N° 1397 Wal 2-5-96

No. 245, Marine, 8th April 1896.

GOVERNMENT OF MADRAS.

MARINE DEPARTMENT.

Read—the following papers:—

From F. W. ASHPITEL, Esq., Executive Engineer, Public Works Department, lately on Special Duty, Marine Department, to the Chief Secretary to Government, dated Madras, 22nd June 1895, No. 20 W.

With reference to G.O., No. 318, dated 10th August 1894, I have the honour to forward herewith a report on the lighthouses in the Madras Presidency.

Enclosures.

REPORT ON LIGHTHOUSES IN THE MADRAS PRESIDENCY.

1. In 1890 Mr. W. T. Douglass, the present Consulting Engineer to Trinity House, inspected the lights of this Presidency and his opinion regarding their condition and state of efficiency may be gathered from the following extracts from his report:—

"As a subject of first importance, I would beg to suggest the desirability of "improving generally the coast lights, on which the safety of shipping so much "depends" . . . "With the exception of Aleppi, Madras, Armeghon, and Vakalapudi, "the lights have no distinctive character, hence great danger is incurred by mariners "from the possibility of mistaking one light for another, or a shore or a vessel's light for "a coast light. The object in establishing a coast signal light is either to indicate to "the mariner the landfall he has made—and with as much certainty by night as by "day—or to reliably mark some hidden danger. It therefore becomes a matter of the "utmost importance to impress upon each coast signal light such a trustworthy dis-"tinctive character as to effectually prevent the possibility of its being mistaken for "any other light, either ashore or afloat" . . . . . "The coast signal "lights of this Presidency are very inadequate in penetrating power for the service of "their respective stations; this is due, not only to the small quantity of oil sanctioned "for each establishment and insufficiency of ventilation, but to the restricted dimen-"sions of the optical apparatus" . . . "In very clear weather the better lights "are frequently visible at the limit of the range due to their height above the sea-"level, but when the atmosphere is slightly impaired by rain, haze or fog, and con-"sequently when they would prove of the utmost service to the navigator, they are "obscured at a distance of from two to three miles" . . . . . "With "a view to increasing the intensity of the lights, and giving to the existing stations "a power and character suited to the ever increasing demands of coast navigation, I "would suggest, in addition to improved burners, increased ventilation and the use "of heavy mineral oil, the adoption of illuminating apparatus of larger dimensions at "stations where the light is to be maintained throughout the year, and where it is of "direct service to steamers and other vessels passing up and down the coast during "the south-west monsoon. I am decidedly of opinion that a flashing or occulting dioptric "apparatus of the 2nd order or 700 m.m. focal distance, is the smallest that should "be adopted for such lights. For some of the more important landfalls an apparatus "of 1330 m.m. focal distance should be adopted. The 4th order apparatus of "250 m.m. focal distance is an efficient size for the illumination of ports and "entrances of small rivers where the light is not directly required for the navigation "of the coast."

2. This condemnation of the system of placing port lights on high columns and calling them sea-lights, in spite of the fact that, when the atmosphere is impaired, their rays have no chance of reaching the horizon, is nothing new, for, in F.M.G., No. 36, dated 14th November 1867, Marine Department, a letter from Messrs. Chance Brothers is printed from which the following is extracted :—

"We are of opinion that the range of visibility respectively appropriated to the "proposed lights by the Superintendent of Marine at page 15 of the printed docu- "ments, are in general considerably too great. The extreme distance at which fixed "dioptric apparatus of the 4th and 6th orders can be seen, in a mean state of the "atmosphere, is respectively eleven miles and eight miles. The greater and lesser "distances of visibility under exceptional atmospheric conditions of clearness or "mistiness ought not to be taken into account in determining the order of the "apparatus to be employed."

"We therefore request to know whether, on the one hand, the stipulations as to "the range can be reduced to suit the mean power of the apparatus proposed, or "whether, on the other hand, apparatus of larger dimensions can be selected to give "effect to the stipulations."

3. As regards the desirability of generally improving the lights of this Presidency it seems unnecessary to make further remarks. Thirty years ago Messrs. Chance Brothers brought to notice the inexpedience of installing 4th order fixed apparatus as sea-lights and Mr. Douglass reiterated Messrs. Chance's remarks in 1890. If the opinions of Messrs. Douglass and Chance, which have not been accepted, have needed any proof, it has been signally afforded by the disastrous wreck of the *Lanark*,—and I can but echo those opinions.

4. It may be worth while, however, to give a few typical instances in which lights of insufficient power have been installed :—

(*a*) The present light at Hope Island was installed as recently as 1893, when a new 4th order fixed apparatus was obtained from England. The Sacramento Shoal, one of the dangers this light is supposed to mark, is distant some 14 miles from the light which, unless the weather is very clear, has a range of only 12 miles. As happened in the case of the *Lanark*, therefore, a ship may be ashore on the Shoal before sighting the light. This apparatus was installed in direct opposition to Mr. Douglass' recommendation with the idea that two dangers could be guarded by one light of insufficient power exhibited from a tower whose location is unsuitable for either.

(*b*) Another instance is at Manapaud Point, where a small port light apparatus with a range of about 7 miles is supposed to guard dangers which extend from 10 to 12 miles from the point. In this case the light does not even show over the whole sea-horizon and a ship might be ashore near the point without the light being seen.

(*c*) Mangalore light is an instance of a port light with a range of about 12 miles installed at an elevation of 240 feet, corresponding to a range of 22 miles. This light is one of those against the installation of which Messrs. Chance protested thirty years ago, as it is only under exceptional atmospheric conditions that the light reaches the horizon. The brightest part of the beam, in an ordinary state of the atmosphere, is of no service to the mariner, being wasted in the air (See also Appendix A, paragraph 2).

5. Assuming that the necessity of improving the sea-lights in this Presidency does not admit of further argument, the question of what new lights are required for the efficient lighting of the coast has to be determined. Fortunately, on the coasts of Madras the atmosphere is very much clearer than in Europe and there is no necessity for the installation of lights of great power. Some two years ago a 3rd order double flashing apparatus (lenses only) was obtained from England for the new Madras lighthouse ; before this apparatus was placed in position, its intensity was determined and, after its exhibition, the light-keepers at Pulicat were instructed to note in their log book whether the new light was always visible from that station. The result of these observations was that the new light, with its intensity of 18,000 candles, was, during the months October to March 1894, visible at Pulicat every night except at intervals of a few hours, and, in many cases, of only a few minutes at a

time. Pulicat is distant $20\frac{1}{2}$ miles from Madras and the observations were made during the most unfavourable months in the year over land where there is occasional haze, which does not necessarily extend seawards ; and, therefore, for all practical purposes, it seems perfectly safe to assume that the new Madras light has a range of 19 miles in all weathers and at all seasons of the year. Enquiries made at other stations during the recent tour of inspection appear to confirm this assumption, and, in the absence of any evidence to the contrary, it seems probable that, if this standard of efficiency is worked up to, the lights in this Presidency will be seen, throughout the year, at the extreme limits of their ranges. The fact must not be lost sight of that, in India, it is not necessary to go to the expense of lights of great power, as the atmospheric conditions are totally different from those obtaining in England, where frequent fogs render the installation of lights which will be always visible at their extreme ranges an impossibility, and all that can be done is to provide the maximum power within reason available, and, when the weather is foggy, to start a sound signal.

6. In any scheme for the efficient lighting of the coasts of the Madras Presidency it appears to be advisable to distinguish between sea and port lights. The former are exhibited for the benefit of the general navigation to indicate to the mariner his position, and to warn him of his approach to the coast line or to some hidden danger, while the latter are merely required to provide him with the means of proceeding safely to his destination after his position has been indicated by the sea-light. For the sea-light service complicated apparatus of considerable power is necessary and a more-highly trained establishment of keepers is required than for the service of simple port lights, which only benefit a particular port and are, comparatively speaking, not of so much importance. It is suggested, therefore, that the lights of this Presidency should be divided into two services : the one a "Provincial" service (sea lights) for the benefit of general navigation and maintained by dues collected from the shipping ; the other a "Local" service (port lights) maintained from the funds of the port at which the light is exhibited. This division of lights will relieve some of the ports, especially in the Eastern group, of the expense of maintaining sea lights which do not exclusively benefit them, and will render possible the construction of the additional lights required for general navigation which have, so far, been held in abeyance for want of funds.

7. The lights, existing and proposed, which appear to be absolutely necessary for the efficient lighting of the coast, are shown in Table I and are marked on chart No. I which accompanies this report. At the present time, the only lights which have a distinctive character are Aleppi, Madras, Armeghon, Vakalapudi and Kalingapatam : the rest, with the exception of Muttum and Santapilli, are merely small port lights exhibited from towers which are, as a rule, of very inconvenient design, badly ventilated, and quite unsuitable for anything but port lights. These lights are, moreover, of but little use to general navigation, being, in many cases, exhibited at ports where no special dangers to navigation exist (see chart No. II).

8. The chief dangers to navigation along the coasts of this Presidency, commencing on the west, are —

(*a*) Mulki Rocks and St. Mary's Isles with several rocky patches between and adjacent to them. An 18-mile triple flashing light, on the mainland opposite Mulki Rocks, or, better still, on the rocks, if sufficiently smooth water can be found alongside, would guard these dangers and would form an efficient landfall light for direct steamers from Europe, and for steamers from Bombay which make Mangalore a first port of call. The Mulki Rocks stand some 50 feet out of the water and are of sufficient size for a tower and the necessary quarters for establishment. It would be a pity if, owing to the difficulty in landing stores, the light has to be placed on the mainland where it will not be nearly so efficient.

(*b*) South of Mulki the next danger to navigation is the Sacrifice Rock 40 feet high and with deep water all round. This rock is $4\frac{1}{2}$ miles from Cotta Point and is in the direct track of steamers from Bombay. An 18-mile double flashing light, on

the rock, would guard this danger and be useful as a landfall light for the ports of Tellicherri and Calicut, the existing lights at these stations being relegated to their proper duty as port lights.

(*c*) South of Sacrifice Rock the existing light at Aleppi, maintained by the Travancore Government, is of sufficient power. It guards no danger but is useful as a guide to the natural harbour or refuge south of the lighthouse.

(*d*) The next danger to navigation, south of Sacrifice Rock, is the Tangacheri Reef distant $\frac{3}{4}$ mile south-east from the point of the same name. This reef and the detached rocks near it, stretch from the south of the point 3 miles to seaward and 7 miles north, and is a distinct danger to navigation. An 18-mile triple flashing light, which would also serve as a landfall light for the important port of Quilon, is required. A light here is much needed as, in its absence, ships are likely to pass the port owing to the necessity of giving the rocks a wide berth. There has been correspondence with the Travancore Government about a light at this point and, when I visited the Aleppi lighthouse, the Commercial Agent informed me that the British India Agents had recently complained that, for want of a light, steamers making for Quilon at night have great difficulty in finding the place and often miss it altogether, going 10 to 20 miles beyond and having to return at a loss of time and money. The question of a light at Quilon (Tangacheri) has previously been raised (*vide* G.O., dated 13th November 1894, No. 443, Marine), but was dropped as the Travancore Government wished the British Government to construct and maintain the lighthouse as being more likely to benefit Imperial navigation than the shipping of any port in the State. From the information given by the Commercial Agent, however, it seems evident that a light on Tangacheri Point would benefit the shipping at Quilon, but, as a sea-light is required in the interests of general navigation and the cost of construction and maintenance can be met from the proposed light dues, any difficulty regarding funds is removed. This question of funds, apparently, was the real cause why the proposal was dropped, and, as this objection will be met if the proposed light dues are collected, there seems to be no reason why the exhibition of the light should be postponed.

(*e*) South of Tangacheri there is no special danger to navigation up to the Crocodile Rocks off Point Muttum and the existing light there is sufficient. It would be better, however, to increase the range to 18 miles so as to show beyond Cape Comorin, and this can be done by using a 6-wick burner in misty weather.

(*f*) Between Cape Comorin and Pambam the chief danger to navigation is the shoal off Manapaud Point. As mentioned in paragraph 4 (*b*) the existing red light on Manapaud Point is very unsatisfactory; it does not show over the whole sea horizon, and has not sufficient power to reach the dangers it is supposed to guard, except in very clear weather. An 18-mile double flashing light is suggested to guard the dangers and to serve as a landfall light for the port of Tuticorin.

(*g*) The existing light at Pambam can be retained as a port light; vessels are said not to attempt to pass Pambam during the night.

(*h*) Between Pambam and Negapatam the shoals off Point Calimere and Negapatam are dangers to navigation which are not properly guarded by the existing lights at Point Calimere and Negapatam. The former is a 6th-order (red) port light exhibited from a mast, and a glance at the chart will show how insufficient its range of 6 miles is. An 18-mile revolving light at Point Calimere will, with the existing light at Negapatam, efficiently light this part of the coast. The new light will be of great service to steamers from Ceylon and to the small craft which navigate Palk Straits. From a steamer's bridge the range of the proposed light will be 19 miles.

(*i*) Between Negapatam and Madras no sea-lights appear to be necessary except to guard the Tripalur Reef off Seven Pagodas. The present light at Seven Pagodas is a 4th-order fixed red light of small power, exhibited at an elevation of 119 feet corresponding to a range of 17 miles. The light is very inefficient and the building unsuitable. An 18-mile triple flashing light is suggested and would be most useful to coasting and other steamers, especially the direct line from Negapatam to Burma.

(*j*) The existing light at Madras requires no alteration.

(*k*) North of Madras the first danger to navigation is the Pulicat Shoal, which the existing light, with the new Madras light, guards sufficiently well. It would be better, however, to increase the range to 13 miles by substituting a 3-wick burner when the atmosphere is impaired. The present light has a range of only 12 miles.

(*l*) North of Pulicat is the Armeghon Shoal, which is guarded by the existing 4th-order revolving light with a range of 14 miles. The present apparatus is sufficient, but the range may be increased to 15 miles by installing a 3-wick burner when the weather is misty.

(*m*) North of Armeghon no lights are necessary up to the mouth of the Kistna river. The existing light at Point Divi is very inefficient, being wrongly located and at too great a distance from the sea, thereby rendering the light liable to be obscured by the haze which often hangs over the land. The range of 12 miles does not cover the False Point, and vessels coming from the south are liable to be set in by the strong and variable current and might be ashore before the light is seen. This, apparently, often happens in the case of native craft. A new light should be exhibited from the False Point near the sea. The height of the tower need only be sufficient for a range of 16 miles, when viewed from a height of 15 feet above the water, as this will be sufficient for native craft, but the power should be sufficient for a range of 18 miles when viewed from a steamer's bridge. With the proposed new light on False Point, the existing light at Point Divi can be discontinued, as the approaches to Masulipatam will, with the proposed port light at that place, be efficiently lighted.

(*n*) North of Masulipatam the next dangers to navigation are the Sacramento Shoal and the dangers off Gódávari Point. To mark these dangers and to light the approaches to Cocanada, the lights at Hope Island and Vakalapudi were installed. As pointed out in paragraph 4 (*a*), the existing light at Hope Island is very inefficient as its range of about 12 miles is insufficient to cover the Sacramento Shoal. The existing revolving light at Vakalapudi is sufficient, but its range may be increased to about 15 miles by installing a 3-wick burner during misty weather. If a new 18-mile light (from a vessel's bridge) is installed on the mainland opposite Sacramento Shoal the ranges of the two lights will cut in 30 fathoms off Coringa and the approaches to Cocanada will be efficiently lighted. The new light can be exhibited from a pile lighthouse if sufficiently good foundations cannot be obtained for a masonry tower. The height may be sufficient for a range of 16 miles when viewed from a vessel's deck, but the power should be sufficient for a range of 18 miles when viewed from a steamer's bridge. The Presidency Port Officer originally suggested a site for the new tower at Thirtlamundi, distant some six miles from Sacramento Shoal. This site is, however, very inaccessible and there is no good water available. The Executive Engineer, Gódávari Western Division, on a further reference, reports that the proposed site, opposite the shoal, is infinitely superior and more accessible, but, before anything is settled, further information on this point is necessary.

(*o*) North of Vakalapudi the next danger to general navigation, along the coast of the Madras Presidency, is the Santapilli Rock lying some 6 to 7 miles from the existing light. This rock is described as one of the most dangerous shoals which the mariner has to avoid in the Bay of Bengal; there is deep water close alongside and, during fine weather, the sea is said not to break on the shoal. The existing 2nd-order apparatus is barely sufficient and, as it is exhibited from a great elevation, it would be better, in misty weather, to install a more powerful burner so as to ensure that the light shall reach the horizon as often as possible. If a 6-wick burner is installed the range will be increased to 17 miles, except perhaps in extraordinary weather when a mariner should be extremely cautious in approaching the coast. The ventilation of the existing lantern requires to be considerably improved, as at present the light-keepers find great difficulty in maintaining the light at more than $\frac{1}{2}$ power of the existing burner.

(*p*) The only other light proposed to be classed as a sea-light is at Kalingapatam, where a new 4th-order occulting light has been recently installed. This light is said to be useful for steamers from Madras or Ceylon to Calcutta, and marks a reef of rocks which extends about $\frac{1}{2}$ a mile to seaward.

9. It will be observed that the new lights proposed to be installed are all of the flashing type as recommended by Mr. Douglass. To install any other class of light would mean a needless waste of light and money, as these lights are about eight times more powerful than fixed or occulting lights of a corresponding order, with the same cost of maintenance. The flashing system has now been universally adopted as being the most efficient, easily maintained and easily identified, and, as Mr. Douglass remarked in a paper read at a meeting of the International Maritime Congress, "the language of numbers is a universal one and 4 to 14, indicated by flashes, "conveys an identical meaning to the master of a Chinese junk, the captain of a "French chasse marée, or the skipper of a North country whaler." If he had thought of India, he would no doubt have included the British India skipper and the masters of the native craft which navigate these waters, as there is no reason to suppose that they are one whit inferior in intelligence to those he did mention. It is proposed that the new lights shall have three characteristic distinctions, viz., one, two, or three flashes, separated by intervals of darkness, a group being followed by a comparatively long eclipse; they are all of the same description as the new Madras light and are at such distances apart as to fulfil the condition fixed by the French Administration that no two lights of the same character should recur at intervals of less than 80 miles. To identify one of these lights, the mariner will only have to count the number of flashes forming a group, and need not attempt to time the duration of light and darkness,—a matter of considerable difficulty in bad weather.

10. A difficulty in the efficient management of the lights of this Presidency is the absence of a properly trained establishment, capable of taking charge of any light and having a practical knowledge of matters relating to a light-keeper's duty. At present, light-keepers appear to be selected at random; clerks, fishermen, or even the ordinary cooly, are considered to be quite good enough to take charge of a light with its valuable appurtenances, and, with the exception of the Superintendents, the scale of pay is, apparently, fixed on this assumption. There is no central place where expectant light-keepers can be trained as is the case in Europe, and the result is, badly managed lights and a staff of keepers who have no idea of discipline and who fail to appreciate the importance of keeping their light at the maximum service intensity. The whole establishment is, in my opinion, wrongly organized, without proper training and in many cases far too numerous. The employment of a large number of cooly keepers does not compensate for the want of individual efficiency.

11. The system now in force in the Madras Presidency is to make the Port officers ex-officio inspecting officers of the lights near their ports; if the light is within the port limits the Port officer is the ex-officio Superintendent; but if the light is at a distance, a Superintendent is appointed, who is expected to live at the station, and is under the orders of the local Port officer, who visits the light at stated intervals. The whole working establishment consists of cooly-keepers on small pay, whose numbers, apparently, depend on no recognized rule. This system of managing lights might have some chance of being efficient had either the Port officers or the Superintendents received any special training; but, as a matter of fact, Port officers are recruited from the officers of merchant service and have not necessarily been inside a lighthouse up to the time they are called upon to take charge of, and supervise, the lights in their district. With a supervising establishment not necessarily acquainted with the practical working of lights, Superintendents who have had no proper training, who take no watch and do no actual work, and a number of ill-paid light-keepers who practically form the working establishment, the lights in this Presidency cannot be expected to be efficient, and any attempt to materially improve the lighthouse service must be unsatisfactory unless the establishment is reorganized. There is, in the English lighthouse service, no one who corresponds to the Madras Superintendent and the appointment might well be abolished.

12. The following instances appear to support the above condemnation of the Madras lighthouse establishment:—

(*a*) At Muttum, an important landfall light, the establishment consists of one Superintendent on Rs. 100, one head-keeper on Rs. 15, one assistant keeper on Rs. 9, one assistant keeper on Rs. 8 and two assistants on Rs. 7,—a total establishment of six persons, costing Rs. 1,752 per annum, at a station where, in England, two men would suffice. Of this establishment only four men, at the time of my inspection, were in the habit of keeping a watch or doing any actual work. The Superintendent considered it to be "derogatory to his dignity" to either take a watch or to do any work, and the head light-keeper followed the lead of his superior. This important light was, therefore, practically in the hands of cooly keepers throughout each night.

(*b*) At Point Calimere the establishment consists of one head-keeper on Rs. 12, and two assistants on Rs. 8 and Rs. 7, respectively. This light is a 6th-order port light and does not require an expensive establishment, but, owing to the necessity of filling up certain forms and returns, a head-keeper who can read and write English is considered a necessity. A boat overseer's clerk, a young Brahmin who has had no previous training, and who is plainly ignorant of his work, has been appointed. The result is that the cabin and mast is very badly maintained and the apparatus is not kept clean.

(*c*) At Point Divi, an important light about which there are frequent complaints, the establishment consists of one Superintendent on Rs. 70, one head keeper on Rs. 12 and four assistants. The establishment, therefore, numbers six persons whose total annual pay amounts to Rs. 1,356, of which one man, who does no work, and who is apparently often absent from the station, takes Rs. 840. None of the men live regularly at the station, and judging from the log book the light is often in charge of three men only, the rest being absent in Masulipatam where their families live. Three men, properly trained, are no doubt sufficient for the service of this light, but, in that case, the advantage of maintaining an establishment of six light-keepers is not evident.

