
- (4) To observe and record the variations of the elements of terrestrial magnetism at an important intertropical point of the earth's surface, so as, in conjunction with the operations of other magnetical observatories, to assist in educing the laws of the phenomena of magnetic force, both for the direct advancement of this science and its application to others.

The Committee pointed out that many of the instruments were out of order, that the time balls were not in the best position, that the Meteorological Department was not in a sufficiently efficient state, that the attempts made at original research had been "singularly unscientific," that masses of observations,—tidal, meteorological and magnetical,—had been accumulated without any attempt at discussion, that no attempt had been made to improve methods of reduction, and so on.

Further, the site is objected to, and the transfer of the observatory from the Marine Department is suggested, and it is further recommended that a qualified Superintendent and a Board of Visitors be appointed.

As one of the results of the Report of this Committee, Mr. Chambers was appointed, as whole-time officer, in 1865.

Mr. Chambers' activity in his new position will be gathered from the following list of his published papers. I especially call attention to the 14 volumes containing the Magnetical and Meteorological Observations, 1867—1894.

LIST OF PUBLISHED PAPERS ON TERRESTRIAL MAGNETISM AND METEOROLOGY BY THE LATE CHARLES CHAMBERS, F.R.S.

Compiled by Professor N. A. Moos, Director of Government Observatory, Colaba, Bombay, and by L. A. Bauer.

A.—Papers Discussed and Published under the Authority of Government.

On the solar variations of magnetic declination at Bombay. Phil. Trans., 1869, pp. 363—386.

The absolute direction and intensity of the earth's magnetic force at Bombay. Phil. Trans., 1872, pp. 75—90.

The normal winds of Bombay. Appendix I to Bombay Magnetical and Meteorological Observations, 1865—70, pp. 199—212, Bombay, 1872.

On the lunar variations of magnetic declination at Bombay. Appendix III to Bombay Magnetical and Meteorological Observations, 1865—70, pp. 235—242, Bombay, 1872.

Meteorology of the Bombay Presidency. One vol. 4to, pp. 1 to 295, and one portfolio of 82 diagrams, etc. Eyre and Spottiswoode, London, 1878.

Notes on a comparison of two unifilar magnetometers, and on magnetic induction as affecting observations of the intensity of the horizontal magnetic force. Appendix to Bombay Magnetical and Meteorological Observations, 1871—78, pp. [53]—[60], Bombay, 1881.

Bombay Magnetical and Meteorological Observations, 1864 to 1884. Introductions and Compilations, 14 vols., 4to, Bombay, 1867—1895.

Appendices to Bombay Magnetical and Meteorological Observations, 1879—82, one vol., 4to.

- I. History of the set of magnetographs established at the Colaba Observatory, with a new theory of the vertical force magnetometer, pp. [1] to [83].
- II. On the solar and lunar variations of magnetic declination at Bombay in the years 1846—1872, pp. [84] to [137].
- III. On the solar and lunar variations of the earth's magnetic force at Bombay in the years 1847—1872, pp. [138] to [193].
- IV. The solar diurnal variations of declination, horizontal force, and vertical force at Bombay, as derived from the registrations of the Colaba magnetographs, pp. [194] to [235].
- V. Influence of height above or below the ground level upon the diurnal variations of declination and horizontal force, pp. [236] to [241].

Diurnal variations of declination and of horizontal force for each month (and year) of the years 1865 to 1872, deduced from the readings of Grubb's declination magnetometer and of Grubb's horizontal force magnetometer. Appendix to Bombay Magnetical and Meteorological Observations, 1884, pp. [1] to [16].

Appendices to Bombay Magnetical and Meteorological Observations, 1886.

- I. On the luni-solar variations of magnetic declination and horizontal force at Bombay, and of declination at Trevandrum.
- II. Luni-solar variations of magnetic declination at Batavia, and references to later extensions of the investigations of the preceding paper.
- III. On the influence of temperature upon the bifilar magnetometer.
- IV. Effect of heating the magnetograph room on the scale-coefficient of the vertical force magnetograph.
- V. Temperature coefficient of the vertical force magnetograph.
- VI. Temperature coefficient of the horizontal force magnetograph.

Appendices to Bombay Magnetical and Meteorological Observations, 1888—89, one vol., 4to.

- I. History of the set of magnetographs established at the Colaba Observatory, Bombay.
- II. The solar diurnal variations of declination, horizontal force, and vertical force at Bombay, as derived from the registrations of the Colaba Magnetographs [continued].

Appendix to Bombay Magnetical and Meteorological Observations, 1890.

The absolute magnetic declination and horizontal force at Bombay, and their secular and annual variations.

Appendix to Bombay Magnetical and Meteorological Observations, 1891—92, one vol., 4to. The secular variation of magnetic dip at Bombay during the years 1867 to 1892.

B.—Papers Published by Learned Societies.

On the direct influence of a distant luminary upon the diurnal variations of the magnetic force at the earth's surface. Phil. Mag., March 1858.

On the nature of the sun's magnetic action upon the earth. Proc. Roy. Soc., vol. 12, 1862—63, p. 567.

On the nature of the sun's magnetic action upon the earth. Phil. Trans. R. S., 1868, pp. 503—16. Declination-disturbances at Bombay, 1866. Proc. Roy. Soc., vol. 15, 1867, pp. 111—114.

On the uneliminated instrumental error in the observations of magnetic dip. Proc. R. S., vol. 17, 1868—69, p. 427.

On the solar and lunar variations of magnetic declination at Bombay. Part I. Proc. Roy. Soc., vol. 17, 1869, pp. 161, 162.

Observations of the absolute direction and intensity of terrestrial magnetism at Bombay. Proc. Roy. Soc., vol. 17, 1869, pp. 428, 427.

On the lunar variation of magnetic declination at Bombay. Proc. R. S., vol. 20, p. 135, Abstract.

Absolute direction and intensity of the earth's magnetic force at Bombay and its secular and annual variations. Proc. R. S., vol. 20, p. 107, Abstract, Phil. Trans., 1876, pp. 75—90.

On the lunar variations of magnetic declination at Bombay. Proc. Roy. Soc., vol. 20, 1872, pp. 135, 136.

On magnetic induction as affecting observations of the intensity of the horizontal component of the earth's magnetic force. B. A. A. S. Rep., 1877, pp. 33, 34.

Sun-spots and terrestrial phenomena. I. On the variation of the daily range of atmospheric temperature, as recorded at the Colaba Observatory, Bombay. II. On the variation of the daily range of the magnetic declination, as recorded at the Colaba Observatory, Bombay. Roy. Soc. Proc., vol. 34, pp. 231—264.

Examples of the application of a modified form of Sabine's method of reduction of hourly observations of magnetic declination and horizontal force to a single quarter's registrations of magnetographs at the Colaba Observatory, Bombay, to accompany the Second Report of the Committee appointed for the purpose of considering the best means of comparing and reducing magnetic observations. Published with the British Association Report for 1886.

Luni-solar variation of the vertical magnetic force at Bombay for the single quarter, November 1875 to January 1876, to accompany the Third Report of the Committee appointed for the purpose of considering the best means of comparing and reducing magnetic observations. Published with the British Association Report for 1887.

By C. and F. Chambers. On the mathematical expression of observations of complex periodical phenomena, and planetary influence on the earth's magnetism. Phil. Trans., vol. 165, pp. 261—402.

On the luni-solar variations of magnetic declination and horizontal force at Bombay, and of declination at Trevandrum. Proc. Roy. Soc., vol. 40, 1886, p. 316.

On the luni-solar variations of magnetic declination and horizontal force at Bombay, and of declination at Trevandrum. Phil. Trans. Roy. Soc., 1887, vol. 178, A.

Previously to the death of Mr. Chambers, as I shall point out elsewhere, the Bombay Government agreed to the imperialization of the Bombay Observatory on the understanding that the magnetic work was to be continued, and on the 17th February 1896 the Government of India, promising to transmit shortly the changes to be made in consequence of the imperialization, requested that, pending the decision of the larger question, "any local arrangements that may be made for filling up the vacancy caused by the retirement of Mr. Chambers may be temporary and provisional only."

Under these conditions Professor Moos was appointed temporarily in 1896 to carry on the work of the observatory. He has published among other papers a summary of 50 years' results of the Meteorological and Magnetical Observations, and of the records of Grubb's Declinometer.

The Declination Observations, 1894-96.

Notes on the disturbances of the instruments during the earthquake of 12th June 1897, on Dines' Pressure-tube Anemometer, on the Adjustment of Grubb's Declinometer, etc.

THE TAKHTASINGJU SOLAR PHYSICS OBSERVATORY, POONA.*

His Highness Takhtasingju, G.C.S.I., Maharajah of Bhownagur, in 1882 presented a sum of Rs. 5,000 in commemoration of a State visit he paid to Bombay, to form the nucleus of an observatory; an equal sum was given by the Bombay Government.

In 1884, Professor Naegamvala inspected the principal Physical Observatories, both in Great Britain and on the Continent, with a view of determining the best instrumental outfit for the new observatory.

On his return a 16½-inch Newtonian reflector and a small single prism spectroscope by Grubb, and also a grating spectroscope, 1½ inch aperture, by Hilger, were obtained. The Bombay Government was asked to recall from the Solar Physics Observatory at South Kensington the 6-inch Cooke with spectroscope attached which was then on loan there and with which Professor Naegamvala had worked while studying the methods employed in Solar Physics.

After considerable correspondence it was determined to establish the observatory at Poona and the main building of the observatory was erected in 1888. The reflector, however, was not installed till the end of the year 1890. Some spectroscopic work of a preliminary character was done during 1891, but it was found that the instrument used was altogether lacking in stability and was very weak in its driving parts. It was thereupon returned to Sir Howard Grubb for radical alterations.

During the absence of the reflector (1892-93) the 6-inch Cooke (which after its return from Kensington had remained packed in its boxes for want of funds) was mounted in the place of the reflector, and for the two dry seasons the "widening of lines" in solar spots in the region "b—F" was observed. An attempt was made to observe all the lines widened, a plan which was found to be altogether too ambitious.

In the meanwhile a demand was made for the 6-inch Cooke by the Indian Government for its transfer to Madras, with the ultimate object of establishing it at the new observatory at Kodaikanal, and the instrument was eventually handed over to the Madras Observatory in 1894. It was found possible, however, to obtain in its stead a 12-inch siderostat by Cooke and an 8-inch lens by Grubb of 11½ inches focus, which, with the Hilger grating spectroscope, are now housed adjoining the main building forming the Solar Section of the observatory.

During the years 1894-95 the repaired Grubb reflector was used in photographing nebulae and clusters, and some interesting photographs have been secured.

* Abridged from an account written by Mr. Naegamvala.

In 1896 Professor Naegamvala was sent to Norway to observe the total solar eclipse, and funds were also placed at his disposal to purchase instruments for observing the eclipse of 1898, and for the general improvement of the observatory appliances. With these funds a 6-inch Taylor-Cooke lens equatorially mounted with two objective prisms, a small 1½ inch quartz-spar prismatic camera, parts for a single-prism spectroscope 3-inch aperture, and a new shutter for the dome of the observatory have been purchased. The 16½ inch mirror has also been replaced by one of 20 inches by Dr. Common, thus allowing 40 per cent. more light than before.

Towards purchasing the instruments for the observatory Rs. 20,000 have been obtained from private sources.

Papers Published.

The following papers have been published by Professor Naegamvala up to the present time:—

- (1) On the Character of the Chief Line in the Nebula in Orion. M.N.R.A.S., li, 7.
- (2) Observation of the Transit of Mercury, 9th May 1891. M.N.R.A.S., li, 8.
- (3) The Spectrum of the Great Sun-Spot Group of February 1892. M.N.R.A.S., lii, 6.
- (4) Note on Nebula No. 6595 of the New General Catalogue. The Observatory, August 1895.
- (5) Note on a Photograph of Nebula M 8 in Sagittarius. Knowledge, August 1896.
- (6) On the above, and on a method of demonstrating faint details in Photographs. Journal, B.A.A., vii, 3.
- (7) Nebula HI, 43 Virginis, M.N.R.A.S., lviii, 8.

THE DEHRA OBSERVATORY.

I shall refer in section 5 to the Memorandum I addressed to the Secretary of State for India in 1877 on the subject of solar photographs in India.

The work was begun, and is still being carried on, at Dehra under the authority of the following letter addressed by the Secretary of State to the Governor General in Council:—

India Office, London,

28th September 1877.