(*d*) At Mangalore the establishment consists of a head light-keeper on Rs. 12, and two assistants on Rs. 8 and 7 respectively. None of the keepers live in the quarters which have been provided for them, and, on one occasion, when I visited the light at night, the head light-keeper was absent without leave. He explained that his uncle had died suddenly and he had attended the funeral, and the acceptance of this explanation seemed necessary as no better man could be obtained for the small pay sanctioned. The proceedings of the acting Port officer at Mangalore, dated 21st January 1895, forming an appendix to this report, are instructive as showing the result of obtaining men, to fill the important post of light-keeper, on the pay of an ordinary cooly. It will be observed that light-keeper Fakeera was suspended no less than five times before he was finally dismissed, and this leniency was necessary because an ordinary cooly can, at Mangalore, obtain wages which compare favourably with a light-keeper's pay without any of the disadvantages of a light-keeper's life.

(*e*) At Madras a new oil store has recently been constructed and is suitable, being fire-proof and provided with an impermeable floor. The oil is, however, stored in cisterns resting on wooden benches. The cisterns sweat a good deal, and the accidental spilling of oil appears to be considerable, with the result that the wooden benches are saturated with oil which also spreads over the floor. To soak up this oil, saw-dust has been thrown down and the oil store in Madras is, therefore, a source of considerable danger. In this instance the object of providing a suitable oil store is, to a great extent, defeated owing to the ignorance of the establishment.

13. The abovementioned instances are some of those which were brought to my notice during my inspection and appear to show—

(*a*) that the present establishment is not efficient;

(*b*) that the working keepers are underpaid and, in some cases, of the wrong class;

(*c*) that the policy of increasing the number of keepers, to make up for want of individual efficiency, is not successful.

14. I recommend that the whole establishment be reorganised and that two separate services be formed for "sea" and for "port" lights. The former—a "Provincial" service—may consist of Eurasians on pay which will attract good men for the service of the important and somewhat complicated sea lights; the latter, of natives on comparatively lower pay. The men forming the "Provincial" service should be either carpenters or mechanics, and both services should be specially trained for their duties.

15. The system of managing lights adopted by the Trinity House Corporation may be taken as a model for the reorganisation of the lighthouse service in this country. For lights, such as the majority of the proposed sea lights, the number of keepers in England, Scotland or France would be two, but, owing to the difference of climate and other causes, it is extremely unlikely that lights, in this Presidency, would be efficiently maintained by less than three men with a reserve to fill temporary vacancies, and for reliefs at a rock station.

16. To supervise this establishment two inspecting officers will be required, one for the East and the other for the West coast, whose duties, in the words of the Trinity House instructions, will be to "frequently visit the stations in his district, examine "carefully the state of each establishment, and see that it is maintained in a substantial "condition, clean, and in good order; also note particulars of any defects and repairs "that may be necessary; but unless it is a case of urgent need, he shall not order "any work to be carried out until after approval, as provided in section 9, General "duties. He shall particularly inspect the lighting apparatus and accessories, and "see that the orders of the Board with respect to them are carried out. He will also "examine the journal, oil book, store accounts, and other records, kept at the "station."

"The Superintendent shall also make occasional visits to the establishment at "night, but not at any stated times or regular intervals. He should immediately on "arrival proceed to the lantern; satisfy himself then of the efficiency of the light; "measure the height of the flame; note the condition of the wicks, their height "above the burner, and amount of char; note the thermometer, and state of ventila-"tion of the lantern, specially in reference to condensation on the glazing; and enter "these particulars, with the name of the keeper on watch, in the order book of the "station with any other remarks necessary." These men should in my opinion be properly qualified mechanics, who have received a special training to fit them for their duties, and have actually had charge of a light. They should be able to test lightning conductors, and should have a sufficient knowledge of drawing and estimating to prepare estimates for the annual repair of the stations in their charge; they should receive ordinary travelling allowances, and be provided with a furnished house, free of rent, at the head-quarters of their district. The cost of these men will be partly met by the saving of the pay and travelling allowances of the present lighthouse mechanic, and the travelling allowances of Port officers who will no longer be required to visit stations at a distance from their ports.

17. The working establishment of each station should consist of three men only with the necessary reliefs, the headman being styled the "Principal light-keeper" and held responsible "for the oil, stores, goods, furniture, and materials belonging to "the establishment; he is to see that no waste or embezzlement takes place and that "economy and good management, consistently with the maintenance of a perfectly good "light, are at all times observed. He is daily to serve out the quantities of oil and "other stores required, to keep an exact account of the quantities thereof received "from time to time, and of the issues for the necessary purposes of the establishment; "also an accurate account of the nightly consumption of oil and other stores, on the "forms provided for that purpose, which are to be made up monthly and delivered, "together with all other accounts for which forms are furnished, to the District "Superintendent at the regulated periods for transmission to this House."

"The keepers are to maintain a regular and constant watch in the light room "throughout the night, the *Principal taking equal duty with the assistant*; the dura-"tion of the watch never to exceed five hours at any period of the year, and when "the length of the days admit, it is not to exceed four. The watches are to be "changed each night, so that the same keeper shall not have the same watch two "nights consecutively."

The above extracts from the Trinity House Service Instructions indicate the proposed system. It will be observed that the advantage of the scheme is that each light will always be in charge of a competent man, who will be responsible for all that happens during his watch; that there will be no non-working men about the station, such as the present Superintendents, and no coolies. Each light-keeper should be provided with comfortable free furnished quarters, uniform, a supply of oil for

domestic purposes, and, in the case of isolated stations, should be allowed compensation for dearness of provisions. Care should be taken to keep a sufficient number of relief keepers in reserve, to ensure that each man shall get the leave which is his due and everything should be done in reason, such as the supply of books and periodicals, to make life at a lighthouse station comfortable. Table V gives details of the existing and proposed establishment.

18. The proposed "Local service" is not so important, and the establishment may be on lower pay and, owing to the simple apparatus in their charge, need not be so highly trained as the "Provincial service." All these lights are established where a Port officer, or a Port Conservator, is stationed and these officers may, as now, be *ex-officio* Superintendents, to exercise a general supervision over the lights, see that the apparatus and station are kept clean, and that the light is properly maintained, and generally exercise the same control as they now do. They should not, however, carry out any alterations or improvements in the service of the light, as the proposed Inspectors can be made available for this purpose. The keepers may be styled "Principals" and "Assistants" as in the Provincial service, and may be recruited, in the first instance, from the existing staff, the number being limited to three for a light exhibited from a tower and to two for a mast light, a few men being kept in reserve to fill temporary vacancies. The lights being ordinarily located in towns, no quarters need, as a rule, be provided, and the pay should include all allowances other than travelling in the event of a transfer. The provision of quarters for the native keepers, who may exclusively fill the appointments in this service, is, I am convinced, unnecessary where there is a town in the vicinity. The men much prefer to live in a town with their families, and resist any attempt to make them live in quarters where they are separated from those of their own caste. The only training necessary for these men is to be sent to a sea light to learn their duties. Table VI shows the establishment proposed for each "Local" light.

19. As regards educational qualifications of light-keepers, it seems unnecessary, in either of the proposed services, to insist on more than a knowledge of reading, writing, and arithmetic, sufficient to enable them to keep the requisite store books and journals. The great thing is to obtain good working men, and to insist on a higher standard of education would probably defeat this object altogether.

20. Tables II and III give the rates of pay proposed to be given in the two lighthouse services, and Table IV shows the rates of pay given in the Trinity House and Scotch services. It will be observed that the rates suggested for the Provincial service approximate to those in the Trinity House service for Principals, when the rupee is converted $\frac{1}{2}$ at par and $\frac{1}{2}$ at 1*s.* 6*d.*, while that proposed for the assistants is less. This deviation from the Trinity House scale of pay in the case of the assistants is suggested as it is thought that, in this country, a greater difference in the pay of the two classes is advisable in the interests of discipline. The proposed cost of the establishment does not appear to be extravagant, and, taking the value of the rupee at 1*s.* $1\frac{1}{2}$*d.* is about the same as that of the ordinary Trinity House scale for two men. The average annual cost per light will be Rs. 2,220, including inspectors and reliefs, or Rs. 155 per month for the actual establishment employed at a station—a sum which compares favourably with present rates, when the difference in the description of the existing and proposed lights is taken into account. The cost per mensem at each of the proposed land stations is, in fact, practically the same as the cost of the establishment now employed at the new Madras light to which the proposed lights are similar. If a comparison is made with the establishment maintained at sea lights in Bombay, Burma and Bengal (*vide* tables VII and VII-A) the result is considerably in favour of the proposed scale, the averages per sea light being Rs. 3,680 in Burma, Rs. 4,545 in Bombay and Rs. 2,793 in Bengal, against Rs. 1,896 proposed in Madras, when cost of inspection and other local allowances are not taken into account. The above rates also do not take into account compensation for dearness of provisions at rock and other isolated stations, but all charges are approximately estimated in Table VIII.

It is suggested that the Provincial service should be entirely recruited by Eurasians as being more likely to give satisfaction and to live contentedly at the out-of-the-way places at which the lights are proposed. The President of the Eurasian

and Anglo-Indian Association suggests that the Association will take the responsibility of selecting respectable men.

21. As regards the proposed reorganisation of the port light service, the only changes proposed are to limit the number of keepers to three for each fixed light exhibited from a tower, and to two for lights exhibited from a mast. The proposed scale of pay is given in Table III and differs from that now in force by the introduction of a higher rate for Principals of long service and the abolition of the last two grades of assistant keepers. The extra cost, at an ordinary port light, is only Rs. 150, and at a mast light Rs. 60 per annum, in excess of existing rates. The first two classes of Principals and assistants are proposed to be reserved for lights exhibited from a tower, and the last class, for establishment employed at mast lights such as Kundapur, Mulpy, and Tellicherri, where the difficulty in management is considerably less. No allowances of any sort will be required for this establishment and quarters need not, as a rule, be provided. The cost of the proposed establishment is not excessive and the proposed increase is trifling and can, it is believed, be easily met from Port Funds, when relieved of the cost of maintaining sea lights. If the additional establishment now maintained at certain stations for signalling purposes can be dispensed with and the light-keepers required to do this work in addition to their other duties, the cost of establishment will be still further reduced.

22. In Table I an estimate of the probable expenditure required for the improvement of existing, and the construction of new lights, is given, but the amount must be taken as only roughly approximate as no detailed estimates have been prepared and but little information is on record as a guide.

23. For the proposed "Provincial" lights, a sum of Rs. 8,00,000 is required, of which Rs. 2,08,000 is for eight new sets of apparatus; Rs. 4,55,000 for improvements to existing towers and for new constructions; and the balance for contingencies and Public Works charges for supervision.

24. The cost of apparatus and machinery is estimated at Rs. 26,000 per light, and has been fixed with reference to the actual amount paid for the new Madras light apparatus, and the lists of various manufacturers. The amount however seems large as the prices quoted in the lists are for complete optical apparatus, while the apparatus required consists of lenses only, the upper and lower catodioptric prisms being omitted —an alteration which should, it is thought, reduce the price considerably. How much of this reduction will be absorbed by the extra cost of helical or inclined lantern framing is not known, and it would probably be as well to obtain quotations from different manufacturers, as a reduction should be obtainable on a large order. The prices also of English, Scotch, and French lanterns and apparatus vary considerably, though practically equally efficient, so that it is a matter of importance to know whether Government is to be tied down to one manufacturer only.

25. As regards the construction of towers, but little information is available as no towers of the same description have as yet been constructed in this Presidency. Mons. Allard, late Inspecteur-General des Ponts et Chaussés, estimates the average cost of building nineteen third order towers in France at 3,200 francs per mêtre of height, corresponding to say, Rs. 450 per foot in India. Accepting this figure in the absence of more exact data, the amount required for construction, including provision of quarters and improvements to existing towers, is Rs. 4,55,000.

26. The approximate annual cost of maintaining the "Provincial" lights is given in Table VIII and, including the pay of inspectors, contribution towards pension, and reliefs, amounts to Rs. 5,500 per light, or Rs. 82,500 for fifteen lights. This estimate agrees fairly well with the actual figures given by Mons. Allard for similar lights in France, where the cost of maintenance is reduced to a minimum consistent with efficiency. If a comparison is made with the expenditure on lights in Burma, Bengal and Bombay (*vide* Tables VII and VII-A), the estimated cost of maintenance for lights in this Presidency appears to be very moderate; the average cost per sea light, exclusive of light vessels, was in Burma, in 1893–94, Rs. 12,346, in Bengal, in 1893, Rs. 6,297, and for lights under the Bombay Port Trust Rs. 8,390. These averages however are based on one year's figures and do not include contribution towards pension.

27. If the cost of construction is met from loan funds bearing interest at the rate of $3\frac{1}{2}$ per cent. per annum, and a sinking fund is provided to repay the original cost in 25 years, the following figures indicate the annual amount required for the maintenance of the proposed "Provincial" lights:—

	Rs.
Interest at $3\frac{1}{2}$ per cent. on Rs. 8,00,000	28,000
Cost of maintenance	82,500
Sinking fund	19,500
Total ..	1,30,000

Rupees 1,30,000 may be thought to be a large sum to spend annually on the proposed sea lights, but such does not appear to be the case, as Burma, in 1893–94, spent Rs. 1,75,317 on eight lighthouses and three light vessels, Bengal, in 1893, Rs. 2,50,005 on thirteen lighthouses and light vessels, and the Bombay Port Trust Rs. 27,167 on four lighthouses. In the light of these figures therefore an annual expenditure of Rs. 1,30,000 on fifteen lights in Madras does not appear to be excessive, especially when it is remembered that this estimate includes interest on capital, provision for a sinking fund, and contribution towards pensions all of which are omitted in the figures given for the other services.

28. From the figures in the preceding paragraph, it appears that the amount required to be provided annually on account of the proposed "Provincial" lights may be estimated at Rs. 1,30,000, and this amount is proposed to be wholly met from light dues. At present the ports on the Madras coasts are divided into groups, and, if a sea light is established within the limits of a group, the cost of construction and maintenance is met from the Port funds of that group, though the light is not exhibited for the exclusive benefit of the ports in the group. The result is that many of the ports are in debt, and there are no funds available to carry out much needed improvements, while the general shipping obtains the service of lights without necessarily paying anything towards their upkeep. The imposition of a light due has been adopted in all European countries, and already Burma, Ceylon, and the Straits collect dues for the upkeep of sea lights. There seems to be no reason, therefore, why a due should not also be levied for the lights required for the extended coast line of this Presidency.

29. The question of a light due has already been considered by Government, but, in former proposals, all lights were proposed to be maintained from that source. An important difference in the present scheme is that only lights which are for the benefit of general navigation are proposed to be maintained from a light due, the "Local" or port lights being still maintained from Port funds. This modification of the previous proposals is in accordance with the usual practice in Europe and has the advantage that, where Harbour or other Boards are formed, the port lights can be handed over to them for management along with other matters connected with the port, the whole expenditure being purely local.

30. In paragraph 28 it was mentioned that light dues were already collected for lights in Indian waters and from the information available it appears (See Table X) that the Board of Trade levy a due of $2\frac{1}{2}$ pies per ton on vessels arriving at, or departing from, ports in this Presidency, which, in the natural course of their voyage, pass near Minikoi island; the Ceylon Government a due of $7\frac{1}{2}$ pies per ton for the Basses lights; and the Straits Government dues of 12 and 6 pies per ton according as vessels pass the whole or a portion of the lights maintained by them. In Burma the large sum of Rs. 2,54,038 was collected in 1893 under Act IX of 1879 (India) at the rate of 18 pies per ton of burden.

31. To collect a due of Rs. 1,30,000 for lights in the Madras Presidency will not, it is thought, be a heavy tax on shipping. It is estimated that the tonnage of steamers employed in the coasting trade amounts to 130,000 tons, the tonnage of foreign steamers to 240,000 tons and of native craft to 40,000 tons. Assuming

that coasting steamers and native craft make six trips and foreign steamers two trips annually, a due of 12 pies* per month per ton on coasting steamers, 6 pies per ton per month on native craft, and 7 pies per ton per voyage on foreign steamers would produce the required amount. Without further information,† however, it is impossible to fix the probable rates, but it is believed that the estimate now made will enable Government to come to a decision on the subject of the imposition of a light due.

* A coasting steamer of 1,200 tons net register would pay Rs. 900 per annum for fifteen lights or at the rate of Rs. 60 per light, or, say, Rs. 5 each time a light is passed.

32. As regards the local port lights the estimated cost of maintenance (*vide* Table IX) amounts to Rs. 882 per light per annum, or to Rs. 15,000 for seventeen lights, which is not much in advance of present rates, if the difference in class of the apparatus proposed at some stations is taken into account. In addition to this annual maintenance, it is estimated (Table I) that a sum of Rs. 80,000 should be expended to render existing lights efficient, and to provide for new constructions. This expenditure of Rs. 80,000 can be spread over five years, as, in many cases, the apparatus is not likely to be available until that time has elapsed, and, therefore, the total estimated annual expenditure from Port funds during the first five years may be taken as Rs. $\frac{80,000}{5}$ or Rs. 16,000 + Rs. 15,000 = Rs. 31,000, and after that period as Rs. 15,000. The average expenditure from Port funds, on lights, during the past three years has been Rs. 55,690, so that for the first five years a sum of Rs. 24,690 and eventually Rs. 40,690 will be set free, annually, for the general improvement of ports or for the reduction of port dues.

33. The total annual expenditure on lights in this Presidency, if the proposed improvements are sanctioned, is therefore estimated at Rs. 1,30,000 for "Provincial," and Rs. 15,000 for "Local" lights, or a total of Rs. 1,45,000 per annum for the maintenance of 32 lights.

† NOTE.—The information called for in G.O., dated 19th April 1895, Mis. No. 1534, Revenue, has not been fully received.

F. W. ASHPITEL,
Executive Engineer,
On Special duty, Marine Department.

MADRAS,
22*nd June* 1895.

TABLE I.

List of Existing and Proposed Lights.

[*Note.*—The figures in column 10 are calculated for an elevation of 15 feet above water-level for "Provincial" lights and for 9 feet above water-level for "Local" lights.] Columns 11 and 13 are merely approximate.

Name of light.	Proposed location.	Colour. Existing.	Colour. Proposed.	Description. Existing.	Description. Proposed.	Range in miles. As per light list.	Range in miles. Actual or proposed.	Height of F.P. above H.W.L. in feet. Existing as per light list.	Height of F.P. above H.W.L. in feet. Suitable to range of light.	Height of F.P. above H.W.L. in feet. Proposed.	Height of tower in feet. Existing as per light list.	Height of tower in feet. Proposed.	Character and order as per light list.	Character and order as proposed.	Cost of improvements; Port Fund approximate.	Cost of improvements; Light dues approximate.	Remarks.	Service to which light is proposed to belong.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Kundapur ..	Near the southern boundary pillar of the post.	White.	White.	Fixed.	Fixed.	6 to 8	8	45	16	56	40	..	6th order port light.	6th order port light.	Rs. 2,000	Rs. ..	The height of focal plane in the list of lights appears to be wrongly entered. It is said to be 56 feet above H.W.L.	Port or "Local" light.
Barkur ..	To the north of the bar.	..	Red.	..	Do.	..	..	..	6	20	..	..	....	Do.	2,000	..	A 6th order port light will suffice. The existing apparatus at Point Calimere may be installed.	Do.
Mulpy ..	Near the Custom House.	White.	White.	Fixed.	Do.	6 to 8	8	53	16	56	40	..	6th order port light.	Do.	..	81,000	No charge ..	Do.
Mulki ..	On the rocks or on the mainland opposite the rocks.	..	Do.	..	Flashing.	..	18	..	135	135	100	..	....	3rd order triple flashing light.	..	..	To be built if possible on the rocks, but if smooth water cannot be obtained alongside, to be built on the mainland opposite the rocks.	Sea or "Provincial" light.
Mangalore ..	A lower site to be selected.	White	Do.	Fixed.	Fixed.	14	12	240	55	55 to 65	65	?	4th order fixed light.	4th order fixed light.	6,000	..	Light to be moved from its present position to a suitable site at a lower elevation.	Port or "Local" light.
Kannanur ..	On the fort rampart.	Red.	Do.	Do.	Do.	6 to 8	12	64	55	55	25	16	6th order port light.	Do.	2,000	..	One of the 4th order fixed apparatus, which will become available, may be installed.	Do.
Tellicherri ..	On the fort wall ..	White.	Red.	Do.	Do.	6 to 8	6	70	6	59	26	15	6th order port light.	Do. ..	2,000	..	Existing light to be improved and light to be dipped.	Do.
Mahé ..	On the south side of the entrance to the river.	Red.	Do.	Do.	Do.	7	7	..	..	..	..	..	....	....	..	..	Maintained by the French Government.	Port light.

TABLE I—*cont.*

List of Existing and Proposed Lights—*cont.*

[*Note.*—The figures in column 10 are calculated for an elevation of 15 feet above water-level for "Provincial" lights and for 9 feet above water-level for "Local" lights.] Columns 11 and 13 are merely approximate.

Name of light.	Proposed location.	Colour.		Description.		Range in miles.		Height of F. P. above H. W. L. in feet.			Height of tower in feet.		Character and order as per light list.	Character and order as proposed.	Cost of improvements; Port Fund approximate.	Cost of improvements; Light dues approximate.	Remarks.	Service to which light is proposed to belong.
		Existing.	Proposed.	Existing.	Proposed.	As per light list.	Actual or proposed.	Existing as per light list.	Suitable to range of light.	Proposed.	Existing as per light list.	Proposed.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
															Rs.	Rs.		
Sacrifice rock ..	On the rock ..	..	White.	..	Flashing	..	18	..	135	135	..	105	..	3rd order double flashing light.	..	1,00,000	The new tower to be built on the rock if possible.	Sea or "Provincial" light.
Calicut	Near the beach ..	White.	White.	Fixed.	Fixed.	14	12	102	55	65	98	61	4th order fixed light.	4th order fixed light.	6,000	..	Tower to be lowered to suit range of light and to be fitted with spiral staircase.	Port or "Local" light.
Narakal ..	To be abandoned ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Light to be moved to Mallipuram.	..
Mallipuram ..	On the beach ..	..	Red.	Fixed.	Fixed.	..	6	..	6	15	..	..	..	6th order port light.	..	..	A cabin and mast will be suitable, or a port light exhibited from the roof of a small building.	Port light.
Cochin	On a small mound which formed the bastion of the old fort.	White.	White.	Do.	Do.	14	12	100	55	65	91	56	4th order fixed light.	4th order fixed light.	6,000	..	Tower to be lowered to suit range of light and to be fitted with spiral staircase.	Port or "Local" light.
Aleppi	On the beach ..	Do.	Do.	Revolving.	Revolving.	17	..	113	..	..	115	..	Catadioptric revolving light.	..	..	..	No change necessary. Light maintained by Travancore Government.	Sea or "Provincial" light.
Tangacheri ..	On the point ..	..	Do.	..	Flashing.	..	18	..	135	135	..	90	..	3rd order triple flashing light.	..	77,000	To mark dangers off the point and to guide vessels to the anchorage.	Do.
Muttum ..	On a rocky promontory.	White.	Do.	Fixed.	Fixed.	17	18	142	135	142	72	72	1st order fixed light.	1st order fixed light.	..	4,000	Occulting apparatus may be fixed if considered necessary and range increased 18 miles by using a 6-wick burner during misty weather. Light will then show beyond Cape Comorin.	Do.

TABLE I—*cont.*

List of Existing and Proposed Lights—*cont.*

[*Note.*—The figures in column 10 are calculated for an elevation of 15 feet above water-level for "Provincial" lights and for 9 feet above water level for "Local" lights.] Columns 11 and 13 are merely approximate.

Name of light.	Proposed location.	Colour.		Description.		Range in miles.		Height of F. P. above H.W.L. in feet.			Height of tower in feet.		Character and order as per light list.	Character and order as proposed.	Cost of improvement; Port Fund approximate.	Cost of improvement; Light dues approximate.	Remarks.	Service to which light is proposed to belong.
		Existing.	Proposed.	Existing.	Proposed.	As per light list.	Actual or proposed.	Existing as per light list.	Suitable to range of light.	Proposed.	Existing as per light list.	Proposed.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
															Rs.	Rs.		
Manapaud ..	On Manapaud point.	Red ..	White.	Fixed.	Flashing	6 to 8	18	104	135	135	27	58	6th order port light.	3rd order double flashing light.	..	60,000	To cover the danger distant ten miles and as landfall light for Tuticorin.	Sea or "Provincial" light.
Tuticorin ..	On Hare Island ..	White.	Do.	Do.	Fixed.	14	11	85	45	65	91	71	4th order fixed apparatus.	4th order fixed apparatus	4,000	..	Tower to be lowered to suit range of light. Present tower too slight.	Port or "Local" light.
Pámbam ..	On a sand hill ..	Do.	Do.	Do.	Do.	14	11	97	45	97	72	72	Do.	4th order fixed.	4,000	..	Tower to be improved.	Do.
Tondi	Near Custom House..	Red ..	Red ..	Do.	Do.	6 to 8	6	63	5	63	52	52	6th order port light.	6th order port light.	..	..	No change. Light may be dipped.	Do.
Point Calimere.	On the point ..	Do.	White.	Do.	Flashing	6 to 8	18	49	135	135	..	130	Do.	3rd order revolving light.	..	85,000	Land-fall light for steamers from Ceylon to Negapatam and Pámbam and to cover dangers off point.	Sea or "Provincial" light.
Negapatam ..	On the jetty ..	White.	Do.	Do.	Fixed.	14	13	79	70	79	83	..	4th order fixed light.	4th order fixed light.	2,000	..	Range to be increased to 13 miles by installing a three-wick burner in misty weather.	Port or "Local" light.
Karikal	At the mouth of the Arasalar river.	Do.	..	Do.	..	..	..	..	..	..	..	..	..	..	..	..	Maintained by the French Government.	Port light.
Cuddalore ..	Near the present light.	Red ..	White.	Do.	Occulting.	6 to 8	12	130	55	..	31	..	6th order port light.	4th order occulting.	4,000	..	Range to be increased and new apparatus to be installed on roof of small building. A spare apparatus is available.	Port or "Local" light.

TABLE I—*cont.*

List of Existing and Proposed Lights—*cont.*

[*Note.*—The figures in column 10 are calculated for an elevation of 15 feet above water-level for "Provincial" lights and for 9 feet above water-level for "Local" lights.] Columns 11 and 13 are merely approximate.

Name of light.	Proposed location.	Colour.		Description.		Range in miles.		Height of F.P. above H.W.L. in feet.			Height of tower in feet.		Character and order as per light list.	Character and order as proposed.	Cost of improvement; Port Fund approximate.	Cost of improvement; Light dues approximate.	Remarks.	Service to which light is proposed to belong.
		Existing.	Proposed.	Existing.	Proposed.	As per light list.	Actual or proposed.	Existing as per light list.	Suitable to range of light.	Proposed.	Existing as per light list.	Proposed.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Pondicherri ..	Near the beach ..	White.	White.	Fixed.	..	..	..	..	..	..	..	..	..	..	Rs. ..	Rs. ..	Maintained by the French Government.	Port light.
Seven Pagodas ..	On a rock	Red ..	Do.	Do.	Flashing.	14	18	119	135	135	26	50	4th order fixed light.	3rd order triple flashing.	..	53,000	A site to be fixed on one of the rocks near existing light.	Sea or "Provincial" light.
Madras ..	On main tower of Law Courts.	White.	Do.	Flashing.	Do.	19	19	166	..	166	190	190	3rd order double flashing light.	3rd order double flashing light.	..	..	No change	Do.
Pulicat ..	Near the beach ..	Do.	Do.	Fixed.	Fixed.	14	13	68	55	68	57	57	4th order fixed light.	4th order fixed light.	..	4,000	Range to be increased to 13 miles three-wick burner to be used in misty weather. Present range of light, 12 miles.	Do.
Armeghon ..	On the mainland near Moonapaliem .	Do.	Do.	Revolving.	Revolving.	14	15	107	85	107	111	94	4th order revolving.	4th order revolving.	..	4,000	Three-wick burner in misty weather.	Do.
Point Divi ..	On False point ..	..	Do.	..	Flashing.	..	16 to 18	..	100	100	..	100	..	3rd order triple flashing light.	..	85,000	The range will be 18 miles from steamer's bridge.	Sea or "Provincial" light.
Masulipatam ..	On the beach to the south of bar.	White.	Do.	Fixed.	Fixed.	6	12	69	55	45	..	50	4th order port light.	4th order fixed light.	15,000	..	Site of light to be changed and new light to be exhibited from a masonry or pile lighthouse.	Port or "Local" light.
Sacramento Shoal (Hope Island).	Opposite to shoal ..	Do.	Do.	Do.	Flashing.	14	16 to 18	..	100	100	..	100	4th order fixed.	3rd order double flashing light.	..	85,000	Hope Island light-house to be abandoned and new light placed opposite shoal. Range will be 18 miles from steamer's bridge.	Sea or "Provincial" light.

TABLE I—*cont.*

List of Existing and Proposed Lights—*cont.*

[*Note.*—The figures in column 10 are calculated for an elevation of 15 feet above water-level for "Provincial" lights and for 9 feet above water-level for "Local" lights.] Columns 11 and 13 are merely approximate.

Name of light.	Proposed location.	Colour.		Description.		Range in miles.		Height of F.P. above H.W.L. in feet.			Height of tower in feet.		Character and order as per light list.	Character and order as proposed.	Cost of improvement; Port Fund approximate.	Cost of improvement; Light dues approximate.	Remarks.	Service to which light is proposed to belong.
		Existing.	Proposed.	Existing.	Proposed.	As per light list.	Actual or proposed.	Existing as per light list.	Suitable to range of light.	Proposed.	Existing as per light list.	Proposed.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Vakalapudi ..	4¾ miles north of Cocanada.	White.	White.	Revolving.	Revolving.	14	15	80	80	80	76	76	4th order revolving.	4th order revolving.	Rs. ..	Rs. 9,000	Range may be increased to 15 miles by installing a three-wick burner in misty weather.	Sea or "Provincial" light.
Vizagapatam ..	Near the Port office.	..	Do.	..	Fixed.	..	12	..	55	40	..	..	..	4th order fixed light.	5,000	..	New light required as guide to anchorage.	Port or "Local" light.
Bimlipatam ..	....	..	Do.	..	Do.	..	10	..	33	35	..	..	..	4th order port light.	2,000	..	New light required as guide to anchorage.	Do.
Santapilli ..	On small basement on top of hill.	White.	Do.	Fixed.	Do.	16	17	164	116	164	31	31	2nd order fixed	2nd order fixed	..	8,000	Range to be increased and six-wick burner used during misty weather.	Sea or "Provincial" light.
Kalingapatam ..	On the point ..	Do.	Do.	Occulting.	Occulting.	13	13	76	55	76	73	73	4th order occulting.	4th order occulting.	..	8,000	No change. Proposed expenditure on quarters required for establishment.	Do.
Gopalpor ..	On flagstaff ..	Do.	Do.	Fixed.	Fixed.	10	10	54	25	..	33	33	4th order fixed port.	4th order fixed port.	500	..	The elevation of the light may be reduced.	Port or "Local" light.
														Total ..	62,500	6,63,000		
														Contingencies ..	2,000	24,500		
														Public Works Charges ..	15,500	1,12,500		
														Total ..	80,000	8,00,000		

F. W. ASHPITEL,
Executive Engineer,
On Special duty, Marine Department.

22nd June 1895.

TABLE II.

Scale of Pay of Proposed "Provincial" Establishment.

Principal Keepers.

Description.	Pay in Rupees per mensem.
Over ten years' service	70
Under ten years' and over five years' service	65
Under five years' service	60
Assistant Keepers.	
Over ten years' service	50
Under 10 years' and over five years' service	45
Under five years' service	40

Note.—For Trinity House and Scotch establishments, see Table IV. Keepers to be provided with free furnished quarters and with uniform. Compensation for dearness of provisions to be paid at isolated stations.

TABLE III.

Scale of Pay of Proposed "Local" Establishment.

For ordinary Port lights.

Description.	Pay in Rupees per mensem.
Principals—	
Over ten years' service	20
Under ten years' service	15
Assistants—	
Over ten years' service	12
Under ten years' service	10
For Port lights exhibited from a Flagstaff or Mast.	
Principals	12
Assistants	9

Note.—No quarters to be provided except where the lights are at a distance from a town. No allowances to be given.

TABLE IV.

Scale of Pay of Lighthouse Establishments in Great Britain.

—	Pay in sterling per annum.	Rupees per mensem.			
		Pay at par.	Pay ½ at par ½ at 1s. 6d.	Pay at 1s. 6d.	Pay at 1s. 1½d.
Trinity House Establishment.	£. s. d.	RS.	RS.	RS.	RS.
Principals.					
Above ten years' service	70 10 0	59	68	78	104
Above five years' and under ten years' service	66 10 0	55	65	74	99
Under five years' service	64 10 0	54	63	72	96
Assistants.					
Above ten years' service	56 10 0	47	55	63	84
Above five years' and under ten years' service	54 10 0	45	53	60	80
Under five years' service	52 10 0	44	51	58	78
Scotch Lighthouse Establishment.					
Principals.					
Under ten years' service	62 0 0	52	60	69	92
Above five years' and under ten years' service	58 0 0	48	57	64	86
Under five years' service	56 0 0	47	54	62	83
Assistants.					
Under ten years' service	48 0 0	40	47	53	71
Above five years' and under ten years' service	46 0 0	38	45	51	68
Under five years' service	44 0 0	37	43	49	65

Extra allowances are given for rock and other isolated stations including allowances for fuel, uniform, and compensation for dearness of provisions.

TABLE V.

Giving details of existing and proposed establishment for "Provincial" (Sea) Lights.

Existing establishment.

Name of Lighthouse.	Superintendents. 1st-class, Rs. 100.	Superintendents. 2nd-class, Rs. 70.	Superintendents. 3rd-class, Rs. 50.	Head Light-keepers. 1st-class, Rs. 15.	Head Light-keepers. 2nd-class, Rs. 12.	Head Light-keepers. 3rd-class, Rs. 10.	Light-keepers. 1st-class, Rs. 9.	Light-keepers. 2nd-class, Rs. 8.	Light-keepers. 3rd-class Rs. 7.	Total per mensem.	Total per annum.
										RS.	RS.
Mulki	..	Proposed new light.									
Sacrifice Rock	..	Ditto.									
Aleppy	..	Light maintained by the Travancore Government.									
Tangacheri	..	Proposed new light.									
Muttum	1	..	..	1	..	..	1	1	2	146	1,752
Manapaud	..	..	1	..	..	1	..	1	1	75	900
Point Calimere	..	..	..	..	1	..	..	1	1	27	324
Seven Pagodas	..	1	..	..	1	..	1	1	1	106	1,272
Madras	1	..	..	1	..	..	3	1	1	157	1,884
Pulicat	..	1	..	..	1	..	1	1	1	106	1,272
Armeghon	1	..	..	1	..	..	1	1	2	146	1,752
Point Divi	..	1	..	..	1	..	1	1	2	113	1,356
Sacramento Shoal (Hope Island)	..	1	..	..	1	..	1	1	2	113	1,356
Vakalapudi	..	1 + Rs. 10	..	1	..	..	1	2	1	127	1,524
Santapilli	..	1	..	1	..	..	1	1	1	109	1,308
Kalingapatam	..	1	..	1	1	..	1	1		114	1,368
Add pay of Lighthouse Mechanic ..										100	1,200
Grand total ..										1,439	17,268
Average per light ..										120	1,440

Proposed establishment.

Name of Lighthouse.	Principal keepers. Over 10 years' service, Rs. 70.	Principal keepers. Under 10 and over 5 years' service, Rs. 65.	Principal keepers. Under 5 years' service, Rs. 60.	Assistant keepers. Over 10 years' service, Rs. 50.	Assistant keepers. Under 10 and over 5 years' service, Rs. 45.	Assistant keepers. Under 5 years' service, Rs. 40.	Total per mensem.	Total per annum.	Inspectors.	Reliefs.	Grand total per annum.
	Average.			Average.			RS.	RS.	RS. 100 to 150	RS. 40	RS.
Mulki	..	1	..	..	2	..	155	1,860			..
Sacrifice Rock	..	1	..	..	3	..	200	2,400		1	..
Aleppy											..
Tangacheri	..	1	..	..	2	..	155	1,860	1		..
Muttum	..	1	..	..	2	..	155	1,860			..
Manapaud	..	1	..	..	2	..	155	1,860		1	..
Point Calimere	..	1	..	..	2	..	155	1,860			..
Seven Pagodas	..	1	..	..	2	..	155	1,860			..
Madras	..	1	..	..	2	..	155	1,860			..
Pulicat	..	1	..	..	2	..	155	1,860		1	..
Armeghon	..	1	..	..	2	..	155	1,860			..
Point Divi	..	1	..	..	2	..	155	1,860	1		..
Sacramento Shoal (Hope Island)	..	1	..	..	2	..	155	1,860		1	..
Vakalapudi	..	1	..	..	2	..	155	1,860			..
Santapilli	..	1	..	..	2	..	155	1,860			..
Kalingapatam	..	1	..	..	2	..	155	1,860			..
Pay of 2 Inspectors							250	3,000			..
Pay of relief keepers							160	1,920			
Grand Total ..							2,780	33,360			
Average per light ..							185	2,220			

TABLE VI.

Giving details of existing and proposed establishment for "Local" (Port) lights.

Name of Lighthouse.	Existing establishment.								Proposed establishment.								Remarks.
	Head Light-keepers.			Light-keepers.			Total per mensem.	Total per annum.	Principal keepers.			Assistant keepers.			Total per mensem.	Total per annum.	
	1st-class, Rs. 15.	2nd-class, Rs. 12.	3rd-class, Rs. 10.	1st-class, Rs. 9.	2nd-class, Rs. 8.	3rd-class, Rs. 7.			Over 10 years' service, Rs. 20.	Under 10 and over 5 years' service, Rs. 15.	Under 5 years' service, Rs. 12.	Over 10 years' service, Rs. 12.	Under 10 and over 5 years' service, Rs. 10.	Under 5 years' service, Rs. 9.			
							Rs.	Rs.	Average pay.						Rs.	Rs.	
Kundapur	..	..	1 + Re. 1	..	..	1	16	192		1	..	..	1		21	252	
Barkur	..	..	..	..	..	8½ months.	..	..	..	1	..	..	1		21	252	New light.
Mulpy	..	..	1 + Re. 1	..	..	8½ months.	16	192	..	1	..	..	1		21	252	
Mangalore	..	1	..	..	1	1	27	324	1	..	1	1	..		39½	474	
Cannanore	..	..	1 + Re. 1	..	1	..	19	228	1	..	1	1	..		39½	474	New light.
Tellicherri	..	..	1 + Re. 1	..	1	..	19	228	..	1	..	..	1		21	252	
Calicut	..	1	..	..	1	1	27	324	1	..	1	1	..		39½	474	
Cochin	..	..	..	..	1	1	27	324	1	..	1	1	..		39½	474	
Tuticorin	..	..	2 + Re. 1	1	1	..	58	696	1	..	1	1	..		39½	474	
Pambam	..	1	..	..	1	1	27	324	1	..		1	..		39½	474	Same establishment will do for signalling.
Tondi	..	..	1 + Re. 1	..	1	..	19	228	..	1	..	..	1		21	252	
Negapatam	..	1	..	..	1	1	27	324	1	..	1	1	..		39½	474	
Cuddalore	..	..	..	..	2	..	36	432	1	..	1	1	..		39½	474	
Masulipatam	..	..	1	..	1	..	18	216	1	..	1	1	..		39½	474	No extra establishment required for signalling.
Vizagapatam	..	..	..	..	..	..	..	..	1	..	1	1	..		39½	474	New light.
Bimlipatam	..	..	1	..	..	..	..	..	..	1	..	1	..		39½	474	Do.
Gopalpur	..	..	..	..	1	..	18	216	..	1	..	..	1		21	252	Do.
Total	..	..	..	..	..	..	354	4,248	..	..	..	..	..		21	252	
Average per light	..	..	..	..	..	..	25	303	..	..	..	..	..		542	6,504	
									..	..	..	..	..		32	382	

TABLE VII.

Giving details of expenditure on certain Light houses in Burma, in 1893–94.

Head of Charge.	Alguada Reef 1	Table Island 2	Double Island 3	Savage Island 4	Reef Island 5	Eastern Grove 6	China Buckeer 7	Oyster Island 8	Grand Total for Lights Nos. 1, 2, 3, 4, 6, 7 and 8.	Average per light excluding No. 5.
	Catadioptric, 1st order, revolving.	Dioptric, 1st order, fixed.	Dioptric, 1st order, fixed.	Dioptric, 3rd order, revolving.	Dioptric, 5th order, fixed.	Dioptric, 2nd order, fixed.	Dioptric, 1st order, revolving.	Dioptric, 1st order, occulting.		
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Salaries of establishment	7,870 11 9	4,366 14 10	2,155 6 2	2,113 0 0	865 0 0	2,084 4 7	2,124 0 0	5,052 1 5	25,766 6 9	3,680 14 8
Provisions	3,840 12 1	2,436 7 7	2,039 14 0	1,025 3 6	1,085 8 6	961 2 10	1,701 7 9	3,152 13 11	15,157 13 8	2,165 6 6
Oil and stores	2,807 7 6	1,737 15 6	1,251 14 0	145 14 1	278 15 0	209 3 11	1,316 2 0	306 14 8	7,775 7 8	1,110 12 6
Repairs and fittings, contingencies and coal.	1,212 4 8	753 2 4	32 14 7	348 3 1	69 2 4	124 14 2	289 13 5	620 3 5	3,381 7 8	483 1 1
Share of relief and pay of Inspector	1,203 12 4	1,203 12 4	1,203 12 4	1,203 12 4	1,203 12 4	1,203 12 4	1,203 12 4	1,203 12 4	8,426 6 3	1,203 12 4
Public Works outlay	2,091 6 0	1,794 6 0	1,302 6 0	3,457 6 0	1,410 6 0	1,935 6 0	2,027 6 0	7,441 6 0	20,049 10 0	2,864 3 8
Refund of light dues	21 7 6	21 7 6	21 7 6	21 7 6	21 7 6	21 7 6	21 7 6	21 7 6	150 4 6	21 7 6
Cost of Europe stores	138 1 8	65 11 2	162 3 9	2,219 4 2	15 10 6	753 12 3	162 2 8	2,219 4 2	5,720 7 10	817 3 5
Total ..	19,185 15 6	12,379 13 3	8,169 14 4	10,534 2 8	4,949 14 2	7,293 15 7	8,846 3 8	20,017 15 5	86,428 0 4	12,346 13 8

Note.—The total expenditure on lights including light vessels in Burma in 1893–94 was Rs. 1,75,317–4–8 which was wholly met from light dues.

TABLE VII-A.

Giving details of expenditure on certain Lights in Bengal and Bombay in 1893–94.

Bengal.

Head of Charge.	Sea-Lights.					Average.	Port-Lights.				
	Short's Island.	Kutubdea.	False Point.	Saugar.	Total cost of up-keep.		Puri.	Balasur.	Norman's Point.	Kankali.	Total cost of up-keep.
	Dioptric, 3rd order, fixed.	Catoptric, fixed.	Dioptric, 1st order, occulting.	Catoptric, flashing.			Dioptric, 6th order.	Dioptric, 6th order.	2 Ships' lights.	Catoptric river light.	
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Establishment	3,192 0 0	2,374 1 1	..	..		..	312 0 0	264 0 0	828 0 0	..	..
Store	1,043 8 6	2,537 11 0	..	..		..	64 10 7	Not known.	270 8 3	..	..
Provisions	240 0 0	..	..	..		..	..	..	..	..	..
Total ..	4,475 8 6	4,911 12 1	9,878 3 2	5,924 12 2	25,190 3 11	6,297 8 11	376 10 7	Not known.	1,098 8 3	2,336 13 0	..