My Lord,

Paragraph 1. With reference to your Industry, Science, and Art Despatch No. 3 of 1877, dated 16th February, requesting that the instruments recently in use at the Roorkee Observatory might be forwarded to this country, I have to acquaint you that I have received from Mr. Lockyer, well known in connexion with the study of Solar Physics, a memorandum on the subject of the photoheliograph, a copy of which is forwarded herewith.

2. Having considered the suggestions made by Mr. Lockyer, and viewing the fact that a study of the condition of the sun's disc in relation to terrestrial phenomena, has become an important part of physical investigation, I have thought it desirable to assent to the employment, for a limited period, of a person qualified to obtain photographs of the sun's disc by aid of the instrument now in India, on the terms explained in the letter that I have caused to be addressed to Mr. Lockyer, a copy of which is enclosed.

3. The photographer engaged for this duty will leave this country about the beginning of November, and on arrival may probably be best placed under the orders of the Superintendent of the Trigonometrical Survey, who, in communication with Colonel Tennant, might propose, for the consideration of your Excellency's Government, the detailed measures for giving effect to the plan of operations suggested by Mr. Lockyer.

4. It will be distinctly understood that the expense of making these observations shall be restricted to what is essential for obtaining the photographs, and that no outlay is contemplated for buildings or other appliances other than of a purely temporary character, the cost of which will be comparatively insignificant. The photographs will be sent to this country for future examination.

5. The stand of the photoheliograph will be retained in India, and a fresh tube will be sent there to replace that used by Colonel Tennant, which should be sent here as proposed. The other instruments may also be sent to England, and will be placed in the custody of the Science and Art Department, which has offered to take charge of them.

I have, &c.,

(Signed) SALISBURY.

In a letter to me, dated 24th October 1877, from the India Office, information was conveyed as to what steps had been taken to carry out the above recommendations.

It was arranged that Mr. Meins, a highly intelligent sapper who had been trained by me, should proceed to India and take photographs of the sun under the direction of Colonel Walker, to whom was left the choice of Mr. Meins' destination.

Thus, from the beginning of 1878 solar photographs were regularly taken at Dehra Dun in North-Western India, and were forwarded to the Solar Physics Committee at South Kensington for reduction.

Unfortunately Mr. Meins died on 31st March 1879, and the continuity of the Indian daily record was consequently broken until its resumption in December 1879.

In August the Government of India requested to be informed as to the importance of the continuance of the records interrupted by Mr. Meins' death.

In a letter dated 27th November 1879, a reply to the above request was sent by the Chairman of the Solar Physics Committee, in which it was pointed out what advantage had already resulted from the Indian photographs, the following statement being made:—

"The Astronomer Royal has been so kind as to furnish the Committee with a list of the solar photographs taken at the Royal Observatory during the period 21st July 1873 to 18th July 1879, over a part of which Mr. Meins' work extended. It should be mentioned that in both places alike the rule was to take three photographs daily, in the morning, about noon, and in the afternoon, when clear views of the sun could be obtained. In the rare cases in which a fourth photograph was taken on the same day in India, it is not included in the following list":—

Total number of days during which both instruments were working simultaneously, between 11th February 1878 and 31st March 1879	384
	Greenwich. India.
Total number of photographs, reducing where four or more have been taken to three	207 872
Number of days on which one at least was taken	143 342
Number of days on which no photograph was taken	244 42

In view of these facts the Committee was of opinion that the series of Indian sun photographs should be resumed as early as practicable, and should be continued without break at all events for three or four years to come, the then period of increasing solar activity being one of peculiar scientific interest.

The Committee further suggested that the Surveyor-General of India, under whom Sergeant White, the successor of Mr. Meins, would be employed, might usefully be instructed to cause one or more native employes of the Survey Department to be instructed in the process of solar photography, so that risk of interruption of the series from sickness, etc., of the European photographer might be guarded against in the future.

The foregoing letter was submitted for consideration to the Government of India, and in February 1880 the India Office acquainted the Solar Physics Committee with the measures taken to resume the series of daily photographs of the sun's disc. By November in the same year it was reported that the work was being carried on systematically at the Trigonometrical Survey Office at Dehra and that that office possessed a sufficient number of employes to carry on continuously for the future the daily photographs of the sun, the taking of which was resumed in December 1879.

Since that date there has been a weekly despatch of pictures from India to England. At least two negatives have been taken daily in fair weather, and silver prints made of all the negatives.

THE MADRAS OBSERVATORY.*

The Madras Observatory was founded by the East India Company in 1792 "for promoting the knowledge of Astronomy, Geography and Navigation in India." Sir Charles Oakeley, who was then President of the Council and deeply interested in the subject, anticipating the orders from the India House, carried out the design under his own authority, so that when the actual orders arrived the observatory was already built and partly supplied with instruments. This was rendered possible by the liberality of a member of the Madras Government, William Petrie, Esq.

On the south wall of the observatory is a slab bearing the following inscription:—*Astronomia Consecratum Sumptibus Societatis Anglicanae in India mercaturae faciendae favendo Carolus Oakeley, Barr. Praefecto Praesidii Sancti Georgii A.D. MDCCXCII.*, and a translation in Tamil, Telugu, and Hindustani is carved on the granite pier in order that "Posterity may be informed a thousand years hence of the period when the mathematical sciences were first planted by British liberality in Asia."

The first Astronomer was Mr. J. Goldingham, who also held the appointment of Government architect. His earliest observations, made in 1793, are recorded in a manuscript volume, prefaced by an account of the building of the observatory. Two folio volumes contain the observations made by him between 1812 and 1825, while another volume contains an account of pendulum determinations made near the Equator and at Madras. He also determined the longitudes of a number of stations in India and elsewhere, and made a long series of observations on the velocity of sound by means of the Fort and Mount time guns.

A meteorological register was begun in 1796.

The second Astronomer was Mr. Thomas Glanville Taylor, F.R.S., who was in charge of the observatory from September 1830 till early in 1843. He received his training as an astronomer at Greenwich Observatory. He erected new and much more powerful instruments. These consisted of a five foot transit instrument, a mural circle of four feet in diameter, and a five foot equatorially mounted telescope by Dollond. With these instruments Mr. Taylor began the construction of his star catalogue, which, in its final form, was published in 1844, and contains the places of over 11,000 stars.

Hourly meteorological and magnetical observations were begun in 1840 by Captain Ludlow, and transferred to the observatory in 1845, when the buildings were considerably enlarged. Taylor's observations are contained in seven published volumes.

* The following particulars have been condensed from Mr. M. Smith's Report to the Chief Secretary to Government, dated 23rd May 1892.

In 1849 Captain W. S. Jacob, of the Bombay Engineers, was appointed Government Astronomer in succession to Taylor, who died in 1848. He published one volume of astronomical results. Captain Jacob resigned the appointment early in 1859. So far as I can make out the magnetical observations were discontinued in 1855.

The Office of Government Astronomer was held during the next two years after Captain Jacob's death part of the time by Major W. K. Worster, R.A., and the other part by Major (now General) J. F. Tennant, R.E. The instruments up to that time in use having become obsolete, it was resolved to replace them by modern instruments of a high class, a change which caused much delay in the work of the observatory for several years. In 1861 the late Mr. N. R. Pogson arrived at Madras as Government Astronomer, and found the erection of the new transit circle still far from complete, so that it was not till May 1862 that it was fully ready for use. This instrument has a telescope of 5 inches aperture and a circle 42 inches in diameter read by six microscopes. It was made by Messrs. Troughton and Simms.

In 1866 a new equatorial with an 8-inch object glass was erected on the roof of the Astronomer's house. Mr. Pogson accumulated a vast quantity of observations. The transit circle was employed for the preparation of a catalogue of 5,000 stars, each of which was observed five times. The whole of these observations, which were made almost entirely by the Native assistants, were reduced as soon as possible after they were made, and four volumes containing the results for the first twelve years have been published.

On the death of Mr. Pogson in 1891 Mr. Michie Smith succeeded him.

SECTION 3.—CONCLUSIONS TO BE DRAWN FROM THESE HISTORIES.

It is clear that the earlier observatories to which reference has been made were not established merely to supply stringent local needs,—time signals and the rating of chronometers being among the first,—but it is also clear that as time went on other local needs were added, tide tables and weather forecasts among them, and in course of time everything which had not especially to do with these needs, all the pure researches, contemplated possibly by persons unacquainted with the local circumstances had to give way more or less,—the magnetical observations at Madras, the observations in general astronomy and the magnetic survey of the Bombay Presidency, are cases in point,—and at last disappeared from the programme of work.

Even the reduction and discussion of the observations made were at length discontinued, and all this time, in consequence of the isolation of each establishment, of the lack of general control, of reports of progress to a competent local authority or committee, or even of inspection, there was no machinery for preventing breaks of continuity, or neglect, or for bringing about a better state of things for the future.

It would appear that the Government were under the impression that there was a control by the Astronomer Royal, but that official himself disclaimed it. The local needs of India are getting greater every day; at each of the ports more work is required in the shape of local weather forecasts, examination of chronometers and other instruments, and new observations with seismological and magnetic and meteorological instruments are asked for.

Under the present conditions, then, basing my opinion upon what has happened, it is my firm impression that things will not improve with this increase of area of observation, unless there be a definite scientific control in India itself to co-ordinate the various establishments, to inspect them, and to insist upon continuity and efficiency as well as economy in every branch of the work.

For the local needs there must always be duplication of work; for the wider needs it can and should be reduced to a minimum, but this can only be accomplished by an officer in charge of the whole effort, and by an officer on the spot. The Observatories Committee of the Royal Society and the Solar Physics Committee of the Science and Art Department, no doubt can render great service in making suggestions and acting as courts of appeal; but, as the late Astronomer Royal pointed out in 1867, they are, and must remain, ineffective in matters of control.

In Britain a well-used method of controlling the work of observatories is that of appointing Boards of Visitors. This method cannot be employed in India—the men are not there.

SECTION 4.—THE PRESENT CONDITION OF THESE OBSERVATORIES, WITH RECOMMENDATIONS.

1. The Colaba Observatory.
2. The Poona Observatory.
3. The Dehra Observatory.
4. The Madras Observatory (no information).
5. The Alipore Observatory.

The Colaba Observatory.

I inspected this observatory on 28th January, Professor Moos rendering me every assistance. The accompanying plan shows the present arrangement of the buildings.

The following list of instruments at present in use for observational purposes was handed to me by Professor Moos:—

Name of Instrument.	Maker.	Year in which first used.	REMARKS.
ASTRONOMICAL.			
Sidereal Clock	Thwaites and Reed .	1840	
Transit Telescope	W. and T. Gilbert .	1840	
Collimation Meridian Mark	Seid Mohsin .	1840	
Chronograph	T. Cooke and Sons .	1897	
Electric Clock	Shepherd and Sons .	1872	
Mean Time Clock	Samuel Cave .	1840	
Old Mercurial Pendulum Clock	Not known .	1840	
MAGNETICAL.			
Magnetometer, Kew Unifilar, No. 23	Elliot Brothers .	1867	
" " " " 131	Nalder and Brothers .	1896	On loan from Elphinstone College.
Dip Circle	Henry Barrow .	1867	
New Dip Circle	Dover Charlton .	1897	
Old (Induction) Apparatus used as Magnetometer	Not known .	1845	
Grubb's Horizontal Force Magnetometer, with Thermometer	Grubb	1842	
Grubb's Declination Magnetometer	Grubb	1842	
Vertical Force Magnetometer	"	—	Not in use since 1885.
Collimation Meridian Mark	Not known	1842	
Transit Telescope for Declination	Dollond	1842	
Declination Magnetograph and Vacuum Gauge	Adie	1870	
Horizontal Force Magnetograph Thermometer and Vacuum Gauge	"	1870	
Vertical Force Magnetograph, No. 1 Thermometer and Vacuum Gauge	"	1870	
Vertical Force Magnetograph, No. 2 Thermometer and Vacuum Gauge	"	1893	
METEOROLOGICAL.			
Barometer, No. 58, and its attached Thermometer	Newman	1842	
Barometer, No. 48, and its attached Thermometer	"	1847	
Barometer, No. 61, and its attached Thermometer	"	1847	Spare.
Standard Air Thermometer, No. 401	L. Casella	1871	
Standard Wet Thermometer, No. 402	L. Casella	1871	
Rain Gauge	J. Newman	1846	
Rain Gauge, Symon's No. 5797	L. Casella	1877	
Grass Radiation Thermometer, No. 106255	L. Casella	1893	Observations recorded since 1875.
Sun Thermometer, No. 37982	Negretti and Zambra .	1885	Observations recorded since 1875.
Maximum Air Thermometer, No. 1689	Murray and Heath .	1867	
Minimum Air Thermometer, No. 1358	" " "	1865	

Name of Instrument.	Maker.	Year in which first used.	REMARKS.
METEOROLOGICAL—concl'd.			
Minimum Wet Thermometer, No. 1349	Murray and Heath .	1867	
Maximum Thermometer, No. 539	Casella	1871	
Minimum Thermometer, No. 535	"	1871	
132 inches Ground Thermometer	Newman	1879	
60 inches Ground Thermometer	"	1851	
20 inches round Thermometer	"	1861	
9 inches Ground Thermometer	"	1847	
1 inch Ground Thermometer	"	1847	
Barograph and Thermometer	R. W. Munro	1871	
Self registering Barometer	L. Casella	1897	
Photographic Air Thermometer	R. W. Munro	1871	
Photographic Wet Thermometer	R. W. Munro	1897	Observations recorded since 1871.
Pluviograph	Designed by F. Chambers .	1876	
Beckley's Anemograph	R. W. Munro	1867	
Dines' Pressure Tube Anemometer	R. W. Munro	1897	

It will be seen from the list that most of the instruments used in the determination of time are of very old pattern. The transit instrument is dated 1826, and the "want of cleanness of its axis" struck me as it did the Committee of 1835. When funds are available I recommend that a new transit and clock be provided. One of Cooke's transits costing about 80%, similar to that in use by the students in the Royal College of Science, is all that is needed for the purposes for which it is intended.

The time ball service seemed well attended to, Bombay, time being notified. I suggest that in future an additional signal be made so that a difference of five hours from Greenwich time, that is, the time of the 75th meridian, be signalled to the shipping.

Professor Moos indicated to me the want of several meteorological and magnetical instruments and pointed out also the advisability of increasing the staff, but as these matters are certain to be considered when the imperialization of the observatory is carried out, I say, nothing about them here.

With regard to the present system of preparing the paper for the photographic records Professor Moos has informed me as follows:—

"The photographic work is very heavy, as we wax and sensitize our own paper. The process is the same old one discarded long ago by the English observatories. It has been slightly modified, and the result at this observatory at least has been quite successful, the loss of record being absolutely nil and the charts without any flaw. The substitution of bromide paper will no doubt considerably lessen the burden on the photographers, as the time spent in the first three processes, that of waxing, iodising, and sensitizing will be saved. This observatory has been selected by the Seismological Committee of the British Association as one of their stations, and seismological apparatus are shortly to be sent out by the Secretary of State, and in connection with that probably the bromide process will have to be used at this observatory. As in any sudden change of process there is a danger of loss of curve which is sure to follow the introduction of a new process, I think it advisable to wait for a year or so when the photographers will be thoroughly conversant with the new bromide process in connection with seismological apparatus, and I shall then, with the sanction of the Observatories Committee, adopt the bromide paper if the change is found necessary for all photographic self-recording instruments."

This seems the proper course to adopt.

As the observatory stands where it did in 1823 in spite of the very carefully considered recommendations of the Committee of 1865, there must be some dominating reason for the retention of the present site, although, so far as the adjacent fort is concerned, the conditions are, I believe, not much worse than they were formerly. I attempted to get precise information about the change of condition and find that at present the quantity of shell in store is only liable to small alteration as the guns are fired only at one practice annually.

The erection of another first class magnetic observatory at Alipore perhaps makes this question less important than it was when Bombay possessed the only magnetic record.

A considerable number of chronometers and other instruments are sent to the observatory to be compared, but the system of the observatory charging a fee, in vogue in 1864, seems to have lapsed, and whatever sum is paid goes to the assistants. I consider this a bad system. I suggest that the old system be reverted to, complete statistics of instruments examined and fees paid being given in the Annual Report of the observatory.

POONA SOLAR PHYSICS OBSERVATORY.

The accompanying plan shows the present location of the observatory buildings. It will be noticed that the plot of ground on which they stand is very restricted and that it is close to two roads and a railway. There is, therefore, a considerable amount both of dust and vibration. The railway is within 100 yards of the observatory and numerous trains pass both day and night. Nor are these the only objections to the present site. A dense mist arises both morning and evening from the river, which is some 900 yards away from the buildings.

Up to last year all the work done by Professor Naegamvala in the observatory was performed in addition to his full-time duties as Professor of Physics in the College of Science and without any extra remuneration. The Bombay Government has, however, by a recent resolution, relieved him of the duties of the professorship, and, in future, his work will be solely confined to that connected with the observatory.

The main building of the observatory consists of a centre-room 20 feet in diameter, over which is the equatorial room surmounted by a dome 15 feet in diameter with a shutter opening 2 feet beyond the zenith. On the left of this is a room 20 feet x 20 feet, which is used as a transit and clock room, and also as a general instrument store-room. On the other side is a photographic room.

A detached building 20 feet x 12 feet is used as the solar physics room and contains the 8-foot horizontal telescope.

A simple temporary building with sliding roof has just been sanctioned. Under this will be housed the new Cooke Prismatic Camera.

Instruments and work proposed to be done with them.

(1) A Cassegrain Equatorial Reflector by Sir Howard Grubb with Russell control and mouse-wheel electric fine-motion in AR; mirror 20 inches diameter, 135 inches focus, by Dr. Common,—to this is attached a 6-inch finder. It is proposed to mount on the tube two portrait lenses 4 inches and 1½ inch diameter respectively, and to use the reflector and the two lenses in simultaneously photographing nebulae and clusters from 20° N. to 30° S.

(2) A 12-inch siderostat by Cooke, an 8-inch lens 112-inch focus, by Grubb, horizontally mounted, and a spectroscope, 1½-inch aperture with Rowland grating by Hilger (partially spoilt). Arrangements are being made to attach a camera to the spectroscope. These instruments will be exclusively used for daily observations of lines widened in sun-spots.

(3) A 6-inch lens, Taylor-Cooke triplet 93-inch focus, equatorially mounted on a very massive stand with two prisms of 45°, 8 ins. x 6 ins. face. This will be employed in studying stellar spectra photographically, particularly in the Southern Heavens.

Besides these, the following minor astronomical and physical instruments are in the possession of the observatory:—

- (a) Position micrometer by Grubb.
- (b) Parts, viz., slit collimator camera and 60° prism for a 3-inch spectroscope.
- (c) Three-inch transit by Cooke.
- (d) Sidereal clock by Cooke.
- (e) Four-inch induction coil.
- (f) Rosenthal galvanometer.
- (g) A set of batteries.
- (h) A set of small accumulators.
- (i) A Sprengel's pump.
- (j) Set of vacuum tubes.
- (k) Set of pure chemicals.
- (l) Photographic materials, etc.

It is proposed to carry on the work with instrument No. 2 continuously during every clear day of the year, and to forward the observations to the Solar Physics Committee for reduction and discussion.

Staff.

To carry out the above programme it is proposed that the Staff in the future may consist of the following in addition to the Director:—

- (a) Two assistants, the senior assistant being at times put in charge of solar work;
- (b) One instrument keeper; and
- (c) A menial staff of a man and a boy.

Professor Naegamvala has proposed that residential quarters near the observatory should be provided for the assistants and instrument-keeper. This has been accepted in principle by the Bombay Government, and quarters for one assistant have been sanctioned.

To keep up the observatory, to supply it with photographic plates and materials, and to meet miscellaneous expenses, including the occasional purchase of small instruments, Mr. Naegamvala has asked Government to allow for the present a yearly grant of Rs500.

Inspection.

I inspected the Poona Observatory on 29th January, after the receipt of the following letter:—

No. 117 of 1898.

From the Secretary to Government to Sir J. Norman-Lockyer,

K.C.B., F.R.S.

Educational Department, Bombay Castle,
27th January 1898.

Sir,

I am directed to state that this Government will be highly obliged if you can make it convenient to visit the Government Observatory at Poona, and favour Government with any suggestions you may have to make regarding the working of the observatory. The Director of Public Instruction who, I believe, is in personal communication with you, will make arrangements for the inspection.

I have the honour to be,

Sir,

Your most obedient Servant,

(Signed) A. C. LOGAN,

Acting Secretary to Government.

I was more rejoiced than I can say to find that by a recent development of the Observatory, about which I had heard nothing previously, Mr. Naegamvala, who, so far I know, is the only person in India practically familiar with solar physics work (he was for some time in the Solar Physics Observatory at South Kensington), had been placed in such a favourable position for carrying on observations.

Of the instruments above enumerated I saw very little, as Mr. Naegamvala had only just returned from observing the eclipse, on which occasion he had used most of them. He was good enough to show me the results he had obtained, and I found them of a high order of excellence, while the programme of work he undertook showed a large grasp of the various solar problems which await solution at such times. To justify this statement I give the programme here.

Programme of the work undertaken at the Eclipse, 22nd January 1898:—

(1) Prismatic camera, equatorially mounted, 6-inch aperture, two prisms of 45°. Special photographs just at the commencement of totality and at the end. Photographs attempted, seven, and a running plate extra.

(2) Prismatic camera, 1½-inch aperture, quartz and spar. Photographs attempted, nine secured eight.

(3) Slit spectroscope, 3-inch aperture, image formed by an 8-inch lens, 112-inch focus. One photograph.

(4) Visual 6-inch telescope cut down to 4-inch. Six corona pictures, moon, ½-inch diameter.

(5) Portrait lens, 4-inch diameter, 20-inch focus. Five photographs.

(6) Three-inch equatorial telescope with a powerful slit lens, direct-vision spectroscope, used visually.

(7) A four-prism spectroscope deprived of its collimator.

(8) Three-inch equatorial for colour (Tachini), and forms of prominences.

(9) An integrating spectroscope, 1½-inch aperture to take 3° round the sun. (No record.)

(10) Meteorological and shadow band observations; duration, visibility of the corona visibility of stars, effect on plants and animals, etc.

I consider that the assistance proposed is sufficient for present needs, but as the Observatory is connected with an important College at Poona I think it well to point out how additional assistance, if required, can be afforded with great benefit to both institutions, by introducing a system which has been in operation for many years at the Royal College of Science. This is to allow a student who has shown great aptitude to spend a year in the Observatory, after he has taken his associateship, as teacher in training at a small weekly stipend.

I learn that at Poona a somewhat similar system is in vogue. There are post-graduate scholarships (called Dakshochina Fellowships) awarded to the most successful graduates of the year; they are usually tenable for a period of two years. If one of these fellowships were to be assigned to the Observatory, it would not only help the work of the Observatory, but would enable the Educational Department to obtain men practically versed in physical astronomy, and such men on leaving the Observatory might prove much more useful and valuable in teaching such subjects as physical geography and physiography than science graduates fresh from the class.

I would recommend therefore that if the occasion arises this suggestion should be acted on, experimentally in the first instance.

I am of opinion that eventually a better site should be provided.
Other suggestions for the future working of the Institution will be found in the accompanying copy of a letter which, at his request, I wrote to the Director of Public Instruction (E. Giles, Esq.), before leaving Poona:—

Poona,
25th January 1898.

My dear Sir,

Before I leave Poona, and in anticipation of my report on the Observatory here, which I shall not be able to prepare before my return home, it may be useful to state briefly the following opinions which I have formed:—

1. The Observatory is well equipped with instruments, and there is no need of any large expenditure on this head for some time to come.
2. Mr. Naegamvala is a thoroughly competent observer, and the direction of the Observatory may, I think, safely be confided to him when once a programme of work has been settled.
3. Work along several important lines of research can be commenced at once in the present locality.
4. The present locality is not a good one, and sooner or later a site free from vibration and road dust should be found if long period exposures are necessary.
5. The most useful work to take in hand at first is the daily routine observation by eye and photography of the widened lines in the spectrum of sun spots.
6. I think that the Solar Physics Committee would be prepared to discuss and publish these observations in connection with the observations made at home, in the same way that the daily solar photographs taken at Dehra are treated.
7. Photographs of stellar spectra should also be taken of some of the southern stars. These and other observations should be published by the Observatory, in order that Mr. Naegamvala may have an opportunity of showing originality and skill in facing special problems.
8. The (assistant) staff asked for is not unreasonable.
9. Temporary buildings only should be erected at present, as rapid changes in the best way of attacking new problems often occur, and require alterations in the distribution of instruments.

I am, dear Sir,
Very Sincerely yours,
(Signed) J. NORMAN LOCKYER.

THE DEHRA OBSERVATORY.

I visited the Observatory at Dehra on 7th February, and Colonel Gore, R.E., and Mr. Eccles rendered me every assistance in my inspection. I append a plan shewing the location of the two observatories.