Bombay.

Head of charge.	Prongs dioptric, 1st order, flashing.	Kumery catodioptric, 1st order, fixed.	Sunk Rock dioptric, 3rd order, occulting.	Average.	Dolphin Rock anchorage, light, 5th order.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Wages	6,019 5 9	4,778 15 3	2,847 7 6	4,548 9 6	480 0 0
Store	1,855 5 5	3,927 13 3	1,452 3 4	2,411 12 8	328 1 8
Provisions	1,533 7 5	714 12 1	478 5 3	908 13 7	461 3 7
Repairs	553 3 9	537 6 7	361 4 8	483 15 8	725 15 5
Furniture and contingencies.	4 0 0	..	..	1 5 4	..
Library and Periodicals ..	36 6 8	36 6 8	36 6 8	36 6 8	..
Total ..	10,001 13 0	9,995 5 10	5,175 11 5	8,390 15 5	1,995 4 8

TABLE VIII.

Giving details of probable cost of maintenance of proposed "Provincial" Lights.

Head of Charge.	Seven Pagodas.	Madras.	Pulicat.	Armeghon.	Point Divi.	Sacramento Shoal, Hope Island.	Vakalapudi.	Santapilli.	Kalingapatam.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
Establishment	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	Details of cost of maintenance. Rs.
Compensation for dearness of provisions.	180	..	180	180	360	540	180	360	..	Cost of maintenance. 72,700
Oil	1,000	1,000	300	300	1,000	1,000	300	1,500	500	Add pay of Inspectors .. 3,000
Stores	200	200	150	150	200	200	150	200	200	Add pay of reliefs .. 1,920
Repairs (petty)	400	400	200	200	500	500	200	400	200	,, contribution towards pension .. 4,500
Contingencies	220	200	170	170	240	260	170	240	200	Total .. 82,120
Public Works charges.	800	800	800	800	800	800	800	800	800	
Uniform	60	60	60	60	60	60	60	60	60	
Furniture	50	50	50	50	50	50	50	50	50	
Library	30	30	30	30	30	30	30	30	30	
Relief fortnightly ..	..	..	..	..	..	..	..	..	..	
Total ..	4,800	4,600	3,800	3,800	5,100	5,300	3,800	5,500	3,900	Say Rs. 82,500 or Rs. 5,500 per light.

TABLE IX.

Giving details of probable cost of maintenance of "Local" Port-lights.

Head of Charge.	Kundapur.	Barkur.	Mulgy.	Mangalore.	Cannanore.	Tellicherri.	Calicut.	Cochin.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
Establishment ..	252	252	252	474	474	252	474	474	Total cost of maintenance, Rs. 14,830 or say Rs. 15,000. Average per light say Rs. 882.
Oil	60	60	60	260	260	90	260	260	
Stores	30	30	30	50	50	50	50	50	
Repairs, petty ..	25	25	25	50	50	25	50	50	
Contingencies ..	28	28	28	66	66	23	66	66	
Repairs, special ..	100	50	50	250	250	100	250	250	
Total ..	495	445	445	1,150	1,150	540	1,150	1,150	

Head of Charge.	Bimlipatam.	Vizagapatam.	Masulipatam.	Cuddalore.	Negapatam.	Tondi.	Pamban.	Tuticorin.	Cochin.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
Establishment ..	252	474	474	474	474	252	474	474	474	Total cost of maintenance, Rs. 14,830 or say Rs. 15,000. Average per light say Rs. 882.
Compensation for dearness of provisions.	80	260	260	260	300	90	260	260	260	
Oil	30	50	50	50	50	30	50	50	50	
Stores	25	50	50	50	50	25	50	50	50	
Repairs (petty) ..	28	66	66	66	76	28	66	66	66	
Contingencies ..	25	250	250	250	250	50	250	250	250	
Public Works charges.	440	1,150	1,150	1,150	1,200	475	1,150	1,150	1,150	
Uniform										
Furniture										
Library										
Relief fortnightly ..										
Total ..	440	1,150	1,150	1,150	1,200	475	1,150	1,150	1,150	

Head of Charge.	Gopalpur.	Remarks.
	Rs.	
Establishment ..	252	Total cost of maintenance, Rs. 14,830 or say Rs. 15,000. Average per light say Rs. 882.
Compensation for dearness of provisions.	80	
Oil	30	
Stores	25	
Repairs (petty) ..	28	
Contingencies ..	25	
Public Works charges.	440	
Uniform		
Furniture		
Library		
Relief fortnightly ..		
Total ..	440	

TABLE X.

Statement showing the Lighthouse dues for lights on Indian waters.

Presidency or Colony.	Authority.	Rate.	Maximum.	Remarks.
		Actual.		
Burmah ..	Act IX of 1879 (India)..	18 pies per ton of burden per voyage.	....	For eight lighthouse 3 light vessels. Vessels under 50 tons exempted.
Ceylon ..	Ordnance No. 1 of 1882 and proclamations of 23rd July 1883 and 24th June 1892.	7½ pies per ton of burden per voyage.	....	For two lights.
Minicoy ..	Do. do. ..	2½ pies per ton of burden per voyage.	....	For one light.
Straits ..	Act XIII of 1854 and Government Notification, No. 507, of 30th August 1889.	12 pies per ton of burden for passing all lights. 6 pies per ton of burden for passing only a portion of lights.	3 annas per ton in any month. Vessels under 200 tons trading within local limits are exempt.	For eleven lights including port-lights.
		Proposed.		
Madras ..	None	12 pies per ton per month for coasting steamers. 7 pies per ton per voyage for foreign vessels. 6 pies per ton per month for native craft.	....	For fifteen lights.

APPENDIX A.

Remarks on Lighthouse construction and management in the Madras Presidency.

Local Inspections.

These inspections, so far as is possible to judge, are carried out much too hurriedly. The Inspecting officer should, as a rule, halt at least 24 hours at the station and visit the light at night. The present system of rushing out to a light and returning to head-quarters with the least possible delay is, to a large extent, a waste of time and money.

Construction of Towers.

2. (*a*) The existing towers have been located and designed without due regard to efficiency. The idea that a light, however feeble, has only to be exhibited from a sufficiently high elevation to secure a great range, has been systematically followed in spite of the fact that the relation, which should exist between elevation and range, has been more or less accurately determined. The result is that many of the towers, such as Mangalore and Seven Pagodas, are much too high for the power of the apparatus and, when the atmosphere is impaired, the light has no chance of reaching the horizon. To place a light at too great an elevation is to defeat the whole object of the dioptric system for, as the Commissioners appointed in 1861 to report on the condition and management of lights, buoys, and beacons, remark in their report :—

"A beam of given divergence, with its axis in the plane of the geometrical horizon, or at "right angles to a vertical line, must become invisible from the sea if the light is raised to a "sufficient height above the earth whose surface is curved, and the more nearly it approaches that "height the less serviceable it will be, because the greater will be the amount of light thrown on "the sky." On this account I recommend that, when certain lights (*vide* Table I) are improved, the height of the towers shall be reduced.

In addition to excessive height, towers have been constructed of much too small internal diameter without service rooms, proper means of access to the lantern or proper ventilation. Their repairs are not attended to in a systematic way and the fittings are in many cases very indifferent. Cement might with advantage be used to a greater extent for plastering where the work is exposed to the sea air.

(*b*) Many of the towers are very badly lighted owing to the small size of the loopholes. Proper glazed windows of sufficient size should be fixed particularly in the interest of ventilation.

(*c*) Suitable designs for quarters for the different classes of establishment are much required. The needs of different stations are very similar, and if the accommodation to be provided is once laid down, type designs could be prepared. It is suggested that for the proposed "Provincial" establishment the accommodation shown on the design which accompanies this report, is suitable. For "Local" establishments, the standard design for police lines might be adopted, but the buildings should be constructed in a more substantial way than is generally the case with police lines.

(*d*) Painting lighthouse towers and buildings requires to be given much more attention, both as regards workmanship and colour. Towers are generally required to serve as a mark by day and the colour with reference to the background is a matter of great importance. Several instances have been brought to notice in Appendix B regarding the difficulty in distinguishing towers by day. In India white appears to be the most suitable colour, but vertical stripes or diamond pattern may be found useful in some localities where a distinctive character is necessary. Dark colours and black and white horizontal bands do not seem suitable for towers on land as there are generally trees in the background.

Lanterns.

3. (*a*) The type of lantern generally installed in India is the old Trinity House pattern with vertical bars. This type has been practically abandoned in England owing to its want of rigidity and for other reasons. This want of rigidity is very apparent as at nearly all stations a large number of panes of glass are broken. This breakage may be partly due to faulty glazing and to the glass fitting too tight, but it is advisable to stiffen those lanterns where the light is not required to be shown all round the horizon. In future indents for lanterns, helical or inclined framing, should be specified. Care must also be taken when fixing a lantern to place the door facing the direction from which least wind is expected, as otherwise the keepers find a difficulty in maintaining the light properly when the door is opened at night to give access to the gallery. Lantern doors should also be fitted so that they may be fixed open at any angle that may be required. It is a question whether lanterns of larger diameter than the usual standard size should not be obtained in future as, owing to the climate and confined space in which the keepers have to move, the heat is very great.

(*b*) The painting of lanterns is now done by the keepers who do not scrape the old paint properly nor apply the new paint in sufficiently thin coats. Some of the paint supplied does not appear to be of good quality or has been improperly mixed.

(*c*) Communication in the shape of a telephone or speaking-tube should, in the case of sea lights, always be provided in order that the keeper on duty may summon help if necessary.

(*d*) Ventilation at most towers is very defective. Mr. Douglass in his report recommended that the floors of the lanterns should be fitted with open gratings and the pedestals with larger hit and miss valves. He further recommended the improved circular ventilators now adopted by Trinity House, and that the tower windows should be of adequate size, well arranged, fitted with opening sashes and easily accessible from the stairlandings and steps. In carrying out these instructions all that has been done is to replace the close boarded floors of lanterns with open gratings and the necessity of glazing the existing loopholes and otherwise providing means of regulating the draughts has been entirely lost sight of, as also Mr. Douglass' remarks that all lighthouse towers and lanterns should be rendered, as far as possible, fire-proof. The result of the so-called improvement in ventilation has been, therefore, to admit draughts to the lantern which the keepers can only regulate by resorting to the objectionable practice of placing sacks on the floor. Every tower in the Presidency is now almost as badly ventilated as when Mr. Douglass made his inspection, and the alterations made have been partly responsible for the reported breakage of cylinders. At some stations wooden lantern floors are still retained. It will be noted that in his report Mr Douglass remarked that the want of provision for regulating the currents of air through the structures and lanterns for efficient ventilation and for the perfect combustion of the flame was one of the most noticeable features in the lights of this Presidency, and this is still the case.

(*e*) More care requires to be taken to determine the temperature inside a lantern. At present the thermometer is sometimes attached to the apparatus, sometimes to a lantern bar and sometimes to the lantern pedestal with the result that the readings obtained are very unreliable. I would suggest that the thermometers should be placed similarly in each lantern as otherwise any comparison of the temperature at different stations is impossible. The best place to attach a thermometer is, probably, near the top of the pedestal inside the lantern with another thermometer outside, so that the temperatures inside and outside the lantern can be compared.

Lights and Apparatus.

4. (*a*) The burner now generally in use is the Trinity House Douglass burner with a constant level lamp of the ordinary pattern. When I was in France I saw an improved lamp, now in use in the French service, a description of which will be found in the report which I submitted to Government some two years ago. I am inclined to think that it is a pity the French burners and lamps have not been given a trial in this Presidency as, owing to their facility of management, they are more suitable for use by native keepers. The French constant level lamp is so superior to the type now in use in this Presidency that I have no hesitation in recommending its adoption in future for use with all burners which do not require a large overflow. The old Duplex burners, of which there are a large number at the various stations, might be useful in the Government offices in Madras. They are of no use at the stations and only give the keepers additional work to keep them clean.

(*b*) The adjustment of the new burners has been left to the lighthouse mechanic who has fixed them at the same level as the old cocoanut oil burners. The difference is in some cases not very considerable, but he should be instructed to re-adjust them, according to the diagrams of flame, the next time he visits the lights. It was impossible to adjust the burners during the recent tour of inspection, as they are fixed in such a way that to alter them would take a considerable time, and also for want of tools and appliances. At every light the necessary tools should be kept and especially a spirit level for levelling the burner. Some of the ventilator tubes have been fixed out of plumb and should be rectified the next time the light is visited by the mechanic.

(*c*) The keepers do not understand how to trim their burners. They should be taught to burn them off after using the scissors or when much charred.

(*d*) In some lighthouses the keepers have complained that the cylinders often break in the early morning. This may be due to the flame being suddenly lowered and draughts of cool air admitted to the lantern. The flame should be gradually lowered and the cylinders, at all events the larger sizes, kept in a felt lined box when removed from the burner. The breakage, however, generally appears to be partly traceable to defective ventilation.

(*e*) The burners are cleaned with bath-brick, and in order to remove the discoloration and char from the tips without much trouble the bath-brick is not powdered finely enough, with the result is that the tips are rapidly wearing away. They should be cleaned every morning with oil as soon after the light has been extinguished as is possible, and, when much encrusted, may be boiled in water in which potash has been dissolved.

(*f*) The putty which holds the prisms and lenses of apparatus in position is, in many cases, shaken. The lighthouse mechanic should be instructed to repair all defects the next time he visits the lights. He should not, however, be allowed to remove and replace any of the glass.

(*g*) With regard to the consumption of oil, the chief thing noticeable is the great uniformity. The two wick burners apparently consume considerably more than the consumption laid down by Trinity House, and the four wick burners considerably less. Inspecting officers should carefully test the consumption, when they visit a station at night, with special reference

to the height of flame maintained. There is, however, no need to cut down the consumption of the two wick burners if it is found to be as stated. The great uniformity may be due to the system of calling for an explanation if the returns show variation in the nightly consumption of oil. The small consumption of the four wick burners is probably due to the flames being kept low, as was the case when I visited Santapilli. This is partly due to want of ventilation.

Service and Store-rooms.

5. The spare gear and stores at the various stations are not kept as carefully as they should be, and the keepers receive but little encouragement to keep their stores neatly. Mr. Douglass remarked in his report on the inadequate accommodation for storing spare burners, tips, &c., at the several establishments and recommended a glazed cup-board fitted with shelves, properly arranged for holding the burners in a vertical position. It is true that cup-boards have been provided but, as a rule, of the cheapest description and not arranged as recommended. The keepers are also not nearly careful enough in keeping the stock of wicks free from dust and damp; neither do they take sufficient care to keep the leathers and cloths, used for cleaning the apparatus, free from grit. They have not, in some cases, been instructed in the use of the various stores supplied to them.

Oil Store.

6. The oil store is generally a room at the base of a tower or in the block of buildings used as keeper's quarters. It is often also used as the watch room. The oil is partly stored in cisterns and partly in the tins in which it is received from Europe, and in many cases no attempt has been made to either ventilate the store-room or make it fire-proof. Mr. Douglass recommended that at least six months' supply of oil should be stored in iron or steel tanks, tinned internally, fitted with proper draw-off taps, with tight-fitting covers and mounted on stone or slate benches. Tanks have been provided to the extent recommended by Mr. Douglass, but in many cases the draw-off taps are at too high a level and, for slate or stone benches, wooden stands have been substituted. The wooden stands should be removed and stone benches substituted and means of ascertaining the quantity of oil in a tank provided. This may either be done by a tell-tale, a ganging rod, or by a glass gauge fixed to the side of the cistern. Mr. Douglass, used to the large consumption of oil at Trinity House stations, did not probably mean to be taken too literally in his recommendation to limit the capacity of oil tanks to six months' consumption of oil. To avoid the expense of constantly moving small quantities of oil, the capacity of tanks at most stations may be increased to 18 months' consumption. No oil should be stored in the tins in which it arrives from Europe.

Oil.

7. The price of oil used for light house purposes in this Presidency is said to be Rs. 1-3-0 per gallon against a price in Europe of $5\frac{3}{4}$ pence. The difference is so large that it may be worth inquiring whether, in the event of the proposed "Provincial" lights being constructed, oil cannot be procured at a cheaper rate elsewhere. At the time of my visit to Cuddalore two cases (20 gallons) of oil had just been received direct from Europe and I was informed that the freight alone on this small quantity amounted to £1-1-0, or to nearly Re. 1 per gallon. It may be, therefore, that the system of procuring oil in small quantities, separately for each light, is responsible for the high average cost. A system of obtaining 18 months' supply and distributing it from certain centres, say Madras and Cocanada on the East Coast and Cochin on the West coast, might prove more economical.

Forms.

8. The question of reducing the number of forms which a lightkeeper has to fill up may be considered. Weekly returns might be abolished.

Apparatus Coverings.

9. Mr. Douglass in his report recommended that in all lanterns the optical apparatus should invariably be covered between sunrise and sunset with a brown holland cover, and the lantern curtains properly hung. This recommendation has not been carried out as coverings and curtains of the cheapest white dungaree are still used. The object of specifying brown holland is that the smooth surface and light colour reflect the heat rays.

*Lightning Conductors.**

10. In 1889 Mangalore Lighthouse was struck by lightning and two men within the tower were struck, one being killed. This was attributed to faulty earth-connections and a large estimate was sanctioned to take the conductor to water distant $1\frac{1}{3}$ miles from the tower. It seems probable, however, that the accident was really due to a side flash from the conductor to a coil of wire in the building. In 1888 Professor O. J. Lodge delivered a series of lectures on lightning

* On the subject of Lightning conductors I have consulted Mr. R. St. Jones, Acting Government Astronomer, who has given me much assistance.

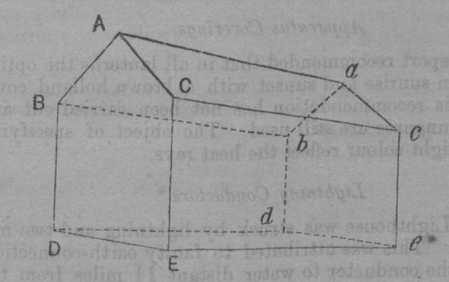
conductors and guards (which with other kindred matter he brought out in the form of a book in 1892) which appear to upset many of the accepted ideas regarding lightning conductors and to render a reconsideration of the method of protecting lighthouses from lightning advisable, not to say imperative.

According to the generally accepted theory, a lightning conductor is a conduit for conveying a certain quantity of electricity from clouds to the earth, and, in spite of accidents to protected buildings, its upholders maintain that all that is necessary is to provide a big enough channel, as it were, through which the discharge can take place and that a conductor will be efficient provided its resistance be small. Professor Lodge points out that these conclusions would be perfectly correct if the lightning discharge was steady. But, as a matter of fact, it is essentially a varying one and in the majority of cases oscillatory. The current rises from zero to a maximum, dies away to zero, reverses, and attains a maximum in the opposite direction, dies away to zero again, and so on several times before the whole energy is dissipated. All this may take place in an extremely small interval of time. Now the behaviour of varying and oscillatory discharges is very different from the behaviour of a steady discharge, because, in the former, electrical inertia is a factor of the first importance. It is not therefore sufficient merely to consider the ohmic resistance of a lightning conductor. The effect of the various factors in determining the path and character of a lightning discharge is entered into fully by Professor Lodge in the volume mentioned above, and the conclusions which he draws are supported by experimental evidence, also fully given, and described in the volume. These conclusions are appended.

But one point to which he draws attention I would mention here. The function of a lightning conductor is to afford a safe and sure means of dissipating a certain amount of energy by providing a suitable path for the discharge. To do so suddenly is by no means the safest way and to provide the discharge with a path along a thick copper conductor may be a positive disadvantage on account of the violent surgings which may take place in it. As Professor Lodge remarks:—

"A thin iron wire is nearly as good as a thick copper rod; and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy and tends to damp out the vibrations sooner. Owing to this cause a side flash from a thin iron wire is actually less likely to occur than from a stout copper rod."

It is impossible to give in full the reasons Professor Lodge gives for his conclusions, but it appears that, in his opinion, so far as high towers are concerned, the best way to protect them from lightning is to fix four iron wire rope conductors, connected at intervals by horizontal bands of wire, each conductor being provided with a separate earth, as good as can be obtained at a reasonable cost, and not necessarily taken down to water. The lantern dome may also be studded with numerous small points. A lighthouse protected in this way, would, it is suggested, be comparatively safe and, even if there are considerable masses of metal within the tower, side flashes are improbable and separate earth connections inadvisable. This system of protecting buildings, with the exception that Professor Lodge shows that the use of copper is a needless expense, is practically the same as that advocated by Professor Clerk Maxwell who says: (*vide* Lightning Conductors by Richard Anderson, page 168) "my plan is to convert a building into a closed conducting vessel by a sufficient number of wires enclosing it. For an ordinary house a skeleton of its edge is quite enough. Aa may be a zinc ridge, Bb and Cc water gutters of zinc or iron; but the pieces ABD, ACE and the circuit DEed should be of stout copper wire or rope built into the wall as a security against theft, but connected to every other piece of metal on the outer surface of the house, and to every gas or water pipe which enters the house from without, but not to any masses of metal wholly within the whole, unless this is desirable for other purposes."



Professor Lodge arrives at certain conclusions from which the following are extracted to show what radical changes will be necessary in the method of protecting buildings from lightning if, as seems inevitable, his deductions are accepted. The subject is of considerable

importance as according to his conclusions none of the towers in this Presidency are, at present, efficiently protected.

Statements made by Professor Lodge regarding the protection of buildings by lightning conductors—

(1) "All parts of a lightning conductor, from points to roots, should be of one and the same metal to avoid voltaic action.

(2) Joints should be avoided when possible, and should be made substantially when necessary. Allowance for expansion and contraction must not be forgotten.

(3) Sharp bends, and corners, and curves, and round about paths to earth should be avoided as far as possible.

(4) The use of copper for lightning conductors is a needless extravagance.