I found the photoheliograph, with which the 8-inch pictures are taken daily, excellent condition. Wet plates are still used, and Colonel Gore, who has made a careful inquiry into the matter, has come to the conclusion that no dry plate at present available is so good as a wet one under the conditions at Dehra.

When it was proposed that the Survey Office should be removed from Dehra, it was suggested by Mr. Eliot that the Observatory should also be transferred and re-erected at Kodaikanal.

Even if the transfer of the Survey had been carried out, the removal of the Observatory to any other locality would have been of very doubtful policy, for the reason that the bad days at Dehra and Mauritius are fortunately almost complementary. And since we are absolutely dependent upon these two stations for the filling of gaps in the Greenwich series, to disturb such a happy state of things till we are certain that there is some other station in India with absolutely identical meteorological conditions, from the point of view to which I now refer, might destroy the present continuous record. I append a table showing how this matter stands based upon the photographs taken in the years 1891-96.

Table showing days on which no Solar Photographs could be taken at Dehra, and on which the gaps in the series were filled by Photographs taken at Mauritius.

Year.	Blank Days. Dehra.	Blank Days. Dehra + Mauritius.
1891	January 11, 16, 17, 22, 23, 24, 27. February 1, 2, 11, 16, 20, 25, 26, 27. March 6, 11, 12, 13. April 9, 12. May 24. July 8, 12, 14, 16, 21, 23, 24, 25, 31. August 4, 5, 6, 7, 12, 13, 14, 15, 21, 25, 26, 27. September 4, 5, 6, 9, 12, 13, 17, 18, 23, 28. October 4, 22, 30.	January 22, 24, 27. February 25. March 11, 12. July 22. September 17.

Table showing days on which no Solar Photographs could be taken at Dehra, and on which the gaps in the series were filled by Photographs taken at Mauritius—contd.

Year.	Blank Days. Dehra.	Blank Days. Dehra + Mauritius.
1892	January 1, 20, 22, 27, 28. February 4, 7, 12, 13, 14, 25. March 1, 3. May 1, 13. June 6, 12, 24, 25, 29. July 8, 9, 14, 18, 19, 21, 22, 25, 26, 27, 28. August 1, 3, 7, 8, 9, 10, 11, 14, 15, 16, 17, 19, 20, 23, 24, 27. September 1, 2, 6, 10, 12, 13, 14, 17, 18, 23, 24, 25. December 15, 16, 29, 30.	January 20. February 12, 13, 14. March 1, 3. August 23.
1893	January 2, 3, 4, 12, 13, 15, 16, 17, 23, 24, 28. February 4, 5, 6, 12, 13, 15, 16, 18, 19, 21, 22. March 5, 6, 10, 11. April 3. May 2, 30, 31. June 1, 20, 21, 22, 24, 27, 29, 30. July 1, 3, 4, 5, 9, 10, 13, 14, 15, 17, 19, 23, 31. August 1, 2, 3, 4, 6, 8, 9, 19, 26, 27, 28, 31. September 3, 4, 5, 10, 12, 16, 18, 19. October 4, 18. November 19, 20. December 25, 30, 31.	January 28. March 6. June 24. July 3. December 31.
1894	January 1, 18, 19, 20, 21, 22, 26, 27. February 2, 4, 6, 8, 9, 13, 28. March 1, 16. April 13. June 10, 11, 16, 19, 22, 28. July 16, 18, 24, 25, 26, 27, 28, 29, 30. August 2, 3, 5, 6, 9, 10, 11, 15, 16, 17, 24, 28, 29, 31. September 3, 4, 5, 6, 7. October 4, 5, 6. November 4, 5. December 4, 7, 10, 11, 14, 22, 23, 29, 31.	January 1, 20, 27. March 16. December 7.
1895	January 1, 4, 7, 8, 9, 14, 21, 22, 24, 31. February 8. March 2, 18. April 1, 2, 3. June 24, 30. July 1, 2, 25, 27, 28. August 3, 4, 7, 11, 12, 13, 14, 15, 16, 17, 25, 29, 30. September 2, 3. October 24. November 26, 27. December 2.	January 7. June 30. September 3.
1896	January 7, 13, 28, 31. February 2, 6, 14, 24, 25, 27, 29. March 22, 28. May 18. June 21, 24, 26, 27. July 13, 15, 16, 20, 21, 30. August 1, 2, 4, 5, 6, 9, 10, 13, 17, 18, 19, 21, 24, 25. October 28. November 6, 21, 22, 23. December 28, 30.	February 14. July 15. August 10.

With regard to the large photoheliograph which gives 12-inch pictures, the result of my inspection was not so satisfactory. Owing to death and the transfer of officers who were familiar with its working, it has not been used for some years, for one reason that no note of the special method of focussing the image on the screen necessitated by the fact that the object the glass is corrected for G light had been left behind. Since some plates exposed at the glass are apparently visual focus had not been successful the idea was formed that the apparatus was inefficient. The erroneousness of this view could not be demonstrated at Dehra because, unfortunately, no glass positives of the exquisite plates previously obtained and sent to the Solar Physics Committee had been retained as standards to work up to.

In consequence of this disuse the dome has been taken possession of by bees. I have sent out some glass allowing chiefly G light to pass through so that the original method of focussing may be re-established, and I trust the 12-inch series will soon be recommenced, especially as I have also informed Mr. Eccles of a chemical method of getting rid of the bees, which has been suggested to me by Professor Tilden.

What I saw and heard at Dehra leads me to the conclusion that, under Indian conditions, observations over heated roofs should be avoided where fine definition is required. Wherever possible the building from which observations are made should be on the ground and stand apart, and iron domes should also be carefully avoided.

Since the idea of the transfer of the survey has been abandoned, and since the work costs nothing, except the chemicals and glass (for I was assured by Colonel Gore that if the observatories were transferred there could be no reduction of the staff), I strongly recommend that if this work is also done at Kodaikanal, for which I see no necessity, the Dehra series shall not be interrupted until there is abundant evidence that the Dehra-Mauritius record is worse than the Kodaikanal-Mauritius one on an average of years.

THE MADRAS OBSERVATORY.

I visited the Madras Observatory on 18th February, and I thought it best to devote the time I could spend there to examining the provisional plans of the proposed Solar Physics Observatory at Kodaikanal and in endeavouring to ascertain what routine work was proposed for that station and when it was to begin. I refer to both these topics later in Section 10.

The following list of instruments at present at Madras has been forwarded to me at my request by Mr. M. Smith:—

List of Principal Astronomical Instruments at Madras Observatory.

- 1 Meridian circle (see Madras Meridian Circle, Observations, 1862, 1863, 1864).
- 1 Small transit instrument.
- 1 Equatorial (8-inch Troughton and Simms).
- 1 " (6-inch Cooke).
- 1 Twin telescope visual lens 6-inch Lerebour and Secretan, photographic 6-inch Grubb.
- 1 Grubb lens 6-inch aperture 40-feet focus.
- 1 Photoheliograph (Transit of Venus form).
- 1 Mean time clock (Shepherd and Sons).
- 1 " (Kullberg).
- 1 Sidereal clock (Dent).
- 1 " (Shelton).
- 1 " (Haswell).
- 1 Chronometer, mean time.
- 1 " sidereal.
- 1 Chronograph.
- 1 Spectrograph, concave grating, 10-feet focus, mounted on Rowland's plan.
- 1 Spectroscope, 6 prisms.
- 2 Spectroscopes (old patterns).
- 1 Micrometer for measuring spectrum photographs.
- 1 Large siderostat (polar) 11-inch mirror.
- 1 Small siderostat (polar).
- 1 Induction coil and battery.

Several small telescopes and minor appliances.

It is proposed to transfer some of these instruments to the new Solar Physics Observatory.

My recommendations will be found in Section 10.

THE ALIPORE OBSERVATORY.

I inspected this Observatory on the 14th February. I give a plan showing the position of the present buildings. Like the observatories of Bombay and Madras this Observatory meets local and special needs. Its local needs consist of time-ball and local forecast. Its special function is that it is the most important of the observatories under the Meteorological Reporter, and in it all instrumental tests and verifications are made. It is of importance to refer to this part of the work at length as its thoroughness is unsurpassed.

The following are the chief verifications of instruments undertaken in the laboratory. All the instruments as received from England, or returned from the Mathematical Instrument Office after repair, are examined.

Barometers.—As soon as they are sent here their vacuum, pouch, and other mechanical conditions are examined. They are then suspended for comparison and a couple of test readings are taken. They are then allowed to rest in the suspended state for some days, after which comparative readings are taken with the standard barometer both at rising and falling pressures. The usual dates of recording the readings are on six successive days.

Aneroids.—These instruments are compared both at ordinary pressures and in the vacuum chamber at lower pressures, both falling and rising.

Thermometers.—After examining their mechanical conditions, they are first compared at the freezing point, then with the standard thermometer in water at intervals of about 20°. After this comparison, the maximum and minimum are exposed in cages in the thermometer shed with standard maximums and minimums, and four comparative readings are taken daily for about a week to see how their action compares with the action of the standards. Those that are found to be irregular in their action, or otherwise defective, are condemned and not issued. The order is "return into store" when they are sent to the store of the

Mathematical Instrument Department, who allow a certain proportion of their value. The same remark applies to all other defective instruments.

Solar radiation thermometers.—These instruments are compared by being exposed with the standard solar radiation thermometer on stands for about 20 days.

Boiling-point thermometers.—Boiling point of these thermometers are tested in the Regnault's apparatus.

Dial anemometers.—These instruments are set up on the south-west turret of the Observatory building, which is about 50 feet above the ground, comparative readings are taken with the standard dial anemometer for about 10 days. Anemometers that are found to have much friction, or to be otherwise defective, are sent to the Mathematical Instrument Office for repair.

Rain-gauges and rain-measuring glasses.—Diameters of the mouths of rain-gauges are measured with a brass-gauge, and whether the mouths are circular or not is also determined. The capacity of rain-measuring glasses are also determined.

These are the most ordinary kind of instruments compared in the Observatory, but other instruments are also examined and compared.

The number of different classes of meteorological instruments examined and verified at the Observatory during the past seven years is given in the annexed table:—

Number of Instruments verified during the past seven years by the Alipore Observatory.

Instruments.	1890-91.	1891-92.	1892-93.	1893-94.	1894-95.	1895-96.	1896-97.
Barometers	99	81	86	50	78	102	107
Aneroids	15	13	10	25	35	10	19
Dry and wet bulb thermometers	85	77	33	69	32	65	30
Standard thermometers	40	6	4	2	2	...	1
Minimum thermometers for air temperature	98	86	98	98	70	83	90
Maximum thermometers for air temperature	56	61	86	47	96	103	60
Minimum thermometers for nocturnal radiation	17	9	13	3	3	3	...
Solar radiation thermometers	13	2	12	4	6	13	3
Sling thermometers	11	...	...	...	...	1	...
Traveller's maximum and minimum thermometers, in pairs	4	...	...	...	2	...	...
Six thermometers	2	...	1	...	...	1	...
Common thermometers	...	4	...	2	...	...	...
Boiling point thermometers	...	826*	80*	184*	...	1	...
Rain gauges	...	2,584*	3	1	...	...	...
Measure glasses for rain gauges	...	195	...	...	11	...	1
Spirit levels	23	...	23	...	...	...	...
Sand glasses	...	136	...	64	26	54	48
Brass gauges for testing rain gauges	46	57	72	...	...	3	...
Anemometers	...	...	...	...	...	...	1
Air meters	...	...	...	...	...	...	1
Richard Freres barograph	...	...	...	...	...	...	...
" " thermograph	...	...	...	...	...	...	...
Total	515	4,143	524	569	362	453	367

The astronomical work is carried on in the transit room on the south-east of the main building. It contains a transit instrument and three astronomical clocks. The time is obtained by meridian observations of the sun, and not by stars. Two time-balls, one on the Semaphore Tower, Fort William, and another on the roof of the Port Commissioner's Office, are dropped daily. All the three clocks are disconnected from the floor of the room; two are fixed to pillars built for the purpose and the third to the wall of the room. The pendulums of the first two oscillate in the direction of north to south and that of the third east to west, so that in case of earthquake all the clocks may not be equally affected. The chronometers of the Indian Marine Department and of vessels under the Port Officer, Calcutta, are lodged and rated at the Observatory. As long as they remain at the Observatory, they are rated and are issued at the demand of the Marine Department or the Port Officer. I suggest that an additional time signal be given shewing the time of the 90th meridian from Greenwich, that is 6 hours from Greenwich time.

In the grounds is a set of four underground thermometers. One is placed on the surface of the ground, the bulb of the second one foot underground, that of the third three feet underground, and that of the fourth six feet underground.