(5) Iron has advantages over every other metal.

(6) The shape of cross section is but little matter, flat ribbon has a slight advantage over round rod, but not enough to override questions of convenience.

(7) Liability to be deflagrated by a powerful flash determines the minimum allowance for size of cross-section. No consideration of conductivity and greater ease of path has the least weight in this connection.

(8) It is hopeless to pretend to be able to make the lightning conductor so much the easiest path that all others are protected. All possible paths will share the discharge between them, and a lot of apparently impossible ones.

(9) A good and deep earth should in general be provided, independent of water and gas mains.

(10) If the conductor at any part of its course goes near water or gas mains, it is best to connect it with them.

(11) If the place to be protected has water or gas pipes inside it, the conductor should be connected to their mains under ground.

(12) At all places where water and gas pipes come near each other, and, in general, wherever one metal ramification approaches another, it is best to connect them metallically.

(13) The neighbourhood of small-bore fusible gas pipes and indoor gas-pipes in general should be avoided in erecting a lightning conductor.

(14) Into powder magazines and such like places no gas or water pipes should be permitted to enter, unless the whole building is made of metal, and they are elaborately connected to it at the point where they enter.

(15) It is not wise to erect very tall-pointed rods above the roof of a building.

(16) A number of points all along the ridge of a roof is better than only a few.

(17) Any part of a building is liable to be struck, and to make quite secure, every prominent part of the outside should have a rod running along it.

(18) Earth-connected as well as insulated bodies are liable to spit off sparks.

(19) No complete security can be attained unless the whole building be metal-lined, floor and all.

(20) In ordinary houses it may be well to try and insulate the lightning conductor from the walls so as to lessen the chance of side flash to metal stones and things inside.

(21) In chimneys it may be well to use insulators to protect the bricks from concussion.

(22) The cheapest way of protecting an ordinary house is to run common galvanized iron telegraph wire up all the corners, along all the ridges and eaves, and over all the chimneys; taking them down to the earth in several places, and at each place burying a load of coke. Rain-water spouts and other outside metal, if all well connected together, may likewise be utilized.

(23) Connecting a lead roof or other such expanse with a lightning conductor is not an unmixed good, for it virtually increases the dangerous proximity of the lightning conductor, and may inadvertently bring it near to many objects which else might have escaped.

(24) One of the most difficult thing is to know what to connect and what to avoid.

(25) The orthodox rule, "connect all pieces of metal to the lightning conductor" requires modification thus:—

Connect all pieces of metal to each other and to the earth, but not to the lightning conductor (?)

(26) It may be always reckoned safe to earth things independently. It is often not safe to connect them to the lightning conductor, *e.g.*, an inside lining of a chimney should be well earthed, but should not be used as lightning conductor nor connected with it. The same with rain-water pipes and gutters. The same also, probably, with lead roofs (?)

(27) In connecting pieces of metal to each other, if they happen to form a nearly closed circuit, the circuit should be metallically completed.

(28) Over the top of tall chimneys it is well to take a loop or arch of the lightning conductor made of any stout and durable metal.

(29) Lightning conductors should be always outside and easily visible.

(30) A conductor detached from the building to be protected is safer than one in close contact with it.

(31) For powder magazines and such-like, an outer cage surrounding the building, with sky points and earth roots, and an inner cage on the building, with independent earth terminals only, is the safest plan.

(32) If under these circumstances there be no gas-pipes nor much ramifying metal work inside the building, and no metal at all going near either cage, the interior may be considered perfectly safe.

(33) The inner cage may often be conveniently made of continuous sheet iron. The outer cage need not then be at all small-meshed; in fact, it need be little more than a dozen vertical conductors.

(34) The resistance of an earth may be tested in the customary way to guard against actual breaches of contact by rust or workmen; but no overweening confidence must be felt, however small the resistance turn out to be.

(35) A Wimhurst machine and couple of Leyden jars afford a convenient mode of testing a conductor for flagrant defects. The testing should be done in the dusk or in moonlight, so that there may be light enough to work by and yet sparks be visible.

(36) Telephones are the handiest things to detect electric surgings in conductors inside the house while discharges are being made to the conductor. But vacuum tubes, gas leaks, Abel's fuses, &c., &c., can also be employed.

(37) Another mode of testing can be carried out on an insolated rod, with an induction coil and spark gap after the manner of a great Hertz oscillator. This is probably the most searching plan. Sparks will then be probably obtained from all the gas-brackets, water-taps, and picture-rails in the house.

(38) Telegraph stations, and houses supplied with electricity from overhead wires, should have an efficient lightning protector at the place where the wires enter the house.

(39) When a number of houses are wired up together for lighting, even by underground wires, it may be well to disconnect them by means of intervening lightning protectors; on the principle of fire-proof doors.

(40) A central lighting station, having a tall chimney connected to its boilers and dynamos, should be, by a lightning protector, disconnected from the leads which carry the current from it; because a small fraction of a stroke getting into the leads might destroy a number of lamps, especially if they were already working at something like their full power.

(41) Telephone arrangements, and any long length of close-packed insulated wires (even underground), should be protected by lightning protectors, else the insulation is apt to be sparked through and spoiled."

Occulting Lights.

11 In the list of existing and proposed lights (Table I) red as a distinctive character has been retained at certain stations, but distinction by colour can be altogether avoided by converting these lights into occulting. The occulting system which is probably most suitable is the Lindberg Trotter as modified by Mr. Wigham. This system is self-acting, affords a variety of occultations and can be fixed to existing apparatus at small cost. I cannot, however, recommend the adoption of self-acting occulating apparatus until it has been subjected to a prolonged trial and its success is assured, as, under certain conditions, it has been known to fail.

Meteorological Observations.

12. It seems possible that lighthouse establishments might, with advantage, be made use of to record meteorological observations, especially at stations near a Post or Telegraph Office. The keepers might be trained for this duty before admission to the service and should submit their returns direct to the Meteorological Department. The reading of simple instruments, such as thermometers, barometers, anemometers and rain-gauges, would not entail much additional work and the results might be of considerable value.

Madras,
22*nd June* 1895.

F. W. ASHPITEL,
Executive Engineer,
on Special Duty, Marine Dept.

APPENDIX B.

Details of visits to Lighthouses.

Kundapur.

(*a*) The location, near the south boundary pillar of the port, is satisfactory. The light is wrongly described in the light list.

(*b*) The cabin and mast are well founded and maintained. A mark should be made on the hoisting chain to show when the apparatus is in position. A small drain is also required in the floor to get rid of water which may leak through the opening in the roof or which has been used for cleaning purposes.

(*c*) The optical apparatus is a sixth order port light (lenses only) with a silvered spherical mirror in rear of the flame. The height of focal plane above H.W.L. is said to be 56 feet and not as entered in the light list.

(*d*) Stores are kept at the Customs House distant $1\frac{3}{4}$ miles from the light. Oil and general store-rooms are required at the station.

(*e*) There are no quarters available for the establishment. Quarters should be provided as there is no village near.

(*f*) A well is required, but care must be taken when selecting a site, as most of the water in the neighbourhood is brackish. The fishermen obtain water from shallow surface wells and probably a deep well would be a mistake.

(*g*) A lightning conductor fixed to the foot of the mast and connected with the cabin is advisable.

Mulpy.

(*a*) The location answers sufficiently well for the present anchorage, but a better site would be on the beach near the north bounding pillar of the port or on one of the islands. The light is obstructed by trees between north through east to south and does not show over the anchorage marked on the chart which is, however, not used by the vessels which now visit the port; some trees near the light require trimming.

(*b*) The cabin and mast are well founded. A mark should be made on the hoisting gear to show when the apparatus is in position. The cabin has recently been painted, but care had not been taken to remove rust before applying the new coat. A drain is required in the floor.

(*c*) The optical apparatus is similar to that installed at Kundapur. The height of the focal plane is 53 feet above the cabin floor.

(*d*) The stores are kept in the Custom House and this arrangement is convenient and need not be interfered with.

(*e*) The light is near the village and no quarters are required. The keepers use the verandah of the Custom House as a watch-room.

(*f*) Water-supply is good.

(*g*) A lightning conductor is advisable as at Kundapur.

Barkur.

A light is required at this port, the trade of which is said to be considerable. The sixth order port light now at Point Calimere will answer well and may be located to the north of the bar (See also Point Calimere).

Mangalore.

(*a*) The tower is located on a hill above the town and the focal plane is 240 feet above high water-level. As previously remarked this elevation is much too great and the best part of the light is wasted on the sky and of no service to the mariner. With the proposed light at Mulki, it will be better to abandon the existing tower which is of very inconvenient design and to re-establish the light on a small tower near the sea and at a lower elevation. The change need not, however, be made until the scheme for the improvement of Mangalore harbour is sanctioned.*

(*b*) The tower is 65 feet high and only 4 feet internal diameter. Access to the lantern is by an extremely inconvenient arrangement of ladders. So inconvenient is this arrangement that if the Inspecting officer happened to be stout it would be extremely doubtful whether he could manage to climb up into the lantern. The lantern is carried on a wooden gallery which, as Mr. Douglass remarks, exposes too great an area to the wind during stormy weather, causing the lantern to vibrate and water to be driven through the glazing. Several of the lantern panes are now broken.

(*c*) The optical apparatus is efficient for a port light, but it is not of sufficient power for the height from which it is exhibited. It is in good order, but the burner requires adjusting.

(*d*) Stores are well maintained, but the arrangements are not satisfactory.

(*e*) Quarters have recently been constructed for the establishment but the keepers refuse to live in them. The design and site are both, in my opinion, unsuitable, as a road runs close in front and there is no screen wall. If the light is moved, these buildings will no longer be required and can be used for some other purpose. It is unnecessary, therefore, to suggest alterations.

* It is presumed of course that a scheme will be sanctioned within a reasonable time.

(*f*) The water-supply is from a well about $\frac{1}{4}$ mile distant.

(*g*) An estimate amounting to Rs. 3,000 has been sanctioned for a lightning conductor with an earth connection $1\frac{1}{3}$ miles long. This estimate might be held in abeyance until the question of a new tower has been decided. In any case the value of an earth connection $1\frac{1}{3}$ miles long seems doubtful, and if, as was suggested, the idea is to connect all the Public buildings in the town to the lighthouse lightning conductor, it is not evident why Port Funds should bear the cost. The original cost of the tower was only Rs. 1,054-7-5 and to spend Rs. 3,000 on a lightning conductor seems out of all proportion. The existing conductor is of $\frac{1}{2}$ inch copper wire rope attached to the lantern pedestal and joined, at the foot of the tower, to a galvanized iron wire $1\frac{1}{3}$ inches diameter, the earth being buried in the ground 60 feet deep. This conductor was tested by an assistant in the Telegraph Department and condemned because the resistance was too high. It is said, however, that the joints were not separately tested and therefore the high resistance may be partly due to defective joints. It seems possible, however, that this high resistance is no great disadvantage and that the alterations to the conductor should not take the form of providing a better earth connection—*vide* Appendix A, paragraph 10.

(*h*) The ventilation is defective. It would be improved by inserting gratings in the floor with means of regulation.

(*i*) The oil cisterns provided have a total capacity of 120 gallons. It would be better to provide storage for at least one year's or, better still, 18 months' supply in order to avoid the necessity of frequent supplies of small quantities of oil. To store quantities of oil in the tins in which it arrives from Europe is not advisable.

Cannanore.

(*a*) The location is suitable, but the elevation is excessive. The light may be dipped if the existing apparatus is retained.

(*b*) The tower is a circular building on the fort rampart and could be easily improved. All that is required is to provide a light room and means of lowering the apparatus into it for cleaning and lighting. The lower part may be used as a watch-room with access to the light room.

(*c*) Stores and oil should be kept in one of the vacant buildings in the fort.

(*d*) The apparatus is a sixth order fixed port light (lenses only) with a spherical silvered mirror in rear. The lenses are damaged. The burner, a Hinks Duplex, is out of order. The light has a range of about six miles which is insufficient. One of the spare fourth order fixed apparatus which will become available may be installed at this station on the existing tower, the height of which may be reduced.

(*e*) Quarters for a signaller adjoin the tower. The light and signalling establishment may be amalgamated, as, with the proposed increased number of keepers required for the new light, there will be no necessity for extra establishment. A watch-room was recently constructed and proposals made for converting a part of the old fort jail into quarters. The old jail does not seem very suitable and quarters do not appear to be necessary as the light is close to the town.

(*f*) When the light is improved the number of oil cisterns should be increased to a total capacity of 18 months' supply.

Tellicherri.

(*a*) The location is suitable, but the elevation is too great for the power of the light which may, however, be dipped. The tower may also be lowered.

(*b*) The light is exhibited from the roof of a small square tower which is of very inconvenient design. The arrangements can be improved by providing means of lowering the apparatus into a service room for lighting and cleaning purposes. Access to this service room should be by a stair case inside the tower. The base of the tower can be used as a watch room.

(*c*) The apparatus is a sixth order port light (lenses only) and is protected by a wooden shelter. With the new light on Sacrifice Rock and the improved light at Kannanur the light at Tellicherri may be coloured red (See appendix A, paragraph 11) to prevent confusion with other lights on shore or with ships lights. The lenses are chipped. The burner is in good order.

(*d*) Stores are kept at present in the Port office and in the base of the tower. They should be moved to one of the vacant buildings in the fort as the room in the base of the tower will be required for a watch-room and the Port office is at a considerable distance from the station.

(*e*) Quarters for establishment consisting of two rooms, with cook-rooms in a separate building, have recently been constructed. The design is, in my opinion, unsuitable, and the keepers do not live in them. All that is required, however, is to add screen walls and as far as possible to assimilate the design to that ordinarily sanctioned for Police lines. Keepers of different castes will not live in single room dwellings with no privacy. It is doubtful whether quarters were really necessary at this station which is within the fort and close to the town. The cook-rooms may, if the dwellings are altered as suggested, be converted into oil and general store rooms.

(*f*) Water-supply is good.

(*g*) The capacity of oil tanks is sufficient.

Calicut.

(*a*) The location is on the beach and is satisfactory. The elevation is too great for the power of the light and when improved the tower may be lowered.

(*b*) The tower is 98 feet high and 4 feet internal diameter. Access to the light room is by a very inconvenient arrangement of ladders. An iron spiral stair case should be substituted. This will not cost much if the tower is lowered as suggested.

(*c*) The optical apparatus, a fourth order fixed apparatus, is efficient as a port light. The burner is a little low and the pipes are leaky. The ventilator tube is a little bent.

(*d*) Stores are kept in the Port office. They should be kept at the station.

(*e*) An estimate has been sanctioned for Rs. 2,350 for quarters for the light-keepers. The space available is very small and quarters do not appear to be necessary. The tower is in the town and it is doubtful whether the keepers would occupy quarters if constructed. There is a watch-room.

(*f*) Water-supply is good.

(*g*) There are two lightning conductors to this tower.

(*h*) The ventilation is bad. About a year ago gratings were fixed in the light room floor, but no means of regulating the draughts provided. This should be attended to.

(*i*) The capacity of oil cisterns should be increased.

Narakal.

(*a*) This light is exhibited from a flagstaff at the mouth of a creek, five miles north of Cochin, at a place where considerable quantities of goods were at one time landed and shipped during the south-west monsoon. Owing to the movement of the mud bank, which has necessitated the abandonment of the old landing place at Narakal, shipping operations are now carried on at Mallipuram, two miles from Cochin. The port of Narakal, in which Mallipuram is included, is, however, kept up as the anchorage for steamers calling at Cochin during the south-west monsoon, as, owing to the mud bottom, the sea is smooth when the Cochin anchorage is too rough for boats to lie alongside a ship. For the use of the port, the Cochin Government levy port dues which amount to a considerable sum, and, therefore, the light is, and should be, maintained by that Government.

The Cochin light is close by and all that is required is a small port light. A cabin and mast red light would answer well and may be located on the beach at Mallipuram. The existing light is exhibited from a flagstaff and consists of a duplex burner with an elliptical reflector in rear. The burner obstructs the greater part of the rays of light from the reflector below the centre of the ellipse, and the reflector scatters the light in all directions. A certain amount of correspondence has taken place with the Resident in Cochin and it is believed that the Cochin Government are quite prepared to improve the light. A range of six miles would be ample.

Cochin.

(*a*) The location is satisfactory, but the elevation is greater than is advisable for efficiency.

(*b*) The tower is 91 feet high and 6 feet internal diameter. The internal arrangement of ladders is very inconvenient and should be replaced by an iron spiral stair case which would not cost much if the tower is lowered to suit the power of the light.

(*c*) The optical apparatus is a fourth order fixed apparatus with a dioptric mirror in rear. It is efficient as a port light, but is damaged and not kept very clean. The burner is in good order. The lantern has been recently painted but, here as elsewhere, the old paint was not removed before applying the new coat.

(*d*) Oil and stores are kept in a detached building. The oil tanks have a capacity of only 120 gallons or about 6 months' consumption. Additional tanks should be provided.

(*e*) There are no quarters for establishment and as the light is in the town none are necessary. The existing watch-room is sufficient for all purposes.

(*f*) Water-supply is from a well $\frac{1}{4}$ mile distant.

(*g*) The ventilation is very imperfect and is not under regulation. The keepers attempt to moderate the draughts of cold air, which enter the lantern through the floor gratings, by placing sacks on the floor. This is a dangerous practice as if anything should happen to the burner and burning oil fall on the wooden floor covered with sacks, considerable damage might result.

Aleppi.

The lighthouse is well maintained by the Travancore Government and the power of the light sufficient. The state of the apparatus and machinery indicate evident careful treatment. The light gives one flash every minute which makes the interval of darkness much too long. It is advisable to increase the speed so as to make one revolution in two minutes.

Muttum.

(*a*) The location is suitable.

(*b*) The tower is built of granite and is 72 feet high and 12 feet internal diameter. It is in good order but requires better windows.

(*c*) The optical apparatus is a 1st-order fixed apparatus with a dioptric mirror in rear. The arc of illumination appears to be wrongly given in the light list. The apparatus and mirror are both damaged but are efficient. The light could easily be given a distinctive character by converting it into occulting, but as there are no other lights in the neighbourhood, this does not seem very necessary. The range may be increased to 18 miles by installing a 6-wick burner during misty weather. The light will then show well over Cape Comorin.

(*d*) Stores are kept in a room in a block of buildings which include the head keeper's quarters and the watch-room. The storage capacity of the oil cisterns is 400 gallons which is insufficient and should be increased.

(*e*) Quarters are available for the head keeper, but if the scheme for establishment for the proposed provincial lights is sanctioned, additional quarters will be required for the assistant keepers. The floors of existing buildings require repair.

(*f*) Water-supply from well; the supply does not appear to be very plentiful.

(*g*) The ventilation at this station is very indifferent and the temperature in the lantern high. Mr. Douglass recommended that the lantern floor should be ventilated and that an improved roof ventilator should be provided. This recommendation has been misunderstood and all the landings as well as the lantern and service room floors have been replaced by iron gratings. The result is that, when the tower door is open, the draught cannot be regulated and, when it is closed, the ventilation is often insufficient. The service room should be floored with Cuddapah slabs or other convenient material and the windows enlarged and properly framed and glazed. An improved roof ventilator is also probably necessary. If these alterations are carried out the ventilation will be sufficient and under control. Muttam is one of the stations at which a heavy breakage of burner cylinders is reported. This breakage, in my opinion, is readily traceable to ill-regulated ventilation and to want of care on the part of the establishment.

(*h*) The consumption of oil at this station is 823 gallons per annum, while it should be accordingly to the consumption laid down by Trinity House 982 gallons. It seems probable, therefore, that the light is not always properly maintained.

(*i*) The tower is painted in black and white horizontal bands and is very difficult to distinguish when viewed from seaward owing to the dark back ground. It would be better to paint it white.

(*j*) The steps, cleaning path and apparatus platform have been painted white which gives the lantern a dirty appearance as the white colour cannot be maintained.

Manapaud Lighthouse.

(*a*) The installation at this station is similar to that at Tellicherry. Owing to rough weather, landing was not considered to be safe and, consequently, this light was not inspected. The S.S. *Margarita* anchored for the night some 3 miles from the light without it being visible; the reason for this is that the light does not show in every direction seaward. The inefficiency of this light has already been noticed in paragraph 4 (*b*) of the report.

(*b*) To guard the dangers an 18 mile flashing light has been proposed—*vide* paragraph 8 (*f*) of the report.

(*c*) The existing tower is said in the light list to be painted white. It is very difficult to distinguish, however, and appeared from the sea to be grey. The White Church near the lighthouse was clearly visible.

Tuticorin Lighthouse.

(*a*) The location is satisfactory.

(*b*) The tower is of brown sand-stone 5 feet internal in diameter and 71 feet high. The focal plane is 85 feet above high water level, whereas a height of 55 feet would be ample for the class of light. Mr. Douglass remarks that the upper part of the structure appears to be too heavy, and that the stones forming the gallery course are too light, and are being seriously shaken during stormy weather. An attempt has been made to stiffen the upper part of the tower by iron framing, but is said not to have succeeded. It would be better to lower the tower as the design is altogether too slight. The lantern glazing has been broken by the vibrations. The stone of which the tower is constructed is weathering a good deal. The bad parts should be cut out and replaced.

(*c*) The optical apparatus is of the fourth order, fixed, and is much damaged; one ring is missing and should be replaced. The lighthouse mechanic is said to have damaged the apparatus when fixing the new burner. One of the prisms was evidently chipped to make way for the feed pipe which could, however, have easily been bent and fitted without damaging the apparatus.

(*d*) Stores are still kept at Tuticorin on the mainland, one mile distant, instead of at the station. This should not be permitted.

(*e*) The quarters for establishment are occupied by the keepers and are in fair order. The head-keeper's quarters require cleaning and the floors plastering with cement. A chimney is required to the cook room. The building would be much improved by an additional verandah.

(*f*) Water for drinking is brought from Tuticorin and is stored in iron tanks. It would be better to provide masonry under ground tanks cemented.

(*g*) The ventilation is bad and is not under regulation.

Pambam.

(*a*) The location is satisfactory.

(*b*) The tower is circular 5′ 2″ diameter, with a spiral stair case and has been raised to show over the trees in the neighbourhood. The upper part is badly constructed being of larger diameter than lower down.

(*c*) The apparatus is of the 4th order fixed and is not properly cleaned. The light-keeper uses his supply of rouge powder to clean the burner cylinders instead of the optical apparatus for which purpose it was supplied. He also does not properly powder the bath brick used for cleaning the metal work. The lantern has no pedestal and the whole arrangements are as inconvenient as it is possible to conceive. The lantern floor being at the level of the bottom of the apparatus, it is impossible for the keeper to tend the light without obstructing it. A new lantern is absolutely necessary. The light is badly served and maintained. A lantern will be available from one of the lights proposed to be abandoned and, when it is fixed, the whole of the lighthouse and its buildings require to be thoroughly overhauled and repaired.

(*d*) Stores are kept in a room at the base of the tower.

(*e*) There are no quarters for establishment and none appear to be necessary. The two small rooms at the base of the tower are used for stores, and by the Port office clerk who records the meteorological observations. The latter should be evicted and the room used as a watch-room.

(*f*) The water-supply from a well near lighthouse is good.

(*g*) The ventilation is thoroughly bad and it is probable that the flame is never properly maintained. The only ventilation is up the stair case and through the door in the lantern glazing.

Tondi.

This light was not inspected. It is merely a small 6th-order cabin and mast port light.

Point Calimere.

(*a*) The location is satisfactory.

(*b*) The light is 6th-order port light (red) exhibited from a mast. The whole arrangements are very indifferent and if this apparatus is transferred to Barkur, the cabin and mast and their fittings will require a thorough overhaul which can probably be effected at the South Indian Railway Workshops at Negapatam. The apparatus is hoisted by a rope; the mast stays are very roughly fixed and secured by string, and the apparatus guides are of insufficient section. The iron work is not properly painted and before applying the new coat, the rust was not cleaned off. The burner is a Hinks Duplex and the reservoir is not large enough. It will be advisable to procure burners similar to those at Kundapur when the light is moved. The burners are dirty and do not fit the apparatus.

(*c*) The apparatus is in fair order but not properly cleaned. The hinge of the dome is broken.

(*d*) Stores are kept in a slovenly way and the keepers do not know the use of some of the gear which has been supplied. Chamois skins for cleaning the apparatus are in stock, but have never been used. The head-keeper appears to know nothing of his duties and to be entirely dependant on his assistants.

(*e*) Temporary quarters for establishment were constructed, but none of the keepers live in them. They live at a village three miles off and it is doubtful whether the head-keeper ever keeps a watch or attends regularly at this station. When the proposed new tower is built, permanent quarters will be required and accommodation for the inspecting officer.

(*f*) Water is brought from a village three miles distant and stored in an iron tank. The water tank is not kept clean.

(*g*) There are two rooms in a separate building, one of which is used as an oil-store, general store-room and as a watch-room; the other is reserved for inspecting officers. The oil should not be kept in a room which is also used as a watch-room. The mud floors should be concreted.

(*h*) It is proposed to establish an eighteen-mile light at this point—*vide* table I and paragraph 8 (*b*) of the report.

Negapatam.

(*a*) The location is sufficiently good as the shoal will be covered by the proposed eighteen-mile light at Point Calimere (visible nineteen-miles from a steamer's bridge) and by the existing light at Negapatam.

(*b*) The tower is five feet diameter with a spiral staircase. The loop-holes should be fitted with properly glazed windows. The building is in fair order, but requires painting and cleaning.

(*c*) The optical apparatus is of 4th order fixed; one prism is missing. It is otherwise in fair order. The burner is in good order.

(*d*) The oil and stores are kept in a room at the base of the tower. The number of oil-cisterns should be increased. The oil-store is used as a watch-room which should not be permitted.

(*e*) There are no quarters for establishment and none appear to be necessary. The signal and light establishments may probably be amalgamated.

(*f*) Water-supply good.

(*g*) Ventilation is through gratings in the light-room floor and through the lantern door which faces the sea, and is not under regulation. This defective ventilation probably accounts for the reported excessive breakage of cylinders.

Cuddalore.

(*a*) The location is suitable, but the elevation excessive.

(*b*) The light is exhibited from the cross trees of a flagstaff and is well maintained. The trade of the port is said to be considerable and a better light would be an advantage. The existing light (red) has a range of about six miles, while the elevation is suitable for a range of 17¾ miles, so that the light only reaches the horizon under very exceptional atmospheric conditions. One of the 4th-order fixed apparatus which will become available may be installed on the roof of a small building. The range will then be twelve miles.

(*c*) The opticial apparatus is a 6th-order port apparatus and is in good order.

(*d*) Stores are well maintained.

(*e*) Establishment quarters are in fair order. Screen walls are required not only for privacy, but also to keep out drifting sand. The roofs are covered with pantiles without flat tiles and sand finds its way through in large quantities. The cook-room requires a small porch or shelter over the door as, during wet weather, the rain beats in.

(*f*) Water-supply good.

(*g*) The land occupied has just been acquired and may be demarcated by a casuarina fence which the keeper should be required to maintain. The remains of old huts recently acquired should be removed and the place tidied up.

(*h*) The building in rear of the flagstaff requires painting.

(*i*) The Deputy Conservator of the Port who looks after this light evidently takes a great interest in it. The light is well maintained.

Seven Pagodas.

(*a*) The location is unsuitable being at too great an elevation for the existing very feeble light. A better site can easily be found on one of the rocks near the existing tower.

(*b*) The light is exhibited on the top of a pagoda and the whole arrangement is very unsuitable. The building is dark, ill-ventilated and very inconvenient. It will be better, and probably just as cheap eventually, to install the proposed eighteen-mile flash light on a new tower where sufficient drop can be obtained for the weight and the ventilation properly provided for. The store cupboard is in a chamber without windows or ventilation of any sort. It is not surprising if cylinders are broken when kept in such a place.

(*c*) The apparatus is a 4th-order fixed apparatus with a silvered spherical mirror in rear. The light is coloured by a red cylinder and, even if converted into white occulting, would be of insufficient power. The feed pipe to the burner is cracked and leaks badly. The burner is out of adjustment and the ventilator tube bent.

(*d*) Stores are partly kept in the chamber mentioned above and partly in a spare light-keeper's dwelling. The room is not ventilated and not properly fitted up. The number of cisterns for the storage of oil should be increased. The draw-off cocks of the cisterns now in use are at too high level.

(*e*) The establishment quarters are in good order and suitable for the present establishment. The keepers live in them.

(*f*) Water-supply is good. The well requires petty repairs.

(*g*) The ventilation is very bad at this station being absolutely insufficient. The keeper maintains a higher flame than is the custom at many stations.

(*h*) An eighteen-mile flash light is proposed for this station.

(*i*) The white paint supplied for the use of the keepers is of bad quality or badly mixed. It has changed colour.

Madras.

(*a*) The location is suitable.

(*b*) The tower is in good order. The gallery railing is not strong enough. The windows are not properly cleaned.

(*c*) The apparatus is not kept clean. The revolving machine is in good order. The burner is in adjustment. A strainer is required to keep insects out of the oil-cup of the burner. The ventilators should be fitted with wire-gauge to keep out insects. The spare burners are not kept clean.

(*d*) The lantern is in good order. The astragals are not kept clean. The damper indicator requires shortening to clear the drip pan.

(*e*) Stores are kept in a slovenly way. The glazed cupboard supplied should have been made to fit close to the wall. All the spare wicks should be kept in this cupboard properly wrapped up. The stores now kept in the oil-store should be removed to the main tower.

(*f*) The oil-store is suitable. The oil-cisterns appear to sweat a good deal. They rest on wooden benches which should be removed and masonry substituted. The dangerous practice of spreading saw-dust on the floor to soak up accidental drippings of oil should be put a stop to—*vide* paragraph 12 (*e*) of report.

(*g*) Quarters for establishment are much needed.

(*h*) A supply of water for the use of the keepers is required.

Pulicat.

(*a*) The location is satisfactory.

(*b*) The tower is well founded. One of the window frames is missing, and all are of very poor design. The lantern has been made rigid by the addition of horizontal iron bars, but is still not sufficiently rigid as a pane of glass has recently cracked. The glass in the panels in the dark arc might be removed and iron plates substituted screwed to the bars.

(*c*) The optical apparatus is of the 4th order fixed with spherical mirror in rear. The illuminated arc does not cut the land towards the north. The apparatus from Hope Island might be installed with a three-wick burner for use in misty weather and the light converted into occulting if considered necessary. The range will then be thirteen miles. The burner is out of focus and the cone damaged.

(*d*) Stores are kept in a room at base of tower which has no ventilation at night. Rain beats in at the windows which are not protected with shades.

(*e*) The quarters are sufficient for the existing establishment, but will have to be improved when the proposed new establishment is entertained. The floor of the verandah of the Superintendent's quarters requires concreting.

(*f*) Water-supply good.

(*g*) The lantern door faces the sea and there is a great draught when the entrance door or windows in the watch-room are opened. It would be better to fit the lantern door with a bolt so that it could be kept opened at any angle and to provide a door with ventilators in the archway at the foot of the stairs in order to cut off the watch-room from the tower. A few of the windows should also be improved and made to open to any extent required. The faulty ventilation accounts for the large breakage of cylinders at this station.

(*h*) The capacity of oil-cisterns should be increased.

Armeghon.

(*a*) The location is satisfactory.

(*b*) The tower is 107 feet above H.W.L. and is of much the same design as Pulicat light-house. The inside was originally polish chunam, but repairs are being carried out in a very rough way with cement. The vibration in the lantern is said to be considerable. The glass in the dark arc may be removed and replaced by iron plates as at Pulicat. The lantern requires painting. The paint recently put on by the light-keepers has turned yellow as at Seven Pagodas.

(*c*) The apparatus is of the 4th order revolving and is efficient. The range may be increased to fifteen miles by substituting a three-wick burner in misty weather. The revolving apparatus is worn and requires seeing to. The rack supplied by the Public Works Department in 1891 has just been fixed; the teeth are very roughly formed and the light does not revolve steadily. This should be seen to. The apparatus is not fixed in the centre of the lantern owing to the small diameter of the tower, which does not provide sufficient space for the entrance to the light-room. The drip pan and ventilator tube are both fixed eccentrically. It would be better to make a bend in the ventilator tube so as to terminate it in the centre of the roof ventilator.

(*d*) Stores are well maintained. The spare wicks are wrapped up in oily paper.

(*e*) The existing quarters are sufficient for the establishment, but will require to be improved when the proposed new establishment is entertained. They are in good order except the roof of the assistant keeper's quarters which is leaky. A few tiles require to be replaced. The woodwork requires painting.

(*f*) Water-supply good. The guard walls of the wells require plastering.

(*g*) Ventilation is through hit and miss valves in the lantern pedestal and through the trapdoor. The loop-holes of the tower are provided with shutters. The ventilation is insufficient and should be improved. Gratings may be substituted for the present light-room floor and a few of the windows near the top of the tower enlarged and improved so as to open to any extent required. The archway at the foot of the stairs should also be fitted with a door with a ventilator in it.

(*h*) The capacity of oil-cisterns should be increased.

Point Divi.

(*a*) The location is unsuitable. The light is two miles from the sea and is of little or no use to the mariner who does his best to avoid sighting it when coming from the south. A new light is proposed at False Point.

(*b*) The existing tower is circular, five feet diameter, the inside being occupied by wooden ladders. It is now being repaired. The tower is painted white but the heavy lantern gallery is tarred, with the result that the building is difficult to distinguish from the surrounding cocoanut trees when viewed from a distance. On the occasion of my inspection the tower was most difficult to distinguish from the sea though we sailed within three miles from it, and, by land, there was the same difficulty. A great deal more attention requires to be paid to the background when deciding on the colour a tower is to be painted.

(*c*) The apparatus is a 4th-order fixed and is in fair order. The burner is out of adjustment and the tips worn by careless cleaning with bath brick. The ventilator tube is not vertical. The bass stand of one of the spare burners is used for other purpose.

(*d*) The establishment quarters are unsuitable but are not regularly occupied, as the keepers apparently live at Masulipatam.

(*e*) Water is stored in a fresh-water tank for domestic purposes; and in nine iron cisterns for drinking purposes.

(*f*) The Superintendent at this station appears to be past his work and should be retired.

Masulipatam.

(*a*) The location is unsatisfactory being too far from the sea. The light is said to be often invisible at the anchorage. A new light is required near the beach to the south of the bar to cut the light proposed to be installed at False Point Divi. The 4th-order fixed apparatus from Point Divi will be available for this purpose.

(*b*) The existing light is a 6th-order port light exhibited from a mast. It is well looked after.

(*c*) The basement of the flagstaff is plastered with chunam which is said to require renewal annually; cement plaster would be better.

Hope Island.

(*a*) The location is unsuitable and a new tower has been ordered to be constructed. The site suggested is opposite Sacramento Shoal—*vide* paragraph 8 (*n*) of report.

Vakalapudi Lighthouse.

(*a*) The light is located $4\frac{3}{4}$ miles north of Cocanada and is intended as a guide to vessels approaching Cocanada anchorage. If the proposed light opposite Sacramento Shoal is established and the range of Vakalapudi is increased to fifteen miles by installing a three-wick burner during misty weather, the dangers off Gódávari Point will be efficiently marked.

(*b*) The tower is six feet diameter and has a spiral wooden staircase. A service room could easily be constructed, but is not absolutely necessary. The building requires to be either painted or white-washed. The loop-holes should be enlarged and fitted with glazed window frames, especially near the top of the tower.

(*c*) The apparatus is a 4th-order six-sided revolving apparatus and is much damaged. The light is said to be always visible at Hope Island distant twelve miles. The revolving machine is much worn and requires to be thoroughly overhauled as the period of revolution cannot be maintained. The burner is in adjustment, but the wick in use did not fit properly between the tips, which have been worn by cleaning with bath brick.

(*d*) Stores are well maintained The capacity of oil-cisterns is sufficient for the present burner, but it would be better to increase the storage to eighteen months' supply.

(*e*) The quarters are sufficient for the existing establishment. When the new establishment is sanctioned, the dwellings will have to be modified. The keepers' quarters have recently been repaired, but the Superintendent's house requires further extensive repairs, including a new roof. Additional quarters are said to be required for a flag lascar, but it seems possible that the proposed establishment can do the signalling without prejudice to their other duties.

(*f*) The water-supply is said to be bad and the Superintendent asked for a new well near his house. It is not evident that this would improve the quality of the supply.

(*g*) The ventilation is fair, but the wooden light-room floor should be removed and iron gratings substituted.

Vizagapatam.

A new light is said to be required as a guide to the anchorage and a site on the Dolphin's Nose where a light was formerly installed, was first suggested. Captain Powell has suggested a light near the Port office to the north of the bar and no doubt this will be the best site if the light is not required to show to the southward. A light on the Dolphin's Nose would be very inaccessible. It is suggested that one of the 4th-order fixed apparatus which will become available may be installed here with a range of eleven miles.

Bimlipatam.

A port light is said to be required here and can be exhibited from the roof of a small building or from the flagstaff. One of the port light apparatus which will become available can be installed. The light can be occulting on the Sindberg system if that system is adopted (*vide* appendix A, paragraph 11).

Santapilli.

(*a*) The light is exhibited at much too great a distance from the danger and at too great an elevation for its power.

(*b*) The light is installed on the basement of a building and the ventilation is very indifferent. Much trouble is caused by insects at this station. The ventilators in the pedestal should be covered with gauze and a wire gauze door fitted. The steps, cleaning path, and apparatus platform, have been painted white which gives the lantern a dirty appearance, as the white colour cannot be maintained.

(*c*) The apparatus is of the 2nd-order fixed, with a dioptric mirror in rear. Nine lenses and six prisms of the apparatus and one prism of the mirror are damaged. The new burner is said to have given a good deal of trouble at first, but now is better managed. The flame appears to be kept rather low, but this may be owing to defective ventilation. A strainer is required to keep insects out of the overflow basin of the burner.

(*d*) Stores are kept in a building close to the light and are well maintained.

(*e*) Permanent quarters for the Superintendent and head keeper have been built. The Superintendents' bungalow consists of two rooms 16′ × 13′, two dressing and two bath rooms with open verandahs in front and rear. The floors are all in bad order, and the roof leaky and full of white ants. Another room is said to be required. A room should also be built for the accommodation of inspecting officers. The cook and store rooms require repairs. The head light-keeper's quarters consist of one room 15′ × 12′, with two small rooms at either end. The accommodation is not sufficient. The floors are all in bad order and should be concreted. General repairs such as painting should be executed and a tree which is damaging the roof cut back. The cook-room is in good order. The assistant keepers are housed in mud huts. If the proposed establishment (*vide* table V) is entertained, additional quarters will be required for the two assistant keepers, the present head light-keeper's quarters being converted into cook-rooms. The Superintendent's quarters can also be brought up to whatever standard is determined on. The Superintendent has built a fowl house and two cattle sheds which he should be required to keep neat and tidy.

(*f*) The light-house property requires to be fenced, and as the keepers have to keep stock owing to their isolated position, grazing ground should be provided. The southern boundary may be moved back to the second palmyrah hedge and continued towards the east to include the land now rented by the Superintendent. The western and northern boundaries should include the hill on which the light-house stands. Two new gates will be required and prickly-pear and jungle should be cleared and the whole property fenced with milk plant with demarcation stones at angles. The cost of fencing and gates will not exceed Rs. 250, and the value of the additional land required, which belongs to His Highness the Maharajah of Vizianagaram, cannot be much.

Calingapatam.

(*a*) A new 4th-order occulting light is now being established.
(*b*) Quarters for establishment are required.

Gopalpore.

(*a*) The location is suitable, but the light is exhibited from a higher elevation than is advisable.

(*b*) The flagstaff is in good order and has recently been repaired. The basement is said to be annually plastered with chunam, but it would be better and cheaper in the long run to plaster it with cement.

(*c*) The apparatus is a 4th-order port apparatus and is efficient. The breakage of burner cylinders is considerable, but is probably due to the difficulty in lighting or tending the burner during bad weather. It would be better to construct a platform at a lower elevation with a shelter into which the apparatus could be drawn during the day and for lighting and cleaning purposes. An alternative would be to exhibit the light from the roof of the Custom House.

(*d*) The light-keeper's quarters require screen and compound walls. A good deal of sand is said to be blown into them.

Madras,
22*nd June* 1895.

F. W. ASHPITEL,
Executive Engr. on Special Duty.

No. 1493.

Referred to the Presidency Port Officer for early remarks. The appointment of Superintendent of the Madras Light should not be *permanently* filled, pending further orders.

Ootacamund,
28*th June* 1895.

(Signed) J. F. PRICE,
Chief Secretary.

From Commander W. J. POWELL, R.I.M., Presidency Port Officer, to the Chief Secretary to Government, dated Madras, 15th July 1895, No. 1271—183-G.

In returning Mr. Ashpitel's report on the lights of this Presidency (received with endorsement, No. 1493, of 28th June 1895, on Marine Current No. 470), I have the honour to state that I agree generally with Mr. Ashpitel's proposals; but many of them require modifying.

2. To take them in detail from Kundapur to Gopalpur will be the simplest way of expressing my views thereon.

Kundapur, Malpe, Barkur.

3. Lights at *Kundapur*, *Malpe* and *Barkur* (Hangarkotta) approved.

Mulki Rocks.

4. Class of light approved but the proposal to establish it on the rock itself I do not support for the following reasons:—No communication for at least four months in the year; great expense in construction; keepers will have to be provisioned; difficulties and expense of inspection greatly increased involving hire of a steamer or the upkeep of a boat on the mainland. The danger can be effectively guarded by a light on the mainland, four miles distant, as a single cast of the lead would at once settle a ship's position after sighting the light. The above remarks apply equally to the proposal to place a light on the Sacrifice Rock. On Cotta Point is the position I propose for the latter light.

Mangalore.

5. Light to be removed to a lower elevation approved if a suitable site can be found. Casuarina plantations have grown up in recent years and it may not be possible to provide an unobstructed view of the light except at great expense; as the light will only be classed as a port light it had better remain as it is unless the change can be effected cheaply.

Cannanore and Tellicherry.

6. Proposals approved. Each light should be in a properly-sheltered light-room.

Sacrifice Rock.

7. Not approved; light should be on Cotta Point for reasons already given.

Calicut.

8. Light to be lowered, &c., approved.

Beypore.

9. There should be a small anchoring light at *Beypore*.

Cochin.

10. Alterations to port light at *Cochin* approved; also provision of small anchoring light at Mallipuram.

Tangacherri.

11. Light on *Tangacherri Point* approved.

Muttum.

12. An increase in the power of the *Muttum* light during thick weather is approved. The present four-wick burners can be used with one of the new 3rd-order lights. Before carrying out this proposal the ventilation at Muttum should be improved.

Manapaud.

13. The installation of a 3rd-order flash light on *Manapaud Point* is very necessary and I would recommend very early sanction to this proposal.

Tuticorin.

14. The *Tuticorin* column should be altered as proposed by Mr. Ashpitel as soon as provision can be made for a temporary light.

Pamban.

15. *Pamban* light is sufficient for present requirements.

Calimere Point.

16. The new light recommended for *Calimere Point* is suitable.

Negapatam.

17. The proposal to increase the power of *Negapatam* light, which is a land-fall light for vessels from the Straits Settlements, is approved. This light should, in my opinion, be classed as a sea light.

Cuddalore.

18. The present light is sufficient.

Seven Pagodas.

19. The alteration of the *Seven Pagodas* light to a 3rd-order triple flashing should also receive very early sanction. The tower for the new light should be built on a site which provides room for storage of oil, &c., close to the tower. The necessary range can be obtained with a less height than that proposed by Mr. Ashpitel, as the only vessels likely to make use of the light frequently will be steamers of large tonnage. An elevation of 120 feet will give them a view of the light when 18 miles distant, *e.g.*—

	MLS.
118 feet elevation gives a range of	12·4
Height of eye from steamer's bridge 25 feet (average) gives a range of	5·5
Total ..	17·9

I would here remark that the towers of all the new sea lights proposed by Mr. Ashpitel may be slightly reduced in height.