Observers for mollusil meteorological stations are from time to time sent to this Observatory to be trained in their duties.

I found arrangements being made for the establishment of a first-class magnetical observatory.

SECTION 5.—SUCCINCT STATEMENT OF THE GOVERNMENT PROPOSALS.

One part of the action of the Government during the last quarter of a century has depended upon the consideration that India would eventually gain by utilising the Indian conditions to study the sun in close connection with the related terrestrial phenomena.

* The great majority of these instruments were tested at the workshops of the Mathematical Instrument Department by the Chief Observer of the Alipore Observatory.

When I was in India in 1871, Lord Mayo, the then Viceroy, requested me to visit Simla to report on a site for a solar physics observatory. I was unable to do this, as I was then Secretary to the Duke of Devonshire's Royal Commission on Science, and on referring for permission to His Grace an extension of time was refused. Some time after the scheme which was then before the Indian Government fell through, as it was bound to do, by its scale, Lord Salisbury permitted me to draw up and send to him a memorandum showing what India could do at small expense.

This I did, and I give it here:—

26th June 1877.

"In accordance with the request made to me, I beg to send the following remarks on the Despatches dealing with the Indian instruments:—

1. Let me premise that solar research is now being specially carried on in Europe at—
 - (1) Potsdam, in the new Sonnenwarte.
 - (2) Paris, in the new Physical Observatory.
 - (3) Rome and Palermo.
 - (4) South Kensington, in connection with the Science and Art Department.
 - (5) At Greenwich, Wilna, and other places it is carried on in a less special way.
2. In these European observatories, however, especially in the more northern ones, we are attempting to make bricks without straw, that is, the climate is such that the observations are often interrupted, at times for weeks together, while in addition to this, in winter the sun's altitude is so small that fine work is impossible.
3. While this state of things holds in Europe, in India, on the other hand, one has an unlimited and constant supply of the *raw material*, by which I mean that there one can, if one chooses, obtain observations of the finest quality in sufficient quantity all the year round. I may even go further, and say that, limiting my remark to English ground, we have in India a monopoly of the raw material.
4. I learn from the papers sent to me, that although most of the instruments are already out in India, there is no immediate prospect of the establishment of a solar observatory on an extended scale for the purpose of securing observations over the whole field.
5. Although students of science cannot but regret that this is so, I still think there is no doubt that the new European establishments to which I have referred, and the proposed Russian observatory north of the Himalayas, render observations in India, over the whole field, of less vital importance than they were when the Indian observatory was first suggested.
6. I beg permission, however, to urge that what we most want now, and what we cannot get satisfactorily in Europe, can be supplied by India without the erection of an observatory in the sense in which that word occurs in the despatches, and at an outlay which need not exceed, let us say, 3000*l.* a year.
7. I refer to daily photographs of the sun's disc, which for the present, at least, can be obtained by the photoheliograph already in India. An intelligent sapper with a slight knowledge of photography, when he is once set going, can take these as well as a highly-paid astronomer, hence the small outlay for which I know such records may be secured.
8. I trust the Government of India may be pleased to receive this suggestion with favour; should they do so, such a photographer can easily be found in India, where I know also there are many able and willing to set him fairly at his daily work.
9. But if any difficulty is anticipated on this score, and it be necessary to fall back on this country, then, if permitted, I will endeavour, free of all expense to the Indian Government, to obtain and train such a man, and indeed I have such a one already to my hand, my present assistant, Sapper Meins, who obtains his discharge shortly, and is willing to proceed to India for a period of two years.
10. Further, if considered desirable, I would willingly receive reports from him, and in this way test and control his work for the first two years while in India.
11. The accompanying memorandum from Major Donnelly also indicates that the reduction of the photographs (the working up of the raw material), which I would also, if desired, superintend, may possibly be secured without expense to the Indian Government.
12. Supposing such a series of photographs started, the stand of the photoheliograph might remain in India, and the tube only be transmitted to the Astronomer Royal after another had been sent out, which has already been examined for distortion of image.
13. The other instruments should certainly come home at once. If not contrary to Indian regulations, I would beg to be allowed the use of them for a limited period. I am authorised to state that they would be held in charge by the Science and Art Department, and would be most carefully looked after.
14. My remarks are longer than I intended; I hope this freedom may be forgiven. I know I am second to many in the value of the advice I can give, but I am second to none in the anxiety I feel for the progress of this work."

The suggestions made in this memorandum were accepted and shortly afterwards solar photographs were commenced at Dehra, where they have been continued for a period of nearly 50 years with splendid regularity and with the greatest benefit to our knowledge of the sun.

In 1889 the Secretary of State asked the Solar Physics Committee how the telescope and spectroscopes then in the possession of the Indian Government should be employed. The Committee in reply suggested that the daily observation of the spectra of sun-spots should be taken in hand.

Another part of the action of the Government has depended upon the growing certainty that scientific inquiries must be imperialised to secure both efficiency and economy. The soundness of this view was established by the success of the Meteorological Department which was imperialised in 1874, Mr. Blanford being the first Director. This suggested then the imperialisation of the remaining observatories, not exclusively meteorological, and expanding them rather than establishing new and unconnected institutions.

At the same time it was felt that it was desirable to build a hill observatory, and preferably in Southern India, as a *succursale* to the existing institutions; and as far back as 1885 Mr. M. Smith was asked to report on the astronomical conditions of Kodaikanal. The death of Mr. Pogson, the Director of the Madras Observatory, in 1891 enabled the Government to take action from both these points of view, *i.e.*, to suggest the imperialisation of the Madras Observatory and the transfer of part of it to a hill station. This was in 1892.

The scheme drawn up by Mr. Eliot, which was referred to both the Observatories Committee and the Solar Physics Committee, contemplated both an astronomical and solar physics observatory and was accepted by both Committees: the Solar Physics Committee, however, pointing out that in case of lack of funds it was desirable to begin with the solar physics observatory.

The Government of India did not see its way, I presume on financial grounds, to equip a complete institution and proposed the erection of a solar physics observatory only. This limitation was referred to the two Committees in 1893 and approved by both, the Observatories Committee stating that they approved of deferring for the present the decision as to the permanent site of the astronomical observatory.

On the 31st of August 1893 the Secretary of State sanctioned the proposal and authorised the necessary outlay. This was to be borne on the meteorological budget (Under Secretary, Government of India, R. and A., E. D. MacLagan, 8th November 1893). The new observatory was placed under Mr. Michie Smith who had succeeded Mr. Pogson as Director of the Madras Observatory in 1891.

With regard to the question of imperialisation, the Government of India asked the Government of Madras in 1893 (Secretary, Government of India, R. and A., E. C. Buck, 4th November 1893) if they agreed to the transfer and to placing the organisation and management of the thus expanded Madras Observatory under the Meteorological Reporter to the Government of India. The Government of Madras at once assented. (From Government of Madras to Secretary to the Government of India, R. and A., No. 941 Public, 21st November 1893).

The general observatory question was expanded and complicated in 1895, when in consequence of the death of Mr. Chambers, the Director of the Observatory of Bombay, the question of the imperialisation of that Observatory had to be considered. Opportunity was taken by Mr. Eliot, who again was called on to prepare a scheme, to point out the importance of the magnetic survey of India which, as I have elsewhere pointed out, was very early laid down in the scheme of work of the Bombay Observatory. This and the reduction of the Bombay magnetic observations were added to the duties of the new hill observatory, a special Director and staff being proposed to look after it. These proposals were submitted for consideration to the Director of the Geological Survey, the Surveyor-General, and Director of the Indian Marine, and after approval by all these authorities they were forwarded to and accepted by the Bombay Government, which also expressed its approval of the proposed imperialisation; but in agreeing to hand over the Observatory to the Government of India, they insisted that the continuity of the Bombay magnetic observations, of which they were justly proud, should not be broken.

I am informed that the Government of India accepted this view, is pledged to continue magnetic observations at Bombay, and has informed that Government that they have no desire to reduce the number of observations made.

SECTION 6.—REMARKS ON THE GOVERNMENT PROPOSALS.

Taking the facts and decisions referred to as they stand, it is clear that it is not the present intention of the Government of India to provide a large establishment for the study of the older astronomy, but rather to improve the existing observatories with their several needs, and, further, to utilise the Indian conditions to study the sun and the terrestrial phenomena which, in the opinion of many competent authorities, are associated with solar changes.

From the beginning the appeals made to the Government of India to further these objects have been based upon the idea that sooner or later results of practical importance to the inhabitants of India would arise.

On this point I need only quote here the opinions of Indian authorities, and I begin with the following from the Famine Commission Report published many years ago now:—
"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 expenses 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."

As early as 1878 the investigations of the Indian meteorologists brought this matter nearer home (Annual Report 1877).

"The following are the more important inferences that the meteorology of India in the years 1877 and 1878 appear to suggest, if not to establish. There is a tendency at the minimum sun-spot periods to prolonged excessive pressure over India to an unusual development of the winter rains and to the occurrence of abnormally heavy snowfall over the Himalayan region (to a greater extent probably in the western than the eastern Himalayas). This appears also to be usually accompanied by a weak south-west monsoon.

"The characteristics of a weak monsoon are, great irregularity in the distribution of the rainfall over the whole of India and the occurrence of heavy local rainfalls which tend by a law of rainfall and of air-motion to recur over the same limited areas. The irregularity of rainfall distribution is often shown by the persistent and prolonged absence of rain over considerable areas. These areas of drought and famine are partly marked off by nature, depending to a certain extent on the geographical features and position of the district. Thus the rains are more likely to fall below the amount necessary for cultivation in the dry region of the Deccan or in Upper India, than over the Malabar coast area, or in the province of Bengal. Geographical position is, however, not everything. It probably explains sufficiently the tendency to the recurrence of famines in certain areas. The primary causes must be sought for in the great atmospheric current which is the source of the rains. The tendency to the occurrence of high pressure and low temperature due to excessive winter rains in Upper India and snowfall in the Himalayan region, assigns an adequate cause for the accompanying variation in the strength of the south-west monsoon. And as the continuance of the south-west monsoon during the months of July, August and September is mainly, if not entirely, due to the indraught which accompanies the rainfall, a weak monsoon and therefore lighter rains than usual in the early stages necessarily produce a feebleness indraught than usual. In other words, so far as this important factor influences the monsoon, if it is weak initially, it will be weak and feeble during the whole period. It is almost unnecessary to add that this has been amply confirmed by the experience of recent years. Hence the tendency at minimum sun-spot periods to the occurrence of excessive winter rains and snowfall in Northern India influences the meteorology of the whole of Northern India, giving rise to increased pressure, diminished temperature, etc., during the period immediately antecedent to the rains. The baric gradient of the south-west monsoon is smaller than usual at its commencement, and the monsoon is weak and feeble; a larger amount of the aqueous vapour is probably deposited over the sea area before it reaches India.

"In India the rainfall is more irregularly distributed than usual. The distribution of the rains in India itself is probably dependent upon the peculiar features of the local distribution of pressure. Local heavy rains over limited areas are accompanied by drought, partial or complete, over other areas. The probability of the occurrence of drought over any area depends partly upon the geographical position of the area, but mainly upon the antecedent abnormal atmospheric conditions, in so far as they modify the direction and strength of the lower atmospheric vapour-bearing currents."

I was anxious to learn from Mr. Eliot, who is at present in charge of Indian Meteorology, which is certainly the most important meteorological organisation in the world, and which, I believe, also covers the largest area, whether the experience of the last 20 years had caused him to recede from the opinion expressed as I have shown in 1873.

He was good enough to give me the following memorandum, with permission to print it here:—

"It appears to me certain, both from experience and theory, that there must be a direct relation between the variation in the distribution of the solar energy and the meteorology of the earth, and more especially of the tropical regions of the earth. The relation is probably not a simple one. It is now a fundamental principle in meteorology that the phenomena of terrestrial meteorology are directly or indirectly the results of the absorption and transformation of the energy of solar radiation by the atmosphere. It is hence evident that any large variation in the radiation of the sun (due to any cause) must give rise to corresponding variations in terrestrial meteorology. The experience of the last twenty years has shown fully that there are large cyclical variations in the annual distribution of rainfall in India to which it has not been possible as yet to assign a physical cause. The only hopeful direction of inquiry appears to me to be to ascertain whether these (and other similar) periodic variations in India are correlated with periodic changes in the sun. Hence the study of solar-physics is essential for progress in meteorology in India. It can be carried on under the most favourable conditions in India, and if a satisfactory solar-physics observatory were started the information would be immediately available for the information of the Meteorological Department, and hence, probably, lead to much more rapid progress than is at present possible in the science of meteorology, and its utilization for the purpose of seasonal forecasts, the most important problem with which the Indian meteorologist has at present to deal."

1st January 1898.

JOHN ELIOT.

The old arguments therefore have been strengthened by time.

I would beg permission in this place to point to the continuity of the intention and proposed action of the Indian authorities in attempting to provide gradually what they could not provide at once; and at the risk of appearing presumptuous, I would point out also how wise have been the steps proposed, not only to provide first what was wanted first, but to secure economy and improved administration over the whole field of observational activity. We have—

1. The idea that it was important to correlate solar with meteorological phenomena. This idea either originated with or was independently arrived at by the Indian authorities before 1871.
2. The starting of solar photographs in 1878.
3. The proposed starting of sun-spot spectrum observations in 1889.
4. The imperializing of observatories in 1891.
5. The approval of a hill observatory in 1893.

SECTION 7.—WHAT HAS HAPPENED TO THE GOVERNMENT PROPOSALS.

The various schemes for advancing solar physics, which, as I have shown have been under consideration from 1871 onwards, were by 1895 reduced to a single one having reference to the building of an observatory in Southern India. In the latter year, Kodaikanal was favourably reported on. In the next eight years the matter was carried a stage further; in November 1898 the Kodaikanal scheme was approved by the Secretary of State, the money granted and an organisation established, and everybody agreed to the imperialization.

But, so far as I can find, although now another period of five years has elapsed, nothing practically has been done. There has been no imperialization, practically no building, and not a single observation bearing on solar physics has been made beyond the photographs of the sun's surface commenced at Dehra in 1878.

The daily routine observations of the sun, including especially the observations of the spectra of sun-spots, the importance of which was pointed out in the Solar Physics Committee letters of 1889 and 1892, which might easily and cheaply have been undertaken at Madras pending the building of the Hill Observatory, are not even yet commenced.

In Mr. Eliot's recommendations, dated 4th March 1893, I find it stated that "the Secretary of State had requested that such observations should be initiated." Mr. M. Smith informs me that he has orders not to proceed with these observations.

There is evidently some conflict of authority, but on this point I have no information. I must state, however, that money has been spent in preparing plans for the Observatory and a considerable sum has been expended in instruments. If a complete scheme of daily work had been drawn up by a competent authority in solar-physics, and the instruments necessary to carry out this programme had been obtained, this expenditure would have marked a real progress; but, unfortunately, I find no such scheme, and I can neither recommend the use of the instruments obtained nor the employment of the methods proposed. I shall give details on these points in another part of my Report; it must suffice here to emphasize the fact that the Secretary of State's letters of 1889 and 1892 are not yet acted on, and that the years lost will retard progress for half a generation, not only in our knowledge of the sun, but in the possible application of that knowledge to meteorology and all its Indian derivatives.

SECTION 8.—THE QUESTION OF ADMINISTRATION.

I pointed out in Section 3 how in the past the work of the observatories has suffered from the absence of co-ordination and control. It is to be hoped that advantage will be taken of the present inquiry to secure the benefit of improved administration for the future for all the observatories. An extension of the decision of the Government of India to place the Madras and Kodaikanal observatories on the budget, and under the supervision of the Meteorological Reporter to the Government of India, is, in my opinion, all that is wanted for this purpose when the others are imperialized. In this way only can all similar scientific work be correlated, and the maximum of output and the minimum of expenditure be secured. Experience has shown that it is unsound policy to treat the existing observatories as independent establishments.

The Meteorological Reporter is already in charge of 9 first class, 70 second class, 113 third class, and 5 fourth class meteorological observatories, and in some of these astronomical, actinometric, magnetic, and seismological work already goes on in connection with the general scheme of work. The generally accepted connection between sun-spots and magnetism, and the possible connection between solar changes and terrestrial meteorology, point to the importance of the association of the allied researches, and their being placed under one control. This being so, the decision of the Indian Government already referred to is obviously the right and proper one.

But, although the proposed new observations in solar-physics and magnetism are more allied to meteorology than to any other scientific work controlled by the Indian Government, I think it quite possible not only that much benefit might arise from consultation between the heads of the different scientific departments of the Government in relation to observatory matters, but that in certain cases officers of the Surveyor-General's and the Geological Departments might co-operate in the prosecution of some of the work of the magnetic survey, as the work of solar-physics is already actually aided at Dehra by the Survey Department. It is

quite obvious that, from the outset, the connection between the magnetic and geological surveys must be of the closest. I would suggest, therefore, that if the present decision of the Government is extended so that the Meteorological Reporter becomes *de facto* Director-General of Indian Observatories—

The Surveyor-General,
The Director of the Indian Marine,
The Director of the Geological Survey,

should be as far as possible consulted on the general and broad questions connected with the working of the Magnetic Survey Department, and that any assistance the Survey and Geological Departments could give towards carrying out the First Magnetic Survey should be as far as possible utilized.

Under such a scheme the Director-General would lay down schemes of work for each observatory, and would arrange for the discussion and reduction of the observations. To help him in these duties he should have power to refer direct to the Observatories Committee of the Royal Society on all questions of general administration, and to the Solar-Physics Committee of the Science and Art Department on all points specially relating to solar physics observations.

Mr. Eliot, in his memorandum on the proposed magnetic work, suggests (29th May 1896) that the Observatory of Bombay be placed under the Director of the magnetic branch of the future hill observatory.

I venture to suggest that, when once all the observatories are placed under the orders of a Director-General, it will be better that all the Directors should report to him. In this way a feeling of emulation encouraging work may take the place of a feeling of subordination discouraging it, and many questions unpleasant to deal with when once raised may never be raised at all.

But it is clear that if this new work be thrown upon the Meteorological Reporter he will require some additional assistance in the performance of his duties, and it is equally clear that the greater scientific responsibility thrown upon the Meteorological Reporter by the new arrangements and observations which give a greater, but not too great, breadth and dignity to meteorological inquiries and place them on a proper footing, will require that the future chief officers in the meteorological service of the Governments shall be men of wide scientific training.

This perhaps is the proper place to point out that the system at present adopted by the Indian Government of treating its scientific servants on a different principle from that adopted in other departments is really not conducive to the best interests of the State. The chief disadvantages under which scientific men now labour in India are want of promotion and of graded increases of salary throughout their service. Men of science are after all men, and are no more likely than others to work heartily without any hope of increased pay or advancement especially when they are reminded by the promotion and increased emoluments granted to those in other branches of the same state service of their own waterlogged condition. It is to be hoped that one result of the present inquiry will be to remedy a state of things which experience has shown is attended with obvious disadvantages.

The welding of the various kinds of observational work into one Department which I have recommended above, would, I believe, not only simplify and strengthen administration by enabling the Government of India to deal with a single officer under their orders; ensure greater economy and efficiency in the conduct of the work of the various branches; but permit of the formation of a Scientific Civil Service, graded as I have suggested and entailing no greater cost than that necessitated by the present unsatisfactory system.

SECTION 9.—THE ORGANISATION OF AN INDIAN SOLAR PHYSICS OBSERVATORY.

The daily presence of abundant raw material in the shape of sunshine must be the first point to be considered in an Indian solar observatory, and it suggests at once a daily registration of every solar change that is going on, because such work is impossible elsewhere. In acting on this principle India cannot only best help on science but supply her own meteorological needs. It is on every ground, therefore, most important to secure daily routine observations above all others and their value depends on their continuity.

The daily observations of the sun which it is necessary to secure, not only to compare with terrestrial relations (magnetism and meteorology), but to advance our knowledge of the sun, are briefly the following:—

- (1) Photographs of the sun's surface, showing spots, faculae, etc.
- (2) Photographs of the sun and chromosphere in monochromatic light showing the relations of prominences to the spots and spot zones.
- (3) Eye observations and photographs of the most widened lines in sun spots.
- (4) Eye observations and photographs of the lines in the spectrum of the chromosphere.

To get anything like continuity in these observations, the experience of the last twenty years has shown that science is absolutely dependent upon tropical countries where sunshine can be depended upon each day.

1. Prior to the commencement of the daily photographic registration of the sun's surface at Dehra and the Mauritius, the number of days on which photographs were taken in a year at Greenwich (where observations were not then made on Sundays) has already been referred to,

page 13; since the taking up of the work in India and the Mauritius, the yearly number has been carried up to 360 (see pp. 24-5).

2. The photographs of the sun in monochromatic light represent a new method of research. I have come to the conclusion that it is quite useless to attempt to employ it continuously at Kensington, as the record is too broken.

3. Although no opportunity has been lost at Kensington on every week day during the last 19 years of observing the most widened lines in sun spots, only about 2,000 observations have so far been accumulated, say in a period embracing roughly 6,000 days.

4. Daily eye observations of the lines in the spectrum of the chromosphere were commenced by the Italian observers and myself, but although their climate is more favourable for this work than the English one, it has been found undesirable to continue them.

The above facts will give some idea of the importance which must be attached to daily spectroscopic routine observations in India. We are justified in considering that the record of phenomena thus obtained will be as satisfactory as that already secured by daily photographs of the sun's surface by the co-operation of Greenwich, Dehra, and Mauritius.

Apparatus for routine work 1.

This consists of a photoheliograph; one has been at work at Dehra for 20 years, and, as I show on page 25, should not be disturbed.

Apparatus for routine work 2.

The object of this routine work is, as I have already stated, to provide the spectroscopic complement of the daily photographs of the sun's surface taken at Dehra. By its means we obtain at the expenditure of a few minutes of time by photography a monochromatic image of the solar spots and prominences, both on the disc and at the limb. The method, though old in suggestion, is recent in its application, and certainly constitutes one of the most important means of helping on our knowledge of the various periods of solar change, and therefore of the physics of the sun generally. It is not necessary to refer in detail to the apparatus here as there are several forms.

Apparatus for routine work 3 and 4.

For this purpose an equatorial is necessary, with an attached spectroscope, of which the dispersion can be varied. The optical axis of the spectroscope must be capable of rotation, so as to be able to observe the chromosphere at any point of the sun's limb with either a tangential or radial slit. The necessary adjustments and motions are naturally somewhat complicated, and as it is essential that they should be made by the observer while the work is going on handles are led to the eye-piece of the spectroscope.

For such observations as those now in question considerable dispersion is necessary, hence a very bright solar image on the slit is essential. So long as this condition is maintained, of course, the larger the solar image is the better; but in practice it is found that the solar image produced by a 6-inch object glass of ordinary focal length is large enough to allow of the observation of both spots and prominences.

Special Researches.

In addition to the routine observations special researches should find a place in a first-class solar physics observatory. What these shall be must depend on the knowledge and skill of the Director; his knowledge, because without it he may lose time by attacking problems of small importance, or which are certain to lead to nothing; his skill, because each research may require some modification in the instrumental equipment or arrangement.

But it should certainly be a rule that no special research should be attempted until the routine work is completely provided for, and is carried on continuously and effectively day by day; and *à fortiori*, the buildings should not be designed with reference to special work and to the omission of all arrangements for the fundamental routine work.

SECTION 10.—THE PROPOSED SOLAR PHYSICS OBSERVATORY AT KODAIKANAL.

In stating the Government action in Section 6 I referred to the proposals (dating from at least as far back as 1871) to build a hill observatory, ending with the decision of the Secretary of State for India, in August 1893, that a solar physics observatory should be built at Kodai-kanal and that the necessary funds should be provided and the work proceeded with at once.

I now proceed to give the results of my inquiries into the present state of this project. The observatory is not yet built, but when at Madras Mr. M. Smith showed me the proposed plans with the statement that they are still under revision. He promised to send me the final plans, but I have not yet received them.

In the provisional plans I found no provision whatever for the prosecution of the daily routine work to which I have referred, with the exception of the daily photographs of the sun which I have elsewhere recommended should, for the present at all events, be continued at Dehra.

Routine Work (2).

Arrangements for carrying out Daily Routine Observations (2) have been entirely neglected, so far as any special provision of instrumental equipment or observatory accommodation at

Kodaikanal is concerned. But as a matter of fact no very special apparatus is required, but rather the utilization of small telescopes, etc., which exist in most observatories.

I pointed out this serious omission to Mr. M. Smith when at Madras, and gave him a sketch of an easily constructed form of apparatus with which the work could be at once commenced at Madras, in order to study the best methods to employ and gain experience.

So satisfied am I that there is no more important solar work to be done in India than this, that on leaving Madras I wrote the following letter to Mr. Eliot, urging the commencement of this work at once at Madras:—

Madras,

18th February 1898.