Madras.

20. *Madras* light is in all respects suitable, but it will be convenient here to offer a few remarks on Mr. Ashpitel's report thereon. I will just mention that the lighthouse mechanic who was in temporary charge of the light had been for some weeks absent on duty at Calingapatam and no person was available to take his place. The hour of Mr. Ashpitel's inspection was the early morning while the men were cleaning

the lantern and apparatus. During the night the windows swarm with insects which get into the corners of the astragals, and naturally the windows do not appear clean until the cleansing has been carried out. No notice of his intention to visit the light was given to this office and his remarks strike me as somewhat captious. It would have been fairer to have remarked on the absence of the person responsible. The other points alluded to at this and other lighthouses will receive attention.

Pulicat.

21. The proposal on page 36 of the report to utilize the present Hope Island light at *Pulicat* is a good one, but I think the existing burners are sufficient; it is not worth while going to the expense of new burners to gain one additional mile in range as the existing range is sufficient. The question of providing an occulting shutter can be considered after experience with the Calingapatam light.

Armeghon.

22. At *Armeghon* new clock-work is required and the three-wick burners suggested by Mr. Ashpitel might also be provided at the same time.

False Point Divi.

23. As regards the proposal to instal a 3rd-order triple flashing light at *False Point Divi* great care in the choice of a site will be necessary, owing to the branches of the Kistna river. Given a suitable and safe site and facilities of communication superior to those existing with the present light on Point Divi, I consider the light should be sanctioned as soon as funds are available.

Masulipatam.

24. The present Divi light is suitable as a port light for *Masulipatam*.

Sacramento Shoal.

25. This light as proposed by Mr. Ashpitel should be installed as soon as possible. Separate correspondence on the subject is now passing between this office and Government.

Godavari Point.

26. Should Pinstch's system of lighting railway carriages by compressed gas be adopted by the East Coast Railway, endeavours should be made to establish a gas buoy off Gódávari Point.

Vizagapatam and Bimlipatam.

27. If available, one of the 4th-order fixed lights might be established at *Bimlipatam* and 4th-order port lights at *Vizagapatam*.

Pending the adoption of some occulting system, these lights should be red at Bimlipatam and *two* white at Vizagapatam, or *vice versâ*. It will not be safe to have another fixed white light within thirty miles of the Santopilly light.

Santopilly.

28. I agree with Mr. Ashpitel's proposal to increase the burner power of this light. Any attempt to mark the shoal by a light involves quite a prohibitive expenditure, having in view the tonnage of the shipping that could be expected to contribute.

Calingapatam.

29. This light has already been improved and an establishment sanctioned.

Gopalpur.

30. This light might be installed under one keeper in a small masonry room on top of the Port Office.

31. The dues proposed to be levied for the construction and maintenance of these lights appear suitable and the estimated revenue therefrom correctly calculated.

32. While practically accepting most of Mr. Ashpitel's proposals, I would remark that, however desirable it may be to have a really well lighted coast, shipping should not be too heavily taxed to attain this result, and in my proposals contained in this office No. 1271—169 G., dated 5th May 1894, I refrained from suggesting more lights than were absolutely necessary to the navigation of the East Coast. My reasons for adding to the number of necessary lights are fully set forth in my No. 1271—271 G., dated 19th July 1894. The new lights proposed for the West Coast I would describe as facilities to safe navigation, but not absolutely essential; still, time is becoming of more importance yearly in sea traffic, and provided that ships are willing to contribute to their maintenance, many and good lights should be provided.

Establishment.

33. I fully agree with Mr. Ashpitel as to the adoption, as far as possible, having regard to local conditions, of the Trinity House system at our lighthouses with the provision of three keepers as against two in English shore lighthouses.

(1) I take exception to the statement in paragraph 15 of his report, viz., "For lights, such as the majority of the proposed sea lights, the number of keepers in England, Scotland or France would be two." Many of the proposed stations for the new lights will be far more isolated than rock stations in the United Kingdom as regards facilities for obtaining supplies and visiting home when relieved.

(2) There will be no steamers to bring the supplies or land the men near a railway. In some cases under the proposed scheme of engaging Eurasians the men will be employed at places a week's journey from their homes; at isolated rock stations four keepers are entertained by the Trinity House; at other rock stations, with which might well be classed many of our proposed sea lights, three keepers.

(3) Mr. Ashpitel has omitted to mention that at a rock station an addition at the rate of £25 per annum is made to the pay of each keeper while on duty there.

(4) Also that in calculating the pensions payable to a keeper £18 per annum is added to his pay, being the estimated allowance for house-rent.

(5) I consider that at all sea lights a provision allowance should be given and that free conveyance of stores should also be granted.

(6) With these additions the present rates of pay might be tried; the present Superintendents to receive their old rates of pay and in specially recommended cases to be allowed to rise to the maximum present pay of Rs. 100 per mensem.

(7) At most sea lighthouses it will be necessary to maintain a scavenger and waterman. These latter are not provided for in Mr. Ashpitel's scheme.

34. As regards the local light service, I agree with the suggestion made in the enclosed memorandum* (drawn up by Mr. Baddeley, Personal Assistant to the Presidency Port Officer, during his recent visit to Australia on privilege leave), viz., that the charge of a port light should be

* Paragraph 10.

the probationary service for promotion to a sea light, and that Eurasians be employed. The only exception to this would be in the case of mast and cabin lights at which a moderately-paid native keeper, with a cooly to assist in hoisting the light up and down, should be entertained. The keeper should receive a small lodging allowance on the understanding that he lives as near as possible to the light, and in the case of lights only exhibited during the fine weather he might be required to sleep near the cabin in a temporary hut. These proposals are, of course, conditional on the establishment of the superior class of lights, from which lights a very efficient check on the maintenance of the smaller lights can be carried out.

35. Pending the final settlement of the question of lights and establishment I would suggest that sanction be accorded to filling up all future vacancies at tower lights by the appointment of an Eurasian, if possible with some mechanical training, on the scale of pay proposed by Mr. Ashpitel for the lowest class of provincial keeper and exempted from the examination rules in the case of unpassed men. When funds admit, all lights except fine-weather lights should be located in light-rooms.

Supervision and Inspection of Lights.

36. As regards the method of inspecting the lights I totally disagree with Mr. Ashpitel. In the first place, mechanics on the pay proposed by him are not suitable persons to exercise the necessary control or to submit reliable reports. It is quite out of the question to entertain an expert from England, nor is one required. There is already on the establishment a lighthouse mechanic who has performed his duties satisfactorily. He has gone through a three months' training under Trinity House keepers in Ceylon and, though there may perhaps be petty details in which he has failed to come up to Mr. Ashpitel's standard, he is for all practical purposes the best man available *as a mechanic*, and I recommend his retention in that capacity; also as Principal Keeper of the Madras lighthouse with an increase of pay. He should also be employed as instructor of the keepers engaged from time to time. To assist him I would propose, for the present (pending the introduction of the new scheme), an Assistant Superintendent; subsequently, three keepers would be appointed.

37. As Inspector of Lights for the Presidency I would strongly recommend Mr. H. D. Baddeley, Personal Assistant to the Presidency Port Officer. Mr. Baddeley was deputed to accompany Mr. Douglass when that gentleman inspected the lights of this Presidency and has for the past five years taken a very keen interest in all matters connected with lights. He has on various occasions, at home and abroad and at his own expense, visited lighthouses. It will not be necessary that Mr. Baddeley should give up his duties as Agent for Government Consignments or as Personal Assistant, though his duties in the latter appointment will principally be confined to lighthouse work. It will be necessary to relieve him of the duties of Government Surveyor, which might be performed, and consistently, by the Deputy Conservator, who is in a similar position to the Port Officers at Karachi, Aden and similar ports, by whom this duty is performed. Mr. Baddeley intends applying for the furlough (leave on private affairs) due to him (six months) next year. I would recommend that Government should allow him to remain at home for three additional months on the usual allowances granted to officers on duty in England, to go through a practical course of instruction in lighthouse inspection and management under the Trinity House. This he is willing to do at his own expense. The financial result of the above proposals does not involve much more expenditure than would be entailed by Mr. Ashpitel's scheme, and the inspection would be much more satisfactory. With the extension of railway communication in this Presidency, recently carried out and projected, there would be no difficulty in the proposed Inspector making at least four visits per annum to each lighthouse without a very prolonged absence from head-quarters. The lighthouse mechanic would accompany him on these inspections. The Inspector should communicate with Government through the Presidency Port Officer and still remain subordinate to that officer, but should be allowed considerable freedom of action and full powers in dealing with all minor matters. He should, in fact, be the head of the lighthouse service under the administrative control of the Presidency Port Officer. The transfer of the duties of Government Surveyor would deprive the Agent for Government Consignments of certain emoluments and the inspection duties would

involve a great deal of travelling, and to compensate him for loss of fees, increased duties and responsibilities, and also to bring him under first-class travelling rules, his substantive salary should be increased. An increase of salary would result in the withdrawal of his personal allowance (*vide* Article 77 of the Civil Service Regulations), and thus unless increased to an appreciable extent would not be of any material advantage. The average emoluments of his present post are approximately Rs. 500 + 45 (personal allowance) + 45 (representing fees for private surveys)—say, Rs. 600 per mensem. When this appointment was originally proposed the salary without fees was fixed at Rs. 600 per mensem and this amount was on two * occasions recommended to the Government of India, who were on the first representation willing to grant the higher salary if the matter had been pressed by the Government of Madras. On the second occasion the recommendation was mixed up with a general scheme for improvement of salaries which was rejected. I would recommend a consolidated salary of Rs. 700 with a Presidency allowance of Rs. 100 per mensem.

* *Vide* G.O., Marine, Nos. 365, 366, of 1st August 1888, also Commander Street's letter, No. 474—474 G., of 22nd October 1889, printed in Marine Proceedings, Nos. 51, 52, of 11th February 1890.

38. As for some years to come Mr. Ashpitel's opinion and advice will be required if his scheme be adopted, I would suggest the desirability of granting him either a lump sum annually or a monthly allowance. All plans for new lighthouses should be revised by him and his opinion called for on technical matters.

39. The Inspector of Lights would be responsible for the cleanliness and efficiency of the lights and the discipline of the establishment. He should grant leave, award punishment and deal with all correspondence and returns. Punishments other than petty ones to be open to appeal to the Presidency Port Officer. An incentive to good work might take the shape of a bonus to every keeper who has a clean defaulter sheet for a certain period.

40. In proposing this additional expenditure I have taken into consideration the fact that a very large initial outlay and yearly expenditure is involved amounting to Rs. 10,00,000 and Rs. 1,50,000, respectively; therefore expense should not be spared in ensuring by efficient inspection and reliable advice the disbursement of these sums to the best advantage.

41. I beg that a copy of Mr. Ashpitel's report may be supplied for record and future reference.

MEMORANDUM ON LIGHTS ON AUSTRALIAN COAST.

During my recent trip to Australia I availed myself of the opportunity of enquiring into the Lighthouse systems of New South Wales and Queensland, and through the courtesy of the Marine authorities of the respective colonies, facilities for so doing were granted me.

2. Having in view the proposed re-organization of the Madras Lighthouse service on the basis of Provincial and local lights, I devoted my attention to the smaller class of lights used as port and leading lights, especially with reference to the establishments maintained and the system of making such lights to a great extent automatic, *i.e.*, the maintenance of a moderate intensity without the presence of a keeper on watch.

3. On the Queensland Coast, there are about 100 minor lights termed secondary coast, and port, and river lights, the majority of which are in charge of only one keeper; in some cases one man supervises two lights. Several of these lights are of the 4th order.

4. The principle adopted is to abolish the damper to exclude all draughts of air not absolutely necessary, and to maintain the flame at a moderate intensity, and the results have been most satisfactory. The smoke-tube is also in two pieces, and the glass cylinder does not enter the lower portion of the tube. This effectually prevents flaring up and depression of the flame from down draughts. On the introduction of the Douglass burner in the smaller lighthouses of this Presidency, stress was laid on the necessity of maintaining a good draught and a maximum intensity of flame, and rightly so, for the lights were performing duties for which the optical apparatus was inadequate, viz., those of coast and land-fall lights. Under the system proposed by Mr. Ashpitel these lights will be relegated to their proper functions as port lights, and guides to anchorages, and a small reduction in their atmospheric range will not only cause no inconvenience to the mariner (who will be guided to the vicinity of the port and warned off outlying dangers by the large and powerful coast lights), but will result in a considerable saving in salaries, oil and chimneys.

5. The burner used for these lights by the Queensland Government is known as the Farquhar, but there seems to be no reason why the small Douglass burner should not be equally efficient. The experiment is worth trying. It was under consideration to supply the Farquhar burner with an overflow tube to increase its efficiency. The oil used is common kerosine of 125° test and many of these lights are situated in the tropics, one of them lying nearer to the equator than is Madras. This oil is used in *all* the lighthouses, heavy mineral being reserved for the light ships. Excellent kerosine of 150° test is procurable in this presidency at about half the cost of heavy mineral oil and, no doubt, a local firm would be prepared to supply the same with a guarantee of its quality.

6. I do not of course advocate using this oil in the larger and more important lights where great heating of the lantern may occur.

7. At the Pile lighthouse at the entrance to the Brisbane river (a most important station), in addition to the 4th-order occulting light are two 6th-order subsidiary lights which show during the nights, by means of coloured shades, the height of tide on the bar. This light with tide guage is maintained by a superintendent and two keepers, whose duties in connection with the guage could only be carried out by the adoption of the system detailed above which relieves them from watching the flame of the light. The fact that this light has a mean range of 12 miles and is used nightly by steamers of large tonnage entering the Brisbane river, seems a very strong argument in support of my proposals. The superintendent informed me that he had removed the damper altogether, and that the flame had never given any trouble. The oil used was common kerosine with a Farquhar burner. The Lighthouse Engineer and Secretary to the Marine Board accompanied me on this trip.

8. Mr. Ashpitel in his report admits the necessity of three keepers at light towers where a perpetual watch is to be kept, and for port lights it is still proposed to employ native keepers. From past experience it has been found difficult to ensure an intelligent use of the damper by native keepers, and continual "flare up" smoking chimneys, and drowsiness on watch have been the result, and this under the supervision of a moderately-paid superintendent who, under the new system, will disappear.

9. I submit that a somewhat reduced range of light, but constant, is better than the higher intensity subject to the vagaries and negligence of low-paid keepers. As a matter of fact, it is extremely doubtful if the three native keepers will maintain any better flame than under the other system.

10. The keeper in the Queensland lighthouses is a well-paid man receiving from £ 90 to £ 200 per annum with quarters, lights and fuel; but all labour there is expensive, and if the minor light appointments on this coast were made the stepping-stones to appointments in the provincial lights, suitable persons would be procurable at moderate salaries.

11. At some of the stations at which only one keeper is entertained, only £ 25 per annum is paid; but, then, the person is a fisherman or boatman residing on the spot and does not devote his whole time to the work.

12. At the large lighthouses superintendents are entertained, and where three keepers are also entertained the superintendent keeps no watch. There are only two lighthouses under these conditions, the usual complement being a superintendent and two keepers who keep watch in turn.

13. The accompanying statement will show the rates of pay obtaining in Queensland and New South Wales. In the latter colony gratuities and pensions are given, but I was unable to obtain particulars of these as the statement was only given to me just before leaving. At Brisbane (Queensland) the question of granting pensions and leave is now under consideration.

14. In the colonial lighthouses a large amount of discretion is given to superintendents and principal keepers, and they are not hampered with numerous petty instructions and preparation of superfluous returns. They are expected to maintain their lights, apparatus and buildings in a clean and efficient condition and to use their discretion as to time of lighting, provided that the light is always exhibited before darkness sets in, and during dark, stormy or hazy weather that it is exhibited, if necessary, before sunset.

Statement showing lights on the coast of Queensland.

Name of light.	Description of structure.	Description of light.	By whom managed.	Salaries of light-keepers * per annum.	Remarks.
Cape Moreton	Circular stone tower	1st order catoptric, revolving every minute, white.	Superintendent and 3 light-keepers.	£ 200. 1 at £ 108, 2 at £ 96.	
Yellow Patch	Square wooden light room	4th order dioptric, fixed, red and white sectors.			
Comboyuro	Wooden tower	Do. do. do.	1 light-keeper	£ 118.	
Cowan Cowan	Do.	Do. do. do.	Do.	£ 118	Part light.
Tangaluma	Square wooden light room	Three 4th order holophotes, white	Do.	£ 118	Do.
Cleveland Point	Hexagonal wooden tower	6th order dioptric, fixed, white	Do.	£ 25	Do.
Pile Lighthouse	Hexagonal, on piles	4th order dioptric, occulting, red and white sectors.	Superintendent and 2 light-keepers.	£ 150 1 at £ 118, 1 at £ 16	Do. Has tidal gauge and two subsidiary 6th-order lights for tidal signals.
Fisherman's Island (Front)	Iron tower	5th order holophote, red	2 light-keepers	1 at £ 118, 1 at £ 96	One keeper for each light. Light situated about ¼ mile apart. No watch maintained.
Do. (Back) and *twenty-five* smaller lights on beacons in the Brisbane river and Moreton Bay.	Do.	5th order dioptric, red and white sectors			
Double Island Point	Circular tower	3rd order dioptric, revolving every 30 seconds, white.	Superintendent and 2 light-keepers.	£ 160. 1 at £ 118, 1 at £ 106.	
Woody Island (Middle)	Hexagonal tower	4th order dioptric, fixed, red and white sectors.	Superintendent and 1 keper.	£ 175. £ 108.	
Do. (North) and *twenty-six* smaller lights in Somdy strait and Mary river.	Do.	Do. do. do.	2 light-keepers.	£ 160 and £ 108.	
Sandy Cape	Iron tower	1st order dioptric, revolving every 2 minutes, white.	Superintendent and 3 light-keepers.	£ 200. 1 at £ 108, 2 at £ 96.	
Lady Elliot Island	Do.	4th order dioptric, white, flash every 30 seconds.	2 light-keepers.	1 at £ 150, 1 at £ 118.	
Burnett Heads and *fourteen* smaller lights on beacons in the Burnett river.	Hexagonal tower	5th order dioptric, white, fixed	Pilot boat's crew.		
Bustard Head	Iron tower	2nd order dioptric, fixed, and flash, white and red.	Superintendent and 2 light-keepers.	£ 200. 1 at £ 118, 1 at £ 96.	
Do.	Square tower	5th order dioptric, white, fixed			
Do.	Mast	Catoptric, white, fixed			
Gatacombe Head	Hexagonal tower	5th order dioptric, fixed, red and white	1 *Light-keeper* †	£ 130	† This keeper controls three lights.
Oyster Rock and two small lights in Port Curtis.	....	Two 6th order holophotes	1 Light-keeper	£ 25	Does not devote all his time to the light.
Cape Capricorn	Iron tower	3rd order dioptric, revolving every minute	Superintendent and 2 keepers.	£ 150. At £ 108 and 96.	
Do. (2)	Light-rooms	Reflectors			
Pilot station, Keppel Bay	....	6th order catoptric, fixed, white	Pilot crew.		
Sea Hill and twenty smaller lights on beacons in Fitzroy river.	....	5th order dioptric, white and red sectors	1 *Light-keeper*.	£ 118	Port light.
North Reef	Iron tower	2nd order dioptric, fixed and flash	Superintendent and 2 light-keepers.	£ 200. At £ 130 and 108.	
Pine Islet	Do.	Do. do.	Do. do.	Do. do.	
Flat-top Islet and thirteen smaller lights in the Pionur river.	Do.	4th order dioptric, fixed, red and white sectors	1 *Light-keeper*	£ 150	Secondary coast light.
Dent Island	Do.	4th order dioptric, revolving every 30 seconds, white.	Superintendent and 1 light-keeper.	£ 150. £ 108.	

* All have quarters and are supplied with light and fuel. One month's leave is granted to each light-keeper yearly. Light-keepers provide their own provisions which are conveyed in Government vessel once a month. Light ships are partly supplied with provisions.

Statement showing lights on the coast of Queensland—cont.

Name of light.	Description of structure.	Description of light.	By whom managed.	Salaries of lighkeepers* per annum.	Remarks.
North Head, Bowen and six smaller lights in Bowen Harbour.	Hexagonal tower ..	5th order dioptric, fixed, red and white	1 Light-keeper ..	£ 25	Does not devote all his time to the light.
Cape Bowling Green	Iron tower	3rd order dioptric, revolving every minute, white.	Superintendent and 2 light keepers.	£ 200. At £ 120 and 108.	
Cape Cleveland and eight other small lights, Cleveland Bay.	Do.	4th order dioptric, revolving every 20 seconds, red and white.	Superintendent and 1 light-keeper.	£ 140. £ 108.	
Bay Rock and fourteen smaller lights in Hinchinbrook channel and Cairns Harbour.	Circular tower ..	4th order dioptric, fixed, red and white	1 *Light-keeper* ..	£ 120	This is a secondary coast light.
Island Point	Circular tower	5th order dioptric, fixed, white	Pilot crew	....	
Low Island	Do.	3rd order dioptric, revolving every minute	Superintendent and 3 light-keepers.	£ 200. 1 at £ 130 and 2 at £ 108.	
Archer Point	Do.	4th order holophote, white, red and green	2 light-keepers ..	At £ 160 and 140.	
Rocky Islet	Do.	4th order holophote, white	1 light-keeper	£ 150	Secondary coast light.
Grassy Hill and two small lights in Cook Harbour.	Do.	4th order dioptric, white, fixed	Master and 3 men.	£ 175. 1 at £ 120 and 2 at £ 108.	
Channel Rock	Light ship	6th order dioptric, white, fixed	Do.	Do. do.	
Claremont Island	Do.	do.	Do.	Do. do.	
Piper Island	Do.	do.	Do.	Do. do.	
Goode Island	Circular tower	4th order dioptric, fixed, red and white sectors.	1 light-keeper	£ 180	Secondary coast light.
Booby Island	Do.	2nd order dioptric, revolving, flash	Superintendent and 2 light-keepers.	£ 200. At £ 130 and 108.	
Prondfoot Shoal and one getty light at Thursday Island and six small lights at entrance to the Norman River.	Light ship	5th order dioptric, occulting, every 14 seconds.	Master and 3 men.	£ 175. 1 at £ 120 and 2 at £ 108.	
Norman Bar	Do.	Dioptric, fixed, white	Master and 2 men.	£ 150. At £ 120 and 108.	