My dear Eliot,

I cannot leave Madras without saying how very strongly I feel that, after all this disastrous delay in getting the solar physics observations under way which were approved some years ago, the situation may to a certain extent be saved for the future with a slight expenditure.

The expenditure, as I understand it, will not be an excess on any estimates, because the staff for the Solar Physics Observatory approved four years ago has not been appointed, and so their pay has been saved.

My suggestion is, that daily spectrum photoheliograph pictures of the sun on the Jannsen-Hale-Deslandres system should be begun at once at Madras in a shanty, the erection of which would be a matter of a few days and pounds, and the affording assistance to Mr. M. Smith, who tells me he is prevented by his orders from undertaking such work himself at the present time. The photographs will require about ten minutes a day when the apparatus is in working order.

I have explained the method of working to Mr. M. Smith, and I fancy he has already instruments which would enable him to begin at once.

I should be much obliged if you will urge this upon Mr. Michie Smith (whom I shall not again have the opportunity of seeing) in the hope that he may take any action necessary to enable him to start these observations as early as possible. I shall be glad if you will give him a copy of this letter if he thinks it will be of any service in the matter.

Sincerely yours,

(Signed) J. NORMAN LOCKYER.

Routine Work (3) and (4).

The Indian Government was in possession of all the apparatus needful for the prosecution of inquiries 3 and 4 between the years 1879 and 1895. The combined instrument was first tested, and the best dispersion for observing the most widened lines in sun-spots and the bright lines in the chromosphere determined at Kensington, where it was used in the series of observations from 1879 onwards.

After this instrument had been adjusted and used for some time, it was sent in 1885, by the desire of the Indian Government, to Poona to continue this class of observation in India, the importance of which was re-affirmed by the Solar

Physics Committee in 1889.* It was, however, not used there until 1892. After use there for two

years the Indian Government in 1894 ordered its transfer to Madras.

No work has been done with it there, but the instrument has been destroyed at an expense of 65%, under guise of reconstruction. A "new spectrograph" bought at an expense of 250%, is quite useless for the purposes of the daily observations either of widened lines in spots, or of the bright lines of the chromosphere. The Indian Government, therefore, is at the present time without an instrument to carry on the observations which the Secretary of State requested should be initiated in 1893.

To make them it will be necessary to provide a new spectroscope with power of rotation and the various adjustments to which I have referred, and attach it to the 8-inch Cooke, thereby bringing us back to the conditions of 1879.

It will be gathered, therefore, that, with the exception of the photoheliograph, the Indian Government is not in possession of instruments fitted for the routine work to which I have referred. It is natural to suppose, therefore, that the plans of the new Observatory do not provide for this work, and this I found to be the case with the provisional plans I inspected when at Madras. I now proceed to consider them.

The Plans of the new Observatory.

In my opinion the proposed plans require considerable alteration before they are carried out. They do not provide for all the essentials, and the non-essentials are not provided for in the best way.

I recommend, therefore, that the plans should be revised so as to provide for the reception of the instruments necessary for the daily routine work of 2, 3, and 4.

At the same time I wish to express my strong opinion, seeing that the observations have already been delayed several years, that the further possible delay may be prevented by putting up, either at Madras or Kodaikanal, temporary sheds in which the work may be commenced at once.

It is important to point out that the Observatories Committee when they agreed to the postponement of the question of a General Astronomical Observatory, had in their minds the experience as to observing conditions, which would be gained at Kodaikanal when the station had been occupied for some time. This was in 1893.

But no experience has been gained because no continuous observations extending even over one year have been made; the matter stands, therefore, exactly as it did in 1893.

The Solar Physics Committee, in its letter to the India Office in 1892, pointed out the possibility, and I now add, after 20 years' experience, the *desirability* of commencing such work as this in inexpensive, temporary, detached buildings, which not only accumulate no heat and permit a free circulation of air, but can be easily and cheaply altered if the actual work shows alteration to be desirable.

I suggest, therefore, that the erection of the permanent buildings to cover the instruments, with the exception of the two domes, be postponed until the final plans have been approved by the Observatories and Solar Physics Committees. The plans were still under revision when I was at Madras. The sooner the routine spectroscopic work is commenced at Madras, in inexpensive temporary sheds, the more experience will be gained.

After, say, a year's regular daily routine observations have been made at Kodaikanal, the question of the Astronomical Observatory there can then, if the Indian authorities wish it, be considered in the light of the experience gained by the solar observations.

If Mr. M. Smith, in consequence of his orders, or for any other reason, cannot commence the routine solar physics work, the initiation of which was ordered by the Secretary of State in 1893, I would recommend that a competent observer be sent from this country to carry on the work until it can be proceeded with on the lines laid down by the Secretary of State. This would not be an expensive arrangement, and I have little doubt that one of the assistants employed in the Solar Physics Observatory at South Kensington, if leave could be obtained, would be willing to go to India for a brief period to set up the instruments in temporary sheds and commence the observations. As already pointed out, a new spectroscope would be required to replace the one rendered useless for routine work (3) and (4); the instrument required for (2) would, I think, not cost more than, say, 150%.

In this way a start would have been made, and the disastrous delay brought to an end.

SECTION 11—THE PROPOSED MAGNETIC SURVEY.

The proposal to erect a Solar Physics Observatory at a hill station, as I have shown, dates from many years back. When the proposed imperialization of the Observatory of Bombay was reported on by Mr. Eliot, he suggested that the reduction and discussion of the Bombay observations should be carried on also at a hill station, and Kodaikanal was suggested, on the ground that, were this arrangement carried out, the daily observations at Bombay might be superintended by a half-time officer, and that the whole-time officer at Kodaikanal might, during the cool season, go on with the magnetic survey of India, which, though inserted early in the Bombay programme, had been consistently neglected.

The development of magnetic observations at Alipore, where in a few months' time a first-class magnetic observatory will be in working order, renders it all the more necessary to establish a system which will facilitate and hasten the publication of magnetic results wherever obtained. It appears to me that Mr. Eliot's suggestion is a very wise one, especially in reference to the Indian conditions of work; and I have elsewhere shown that the magnetic survey should form part of the general observatory organization, although it probably will be found possible that the survey operations in certain regions may be helped by taking advantage of the presence of officers, either of the Surveyor-General's or the Geological Departments in these regions, provided always that enough travelling instruments be available.

I have heard it suggested that the work of the magnetic survey might be carried on efficiently and economically by entrusting it entirely to the Surveyor-General, but I think there are great objections to this view. If the survey is to be conducted rapidly, he would certainly require a suitable addition to the existing staff of the Survey Department, unless it be at present over-manned, which is extremely improbable, and, in any case, the Observatory work at Bombay and Alipore should be reduced and discussed by the Director of the Magnetic Survey, whoever he may be. This scheme therefore would involve the transfer of the magnetic departments of the Observatories of Alipore and Bombay to the Surveyor-General, a responsibility from which I should imagine he would shrink, and a proceeding which, if carried out, would intensify the existing chaos in observatory organization.

I have heard of still another objection, and that is that there will be two Directors at Kodaikanal, and that this is contrary to good administration. I have not seen the site (as I was informed by the Under Secretary of State that it was not necessary for me to see it as so little had been done on it), but I understand that the conditions of the ground are such, that the dwellings of the magnetic staff consisting of the Director and three assistants and two apprentices cannot form part of the building of the solar physics observatory. There must therefore be two separate buildings at Kodaikanal, and I do not see why there should not be two separate Directors, and two separate organizations. Solar physics and magnetism are such distinct sciences that it will not be surprising to find that a master in one branch of the work will be a mere tyro in the other; it will, therefore, be impossible for him to conduct it properly.

But if the disadvantages of the proposal outweigh the conveniences I do not see why the magnetic Director should not be located at Simla, and, indeed, he might be practically nearer his work there.

SECTION 12.—INDIAN STANDARD TIME.

In Section 4 I have suggested that at Bombay and Alipore additional time signals should be given indicating respectively the mean time of the 75th and 90th meridians of longitude east of Greenwich.

I have done this because it is certain that at no distant date India will conform to the time arrangements now adopted almost universally by the civilized world. The difficulties in India are no greater than those already met in Europe, America, and Australia, while experience has shewn that the gain in simplicity of telegraphic and railway communications, etc., greatly outweighs them.

5th May 1898.

J. NORMAN LOCKYER.

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No. 14 of 1899.

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE AND AGRICULTURE.

METEOROLOGY.

To

THE RIGHT HONOURABLE LORD GEORGE F. HAMILTON,

*Her Majesty's Secretary of State for India.**Calcutta, the 2nd February 1899.*

MY LORD,

WITH Your Lordship's Despatch No. 173 (Revenue), dated 22nd September 1898, we received a copy of reports by the Astronomer Royal and Sir J. Norman Lockyer and of a letter and enclosure from the Royal Society in reference to the proposed reorganization of Indian Observatories. We would ask Your Lordship to communicate our acknowledgments to those gentlemen and to the Royal Society for the valuable assistance which they have given to our Government.

2. We now forward, for Your Lordship's information, a copy of a report by Mr. John Eliot, the head of our Meteorological Department and our principal scientific adviser, on the matters discussed in the papers under reference, and of the proceedings of a departmental Committee to which we submitted them for further consideration.

3. Subject to Your Lordship's approval, we propose to accept and act on the recommendations (1) to (9) of the Committee and on the first portion of recommendation (10). The second portion of the last recommendation is in accordance with our general views, but will not come under actual consideration until Mr. Eliot's retirement. The Committee's recommendations provide for the carrying out through the agency of the Survey of India within two or three years of the fundamental magnetic survey of the Indian Continent recommended by Professor Rücker. This survey will be undertaken as part of the operations of the Survey Department, and will be controlled by an officer of that Department. It may be necessary to arrange that the officer selected should undergo a short training in England before the survey is started; but on this point we await the recommendations of the Surveyor General. We agree with the Committee that until the completion of the fundamental survey, so much of the scheme submitted by us in 1897 to Your Lordship for organizing the Kodaikanal Observatory as provides for the appointment of a Director of Magnetic Surveys and appropriate staff, should be held in abeyance.

4. We also agree with the Committee that our work at Kodaikanal should for the present be restricted to the Solar Physics Observatory which is now in course of completion. We have authorized the officer (Mr. Michie Smith), who has hitherto held the post of Madras Astronomer, to assume the duties of Director of the Solar Physics Observatory at Kodaikanal, and we have decided to give immediate effect to the scheme of reorganization for the Madras Observatory and the Kodaikanal Solar Physics Observatory proposed in paragraph 48 of Mr. Eliot's letter No. 410 S., dated 29th May 1896, which formed an enclosure to our Despatch No. 56, dated 1st September 1897. This

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scheme is identical in cost with that sanctioned in Lord Kimberley's Despatch No. 117, dated 31st August 1893, and merely makes certain changes in the subordinate establishment. We also propose to grant from the 1st April next to Miss Pogson, the Meteorological Reporter to the Madras Government, the pension sanctioned in Your Lordship's Despatch No. 193, dated 1th November 1897, and to readjust the office hitherto held by her in the manner explained in paragraphs 52 and 53 of Mr. Eliot's letter above referred to.

5. With regard to the Colaba Observatory, we propose during the next two or three years to maintain its establishment as it is at present. The arrangement sanctioned in Your Lordship's Despatch No. 69, dated 6th May 1897, under which Mr. N. A. Moos receives a salary of Rs500 per mensem while holding the sub. *pro tem.* appointment of Director, may be conveniently continued. But from the 1st April next we propose to bring the Colaba Observatory under the administrative control of the Meteorological Reporter to the Government of India.

6. The financial effect of our present proposals, as summarized in paragraphs 4 and 5 of this Despatch, is shown in the tabular statement appended. The cost of the fundamental survey is excluded, as it is difficult to estimate apart from the regular operations of the Survey Department.

7. We would request Your Lordship to obtain from the Royal Society the information which, in paragraph 4 of their proceedings, our departmental Committee consider to be required in respect of the proposed Astronomical Observatory at Kodaikanal. The establishment of such an observatory two or three years hence will be dependent on financial considerations, and also on the cost of the arrangements which may be made for future maintenance of the Magnetic Survey.

8. We accept the conclusion recorded in paragraph 8 of the Committee's proceedings that an annual inspection of the Indian Observatories by a small board of visitors is not feasible in India. It would withdraw officers from other important work which fully occupies their time, and it would not, in our opinion, result in equivalent advantages. The observatories will from time to time be visited on convenient occasions by our Meteorological Reporter and by the Surveyor General while these officers are on tour. We anticipate much benefit from the submission of the annual reports of the Kodaikanal Observatory and of the Officer in charge of the Magnetic Survey to the Observatories Committee of the Royal Society, and from the assistance which we trust the Observatories Committee will give us in the settlement of definite programmes of work. We approve the recommendation made by Mr. Eliot in paragraph 8 of his letter that a programme for the Solar Physics Observatory be prepared and submitted to the Observatories Committee.

We have the honour to

My Lord,

Your Lordship's most obedient and humble Servants,

CURZON OF KEDLESTON.

W. S. A. LOCKHART.

J. WESTLAND.

M. D. CHALMERS.

E. H. H. COLLEN.

A. C. TREVOR.

C. M. RIVAZ.

List of Enclosures.

1. Letter from the Meteorological Reporter to the Government of India, No. 757-S., dated the 29th November 1898.
2. Proceedings of a Departmental Committee, dated Calcutta, 19th December 1898.
3. Statement shewing the financial effect of the proposed reorganization of Indian observatories.

File No. 9 of 1898.
 SERIAL No. 19.
 No. 1899.
 GOVERNMENT OF INDIA.
 Department of Revenue & Agriculture.
 METEOROLOGY.

No. 14, DATED CALCUTTA, THE 2ND FEBRUARY 1899.

(COPY)

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

SUBJECT.

REORGANIZATION of Indian Scientific Ob-
 servatories.

Minutes of Proceedings of the Committee, Calcutta, 19th December 1898.

PRESENT:

The Hon'ble SIR JAMES WESTLAND, K.C.S.I.
 " " MR. C. M. RIVAZ, C.S.I.
 T. W. HOLDERNESS, Esq., C.S.I., Secy. to the Government of India,
 Department of Revenue and Agriculture.
 Major-General C. STRAHAN, R.E., Surveyor General of India.
 J. ELIOT, Esq., C.I.E., F.R.S., Meteorological Reporter to the
 Govt. of India.

1. That the fundamental magnetic survey of the Indian continent should be undertaken by the Survey of India, and that for the present, until the fundamental survey which is likely to last for two or three years is completed, the question of the appointment of a specialist from Europe as Director of Magnetic Survey is not one that presses for immediate decision. On the completion of the fundamental survey, the question of the future of the survey and of the discussion of the results will have to be considered.
2. That until the fundamental survey be completed the Colaba Observatory be maintained on the present scale.
3. That for the present the efforts of the Government of India be directed at Kodaikanal to the completion of the Solar Physics Observatory, and that the question of the establishment at Kodaikanal of an Astronomical Observatory be taken up hereafter along with the question of the appointment of the Director of Magnetic Surveys.
4. That meanwhile the Observatories Committee of the Royal Society be requested to advise as to the equipment, staff, organization and scheme of observations of the proposed Astronomical Observatory at Kodaikanal, and that when this information has been obtained, a site be selected and plans and estimates for the proposed buildings framed.
5. (a) That with reference to paragraph 3 of the Royal Society's letter the Director of Solar Physics (Mr. Michie Smith) be asked for an estimate of his requirements.
 (b) That the Survey of India continue the daily photographs of the sun at Dehra at least for five years.
6. That with reference to paragraph 4 of the letter the Surveyor General be asked to report on the proposal for the establishment of a permanent magnetic observatory for eye observations at Dehra.
7. That with reference to paragraph 5 the Surveyor General be asked to report as to how he proposes to arrange for the superintendence of the fundamental survey.
8. That with reference to paragraph 6 it is agreed that the proposal for a annual inspection by a small board of visitors is not feasible in India.
9. That paragraph 7 be complied with by the Director of the Solar Physics Observatory and by the officer placed in charge of the proposed magnetic survey.
10. That the Director of the Solar Physics Observatory for the present be placed for administrative purposes under the Meteorological Reporter to the Government of India: and that eventually there should be a scientific adviser to the Government of India, who should be a man of established European reputation and who should occupy the position of Director General over the Meteorological, Solar Physics, Astronomical and Magnetic Branches of all Indian Observatories.

G. I. C. P. O. No. 67 R. 1-2-99.—20.—R. N. D.

6-2-7
7/8

Statement showing the financial effect of the proposed reorganization of Indian Observatories.

	Sanctioned.	Proposed in 1897.	Now proposed.
	<i>R a. p.</i>	<i>R a. p.</i>	<i>R a. p.</i>
Physics Establishment . . .	1,451 4 0	1,499 4 0	1,499 4 0
Tras Observatory . . .	380 0 0	332 0 0	332 0 0
Madras Meteorological Office . . .	1,043 12 0	524 12 0	524 12 0
Pension to Miss Pogson . . .	Nil.	250 0 0	250 0 0
Colaba Observatory . . .	987 0 0	507 0 0	987 0 0
Magnetic Survey . . .	Nil.	1,030 0 0	Nil.
TOTAL . . .	3,862 0 0	4,143 0 0	3,593 0 0

27.3.99

transfer of the control of the
Madras Observatory to the G. G. I.

Public Department's Memo-
Present

Lead G. No. 601.

FOR OFFICES

The Govt. of India intimates
that in anticipation of the Secretary
of State's approval of the scheme for
the reorganisation of Indian Observa-
tories, it is proposed to give effect
to Mr. Elliot's arrangements from the
1st April 1909.

2. The arrangements proposed by
Mr. Elliot are set forth in his letter
No. 410-S, dated 29-5-90 flagged
They are briefly (1) the transfer of
the control of the Madras Observatory,
and the funds connected with it, to
the Govt. of India and the placing of
the organisation and management of

the Solar Physics Observatory under
when

meteorological Reporter to the
the charge.

3. The present Govt.
fixed, and the

now be sanctioned. an

on Provl. funds only from

Febry. to the end of March. of Miss

(an assistant and a peon) are

drawing Rs. 44 & Rs. 10 per mense

pectively and under Mr. Elliot

scheme they will get Rs.

and it is proposed to

Rs. 65 and 12 respectively from 1909.

latter rates of pay from

men arrived at Kodakanaloring letter

do not think there is the
have been till now
in the other men are the
and so

Yes tell India at the
referred that this
what this Govt

consider necessary on
arrived the men at
Kodi. 27.3.99.

the order are referred to
16/3/99.

...ment of a half time officer
a Professor of the Education-
...as Supdt. of the Madras Obser-
atory, under the general charge of the
Director Solar Physics Observatory,
Madikani. The duties of the Supdt.
will be to supervise Meteorological
observations, the working of the local
time ^{have} ~~will~~ service and the distribution
of time signals throughout India, as well
as the Meteorological Reporter's work.
~~named~~ ^{named} above under (2).

5. The Secretary of State has already
sanctioned the grant of a pension of
£250 per annum to Miss Pogson, and she
should now apparently be instructed to
submit her application for pension as
from 1st April 1899.

As the Govt. of India will take
over the control of the Madras Observatory
on 1st April, it is presumed that it will
itself take the initiative in the appoint-
ment of a Supdt., and that no action on
the part of this Govt. is necessary.

6. The scale of establishment
by Mr. Elliot for the Madras
provides for reduced
the three Senior s-
ogson's office
to the Obser

at Asstt. ...

9
Pub

807.

G.O. No. 191 Public, d/2-2-98.

*L. H. ... Perhaps he
is not limited to the work here
that we do not know. India
higher in ~~admission~~ as to the
pay of these men. and the
arrangement which Mr. H.
made is that they may not
be lost
MA 1/16/99*

** Please see notes
at G. & H.*

*I do not think there is the
same kind of a ...
as the other men are the
same as ...*

*has told India at the
referred that this
that this Govt.*

*considers necessary on
arrival of the men at ...
Kodi. AT 27.3.99.*

Nothing is said in Mr. Elliot's Memo-
randum about securing to the present
incumbents their existing rates of
pay until they retire or are promoted.
They have hitherto been servants of
the Madras Govt. and their claims to
retain their present pay might per-
haps be brought to the notice of the
Govt. of India. The local allowances
will no doubt lapse, but pay proper
should not be reduced in the case of
present incumbents.

6. There is one other point.—
Mr. Michie Smith asked for an extra
allowance for the Assistant and peon
whom he was taking to Madikani in
January. It was agreed that the men
should be granted from the date of
their arrival at Madikani the high-
er pay they will draw hereafter under
Mr. Elliot's scheme. The matter was
deferred until it could be ascertained
when the Govt. of India would take over
the charges. The date has now been
fixed, and the increases of pay might
now be sanctioned. The cost will fall
on Provl. funds only from some date in
Febry. to the end of March. The two men
(an assistant and a peon) are now
drawing £4.44 & £4.10 per mense. Submit-
pectively and under Mr. Elliot's
scheme they will get £5.5.0 and £4.5.0
and it is proposed to ^{the service}
£5.65 and £2 respectively ^{from} April 1899.
~~latter rates of pay from~~

men arrived at Madikani ...

AT 16/3/99.

189

[illegible]

189

order 367 of 23-3-18

Commenced to

The Soc. Astronomers and

to the Hittoragail Bank

to Test in continuation

4/50. Aug 1917 *Parula* *delata*

2 July 1978

to the Inspector

Printed with the G. D.

above quoted. The Story of

State functioned the trans-

for a pension of \$250 per

Memorandum to Miss Polyzou

We should now submit

a formal application to
John Dean & Son

from the 1st April 1893.

3. The following letter

will be addressed to

24
18-3-54 *SK*

Letter No 37.00/23-3 - 88
25 ~~March~~ to the Govt of India
Dept of Rev. & Agriculture
(Meteorology)

4.

He acknowledges the receipt of your letter No. 893, dated 9th March 1892, intimating that it is proposed to give effect to the same from the 1st April 1892, to the arrangements under which the control of the Madras Observatory & the funds connected with it will be transferred to the Govt. of India, & he directs it being to the notice of the Govt. of India that the scale of establishment proposed by Mr. Elliott for the performance of meteorological work in the Madras Observatory.

To the Govt: Astronomer
with specimens of comets 2, 3, 4
2 to 10-5 2, 9, 5-9
- Meteorological Reports
to Govt -

Accepted
with share of 400 shares
in 410-557 Lg. 5-96.
Per. Act
Pension Dept

in his letter No 410-S.
dated 29th May 1896, when
formed an enclosure to
your No 2541-11-6 dated
19th Oct^r 1896, provides
for reduced rates of
pay to the three senior
subordinates in Miss
Pozsoni's office, who
will be transferred to
the Observatory, and
that nothing is said in
the ^{correspondence} papers as to securing
present incumbents against
loss of emoluments. The
existing rates of pay &
those proposed by Mr.
Bliss are shown below.

Cost. Present pay - - - Proposed pay.

Asst - Rs 60-80 plus Rs 15-local allow - Rs 5.5-70
for publication of the
Daily Weather Report.

• Asst - Rs 40-55 plus Rs 10-a-do - - - 40-50

• Asst - " 30-40 plus Rs 5-a-do - - - 32 1/2-

2. The S. I. C. proposal for the use of astronomical dept. provides for a Computer on Rs 100 and two Assistants on Rs 60 ^{Rs} 4.

108

Mr. Messrs. respecting,
which the establishment of the
Kodairanal Solar & Physics
Dept. includes four Assist.
grades on Rs 180 to Rs 240,
Rs 100 to Rs 160, Rs 65 to Rs 85
and Rs 50 to Rs 75. This
Govt. has no information
as to whether the assistants
in the meteorological
office are compelled to
do the work required
of the subordinates in
the other two branches,
but from today that
the Gov. in Council hopes
that the Govt. of India
will be able to protect
the rights of existing
incumbents either by
a redistribution of the
duties among individuals,
or by permitting the
present holders of the
posts in the meteorological
office to retain their
salaries until they
retire or are promoted.

5. I am further to refer to my letter
C.S. 7 Public, 6/23-2-20 in which the
Govt. of India was informed that Mr.
Richie Smith was then moving to Kodairanal
and had applied to this Government for
the grant to his subordinates of increased
pay in consideration of their transfer
to a Hill Station. Pending a reply to
my letter quoted above, this Govt. did not
sanction the allowances asked for. I am
now to suggest that the compensation
which it is necessary to allow the
members of the establishment should be
granted not as a special allowance, but
by admitting them from the date of their
arrival at Kodairanal to the increased
pay which they will receive under the
new scheme. I am to request that the
Govt. of India may be moved to pass order
accordingly.

(From orders)
JH
25/3/22

M. J. H.

sent to Press.

for signature.

d in print.

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Order complete. 53
Letter only.
Order complete with letter. 65

G.O. No.
189

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Super Copies soon
2/18*

TO C. No.

OF GOVERNMENT.

OF GOVERNMENT.

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