* All have quarters and are supplied with light and fuel. One month's leave is granted to each light-keeper yearly. Light-keepers provide their own provisions which are conveyed in Government vessel once a month. Light ships are partly supplied with provision.

Classification and Pay of Keepers in New South Wales.

Minimum Salary.	Maximum Salary.	Value of Quarters, Fuel and Light.	Total amount of Salary and Allowances, maximum obtainable.	Annual Increment.
		Principal Light-keepers.		
£.	£.	£.	£.	£.
157	250	50	300	10
		1st Assistant Light-keepers and Principal Light-keepers in Subordinate Lights.		
120	157	30	187	7
		2nd Assistant Light-keepers.		
96	120	30	150	5

A deduction of 4 per cent. per annum is made from the salaries of all persons employed in the service of the Marine Board to entitle them to the allowances and gratuities provided under Parts 5 and 6 of the Civil Service Act.

All the smaller lights used in the navigation of Sydney Harbour by night are without keepers and are under supervision of the light-ship. The master of the light-ship states that he knows of no occasion during the past five years of failure of the lights.

The leading lights at the entrance guiding through the dredged channel are maintained without a perpetual watch.

(Signed) H. D. BADDELEY,
Personal Assistant to the Presidency Port Officer.

Note on Mr. Baddeley's Memorandum on Lights on the Australian Coast.

As I understand Mr. Baddeley's Memorandum, he recommends Government—

(*a*) to reduce the power of (Port) "Local" lights in this Presidency in order to make them more or less automatic and thus save establishment;

(*b*) to effect a saving in the cost of oil by using ordinary 150° kerosine purchased in the local market.

2. It is not quite clear what Mr. Baddeley means by Port lights. In my report on lighthouse illumination, &c., the general principles which should determine the distribution of lights on a coast, as laid down by Monsieur Reynaud, are given. The proposed "Provincial" lights correspond, to a certain extent, to Monsieur Reynaud's system of landfall lights and the majority of "Local" lights to the "Lights of less power" which are necessary to provide a mariner with means of proceeding to his destination. Finally there are the Port lights, such as the lights on the ends of the Madras harbour arms and at Barkur, Mulply, Tellicherry and possibly Mangalore, Cannanore and Calicut. These are the only lights at which Mr. Baddeley's proposal could be adopted, and the saving by making them automatic would be as small as at Madras; owing to the small importance of the lights no special establishment will be required, and at the other stations the possible saving would not exceed Rs. 100 per mensem and might be *nil* if any accident occurred.

3. It is all very well to say that the proposed "Provincial" lights will permit of the "Local" lights being relegated to their proper position as port lights, but it should be observed that, in the proposed scheme, it is not suggested to light the coast to the extent customary in Europe, viz., so that a mariner cannot approach land without seeing at least one of the landfall lights, and, therefore, "Local" lights, though used as port lights, must continue to fill up the gaps in the primary illumi-

nation. For this purpose the existing or proposed ranges are none too great and cannot be reduced without inconvenience and, in some cases, risk to shipping which is not justified by the possible saving in maintenance.

4. Supposing, for the sake of argument, that it is decided to reduce the ranges of the lights mentioned in paragraph 2.

In the case of Barkur (6 miles), Mulply (8 miles), Tellicherry (6 miles), Bimlipatam (10 miles), the burners are of the ordinary, circular, single-wick type, very similar to a table lamp, and it is just as easy to burn them at full power as to keep the wicks low. The only attention (barring accidents) which these lights now require is to change the burner at midnight, and even this would probably be unnecessary if the keepers were trained to trim their burners properly and if a proper shelter for lighting purposes was provided. In any case, however, I do not think a constant watch can be avoided as the lights are liable to be obscured by insects which cannot be removed automatically.

In the case of Mangalore (12 miles), Cannanore (12 miles), Calicut (12 miles), the burners are of the two-wick Douglass type and the apparatus is in good order. If it is thought that the range admits of reduction, the simplest course is, not to put the Douglass burner to a use for which it was never intended, but to instal a single-wick burner of the type in use at the other small stations. This would at once reduce the cost of maintenance, if that is the only object in view. I do not think, however, that this would be justifiable in view of the small saving effected, as the utility of the lights would be much impaired by night and of the tower as a day mark, owing to the necessary reduction in the height.

5. *Paragraphs* 1, 2, 3.—The question of lights burning without attention has been closely investigated by the French and English Engineers during recent years with the result that the former have produced a lamp which, with ordinary light-house oil, will burn for two months without attention (*vide* page 35 of Report on lighthouse construction and illumination) and the latter have found an oil (*vide* page 24 of the same report) which, with an ordinary lighthouse burner, will burn for a considerable time without attention. In Sweden, Norway, &c., the Engineers have invented a light apparatus which will run for ten consecutive days without attention, but in this case the oil used is very volatile and is unsuited for use in India.

To adopt any of these systems might save establishment but would more than double the cost of oil.

6. To adopt Mr. Baddeley's proposal to burn the light at half power would not, I think, be a success, as I do not think Sir James Douglass would have experimented with a special oil if his burner was adapted to run, even at half power, without attention with ordinary oil. To adopt his special oil and provide the necessary special arrangement of automatic valves would mean greater responsibility and require more intelligent keepers on higher pay. Sufficiently trustworthy men may at some future time be available, but, at the present time, it has been thought necessary to provide extra establishment at lighthouse stations because men of the class employed in the Trinity House service are not forthcoming. I may here mention that, from the first, I have been of the opinion that, owing to the greater difficulty in management of the Douglass burner, it would have been better, in the first instance, to have adopted the French burner of 1889 for stations in charge of Native keepers. The Douglass burners have, however, been adopted and the difficulty in management is not such as to justify a change.

7. *Paragraph* 4.—The form of smoke-tube mentioned by Mr. Baddeley was originally introduced by Messrs. Saulter Lemonnier and was, I believe, at one time used in England. The annular spaces between the various lengths were designed to introduce air and, by cooling the smoke, render the combustion more complete. These smoke-tubes were used with the Farquhar and other old forms of burner. Messrs. Saulter only claimed that this arrangement was the best for the old burners with five, four or three wicks and never claimed that it was indispensable for burners of one or two wicks. Since then lantern roof ventilators have been much improved with a view to

prevent down-draughts and lighthouse burners perfected. I have not the papers with me, but I believe that Professor Tyndall demonstrated at Whitby that this form of smoke-tube is prejudicial to the light.

8. *Paragraph* 5.—I fancy that, if enquiries were made, it would be found that the apparatus at lighthouses visited by Mr. Baddeley was supplied by Messrs. Saulter Lemonnier as they are, or were, the sole proprietors of the Farquhar burner. This firm claimed that the Farquhar burner was (many years ago) superior to all others, in that it gave a whiter and higher flame of greater intensity caused by the fact that the tubes for the supply of air to the concentric flames were specially arranged. This burner is, I believe, no easier to manage than the new French burners (*vide* page 34, Report on light-house illumination, &c.) or than the old pattern, Trinity House burner.

In not recommending the Farquhar burner, I am supported by Messrs. Saulter Lemonnier, who in a note written in 1889 say—

> "The burner which we recommend is the Vie Etagé (burner with wick easings in stages) of the type adopted by the French Administration. The burner is furnished with a stand pipe designed to maintain a constant flow of oil and conceived by Monsieur Denechaux, of the French Administration. Lastly this burner is adapted for the consumption of either mineral or vegetable oil."

The Farquhar burner was never intended for use with mineral oil and is in the same undeveloped state as it was many years ago. Seeing that the proprietors do not now recommend its use, I do not think any one else need.

9. To try the Douglass burner with 150° kerosine oil without a permanent watch is a proposal which I cannot recommend. As pointed out in paragraph 4, Sir James Douglass would not have experimented with special oils if there was any prospect of success. This oil might do for the smaller Douglass burners with a permanent watch, but the risk of fire must, in this climate, be considerable and the change could not be made without careful preliminary experiments. It might be used with the single-wick burners with lower reservoir, but in this case the saving would be very small. If any change in oil is made, I suggest a return to cocoanut oil for all lights with Douglass burners (*vide* paragraph 13).

10. *Paragraph* 7.—Calls for no remark.

11. *Paragraphs* 8 *and* 9.—Personally I consider that Native keepers will do excellently for the small "Local" lights and do not admit that they would find any difficulty in manipulating the damper if properly instructed; I do not, in fact, see where the difficulty comes in. Mr. Baddeley is mistaken in saying that these have been Superintendents in charge of any of the proposed "Local" lights (see also paragraphs 2 to 5 of this note).

12. *Paragraph* 10.—See paragraph 22 of Note on Presidency Port Officer's letter, No. 1271—183-G., of 15th July 1895.

13. *Paragraph* 11.—Boatmen and fishermen in this country are not likely to be satisfactory in sole charge of a light.

14. *Paragraphs* 12, 13, 14.—Call for no remark.

15. As Mr. Baddeley has raised the question of reducing the cost of maintenance of lights in this Presidency, I would suggest that, among other ways, this can be done by going back to cocoanut oil. When I was at Alippi I enquired into the cost of this oil and found that the Travancore Governments were purchasing it for the light in their territory at As. 8 * per gallon. There is no objection to the use of this oil, and unless the price of heavy mineral oil can be considerably reduced, I recommend its use, as I do not think Mr. Douglass would have recommended the use of heavy mineral oil had he known that the fall in the value of the rupee would be so great and that the price generally would be so high. I enclose a translation of an extract from a book written by Messrs. Saulter Lemonnier from which it will be observed that Monsieur Reynaud, the French Lighthouse Engineer, considers cocoanut oil to be excellent for lighthouse purposes, its only defect being that it commences to become viscous at 76° Fahr.

* I have not my note-book here, so cannot be certain that this figure is correct.

This does not matter in India as the oil will not be exposed to this temperature. This change would not necessitate any modification of existing apparatus, as the Douglass burners are adapted for use with vegetable oil. I would not, however, recommend any change until it has been ascertained that the present price of heavy mineral oil cannot be reduced. Under no circumstances do I recommend the use of 150° kerosine oil with Douglass burners, as this oil is no cheaper than cocoanut which has the great advantage of being perfectly safe.

Vegetable and Mineral Oils.

[*Translation.*]

Vegetable Oils.—Colza, Arachide (*a*), Olive, Linseed, Cocoanut :—

These different oils have been compared from the following points of view :—

1*st.*—The mean intensity given by the consumption of an equal quantity of oil in lamps of one or several wicks.

2*nd.*—The period of burning, *i.e.*, the time during which the lamp burns without trimming and without apparent reduction in the intensity of the flame.

3*rd.*—The resistance to freezing.

4*th.*—The price.

This last element of comparison varies according to the locality and the season.

Comparison between Vegetable Oils.—Colza oil according to Monsieur Reynaud has many advantages over all the other oils in two very essential respects, viz., intensity in a lamp of several wicks (*excepting cocoanut oil*), and non-liability to become viscous when the temperature falls.* *Olive oil* is a little better for burning in a single-wick lamp and very inferior for burning in a lamp with several wicks; it appears to undergo a rapid change in passing through the burner, and, getting very hot there, necessitates frequent trimming. *Cocoanut oil is excellent*, but commences to become viscous at 24° † degrees above zero. *Linseed oil* is very bad; it produces much char and cannot be used in lighthouses.

* This does not matter in India.

† 76° Fahrenheit.

Mineral Oils.—The essential difference between these oils and vegetable or animal oils is that the former are volatile while the latter are fixed, that is to say, that heat decomposes them without rendering them volatile.

The quantity of colza oil which it is necessary to burn per hour and per unit of light obtained in a burner, of the type adopted in lighthouses before the introduction of mineral oil, having two three or four wicks, varies from 37 to 33 grammes, the smallest consumption being obtained with the largest burner. The quantity of mineral oil which it is necessary to burn per hour in a burner having two, three, four, five or six wicks per unit of light obtained varies from 25 to 29 grammes, the smallest consumption being obtained with the smallest burner. At the same price there is therefore ‡ an advantage in using mineral instead of colza oil. The smaller price of the former makes the advantage still more marked and in all French lighthouses the old colza-oil burners have been replaced by burners with mineral oil with an extra concentric wick without increasing the cost of lighting.

‡ With the old burners.

At the present time perfected § *colza-oil burners are constructed in which* the consumption of oil per unit of light obtained is not greater (*b*) than in mineral oil burners.

§ The Douglass burner or new French burner.

(*a*) I cannot find the meaning of this word.

(*b*) This being the case, the choice between cocoanut and heavy mineral oil depends solely on price.

Note on letter, No. 1271–183 G., dated 15th July 1895, from the Presidency Port Officer.

(1) *Paragraphs* 1, 2, 3.—Call for no remark.

(2) *Paragraph* 4.—It will be observed—page 3, paragraph 8 (*a*), pages 13 and 14, Table I, page 22, Table VIII, and page 19, Table V, of report—that the difficulties brought to notice by the Presidency Port Officer were not lost sight of and only one rock lighthouse was included in the approximate estimate, viz, Sacrifice Rock. Lights on Mulki and Sacrifice Rocks must necessarily be more efficient than on the mainland and the choice of site in both cases merits further consideration. The towers are not likely to be built for a few years and the state of the sea during the monsoon might be observed, as, if a landing can be made about once a fortnight throughout the year, it will be sufficient. I doubt whether the state of the sea alongside either of the rocks is anything like as bad as at the Bishop Rock lighthouse, off the Scilly Isles, which is exposed to the full force of the Atlantic. This question does not affect the scheme to any material extent and need not be decided at once.

(3) *Paragraphs* 5 *and* 6.—Call for no remark.

(4) *Paragraph* 7.—*Vide* remarks, paragraph 4.

(5) *Paragraphs* 8, 9, 10, 11, 12, 13 *and* 14.—Call for no remark.

(6) *Paragraph* 15.—This remark is probably only intended to apply to the class and power of apparatus (*vide* page 34 of report).

(7) *Paragraph* 16.—Calls for no remark.

(8) *Paragraph* 17.—The light at Negapatam is of the same description as at other ports. I see no objection to the Presidency Port Officer's proposal*, neither do I see any advantage except further relief to Port funds. The light can perfectly well be looked after by the local authorities and the proposed "local" keepers (see page 11, paragraph 29, of report).

* Except that "Provincial" establishment will cost more.

(8-A) *Paragraph* 18.—The present light at Cuddalore is at much too great an elevation and the power is very small (red light). To instal one of the 4th-order fixed apparatus, which will, if the scheme is carried out, become available, and to convert it into occulting, is, in my opinion, advisable as the trade is considerable.

(9) *Paragraph* 19.—I do not think that the Presidency Port Officer realizes that to reduce the range at Seven Pagodas would probably result in no saving in cost. The tower is only proposed to be about 50 feet high and this height is required for the falling weight which drives the revolving apparatus. The general question of reducing the ranges of the proposed lights can be considered when the designs are prepared, but the saving would not be very great, as only one light would be affected for certain, viz., Point Calimere, and the saving at this station would be small, as the expense is chiefly in foundations. The usual practice is to enter the ranges in the light list on the assumption that the height of the observer's eye is 12 feet above water level, and this practice should not, I think, be altered in Madras without very good reason. Up to date the custom in this Presidency has been to place lights at excessive elevations and the advantage of now going to the other extreme is not apparent. It should be noted that at Point Divi and Sacramento Shoal I have already suggested that the heights of the towers should be reduced, but this is because a difficulty about foundations is anticipated and the less weight there is in superstructure, consistent with stability, the better.

(10) *Paragraph* 20.—I regret that the Presidency Port Officer should consider that my remarks on the Madras Lighthouse were captious, but I fancy that he is under the impression that the remark "the windows are not properly cleaned" referred to the lantern glazing. This is a mistake, as the remarks, Item B, page 35, Madras Lighthouse, refer solely to the *tower* windows. When I inspected the light the apparatus framing and lantern astragals had evidently not been cleaned for some time, though they would, no doubt, have been perfectly clean had the keepers been aware that I intended to inspect the light. I was not aware that the light was not in charge of a responsible person.

(11) *Paragraph* 21.—If the present Hope Island apparatus is moved to Pulicat, the large two-wick burners may just as well be transferred with it. There is, however, no urgency about this. This may be sufficient, at all events, for the present. I do not think any change is very necessary unless the light is converted to occulting, except perhaps as regards burner.

(11-A) *Paragraph* 22.—The existing clock-work can, I think, be repaired, as the Civil Engineering College has recently imported a machine for cutting teeth. The apparatus does not, at present, revolve properly because the teeth on the pinion, &c., were cut locally by hand and are not uniform.

(12) *Paragraph* 23.—Calls for no remark except that the efficiency of the light as a guide to mariners should, it is suggested, outweigh facilities of communication.

(13) *Paragraph* 24.—Point Divi light is a long way (10 miles) from Masulipatam and difficult to get at. The Presidency Port Officer does not say whether he proposes to maintain also the existing port light at Masulipatam (*vide* page 37 of report). This would be extravagant and neither of the lights would be in the best position for the purpose. A considerable expenditure would also have to be incurred on quarters for establishment if the present light at Point Divi is maintained. My proposal is in accordance with Mr. Douglass' recommendation. I do not see any advantage in maintaining the existing light at Point Divi.

(14) *Paragraph* 25.—Calls for no remark.

(15) *Paragraph* 26.—Need not be considered at present. Gas buoys are expensive—*vide* page 77 of my report on lighthouse construction and illumination.

(16) *Paragraph* 27.—The Presidency Port Officer has transposed the lights proposed by me. I suggested a 4th-order fixed light at Vizagapatam as the East Coast Railway are developing this port and a decent light should, in my opinion, be provided in the first instance. I would suggest that nothing be done towards providing temporary lights at these ports. Associated lights are always expensive and new apparatus would be required.

(17) *Paragraphs* 28 *and* 29.—Call for no remark.

(18) *Paragraph* 30.—If this is the case* the other similar port lights might be in charge of a single keeper. It won't do to suddenly rush to the other extreme. If the proposed scheme is sanctioned there will be plenty of changes in establishments without making more. At many of these ports the keepers are required for signalling and there are keepers available who will otherwise have to be pensioned.

*See note on Mr. Baddeley's Memorandum.

(19) *Paragraph* 31.—This statement should, I think, be received with caution. The necessary information from the Board of Revenue has not yet been received.

(20) *Paragraph* 32.—If the proposed lights on the West Coast are not provided, the scheme practically falls through. It is quite possible that reductions can be made in the estimate when prepared in detail.

(21) *Paragraph* 33.—The statement to which the Presidency Port Officer takes exception is, nevertheless, true. I don't think any lighthouse on the Madras coast can be placed in the same class as the Bishop Rock, Eddystone, Wolf Rock, Bell Rock, &c., where the rocks are covered at high water and the keepers have no place to take exercise except the lantern gallery or pedestal platform.

2. I don't understand the remark about steamers to land men near a railway, as with one, or possibly two, exceptions the proposed stations are on land. There are several steamers a week all round the coast and, as the Presidency Port Officer remarks in paragraph 37, railways are being rapidly extended in this Presidency.

3. The additional allowance of £25 for keepers while on duty at a rock station was not mentioned, as it does not seem necessary to adopt every detail of the Trinity House, Scotch and French Service Regulations; I also do not believe that any such allowance is given except in very special cases. The allowances in Scotland are very much less than £25 and no allowances at all are given for keepers employed at island stations such as Ailsa Craig.

4. I did not go into details regarding pensions but merely entered the contribution at the ordinary rate. The Presidency Port Officer probably alludes to an allowance of £18 per annum which is added to a light-keeper's pay in the Trinity House Service when calculating pensions, as, if not provided with quarters, this additional allowance would have been made for house-rent.

Whether any addition of this sort should be made is a matter for Government to decide. It does not seem necessary, however, to adopt every detail of the Trinity House Regulations as they have not been followed in other respects. Some addition might possibly be made to pensions in the case of men who have a clean defaulter's sheet at the time of retirement.

5. Please see page 9, paragraph 20, and page 22, Table VIII, from which it will be observed that compensation for dearness of provisions has been included at varying rates for all stations except Madras and Calingapatam, where no allowances seem necessary.

6. I also see no reason to give the present Superintendents anything beyond a personal allowance to prevent actual loss of pay. They might, however, be allowed to draw an increased pension. This would tend to make them more contented without upsetting the newly-recruited men.

7. Scavengers and water-men should not, I believe, be pensionable. Their pay may be charged to works or the keepers may provide their own scavengers and water-men and then there will be no probability of too many of these men being employed. In this case, the keepers should receive an allowance on the understanding that menial servants are not to enter the tower or store-rooms connected with it.

(22) *Paragraph* 34.— Please see page 11, paragraph 29. To carry out the suggestion made by Mr. Baddeley would complicate matters considerably and interfere with the proposed gradual handing over of port lights to local authorities. Besides, I do not think that it would increase the attractions of the proposed Provincial service to make men serve for some years on the pay proposed for "Local" keepers, while it would be manifestly unfair to allow Eurasian recruits for the Provincial service to absorb the better-paid appointments in the "Local" service. It should be remembered that it is not, as a rule, proposed to provide quarters for "Local" (native) keepers, while the Eurasian recruits for the Provincial service would have to be provided with quarters or granted an allowance while employed in the Local service. This would be a source of discontent among the native members of the Local service. The importance of reserving one service for Eurasians and the other for natives should also, I think, not be lost sight of. The men in the Provincial service have to live at somewhat isolated stations, and to mix up two classes of keepers, which would be the case if Local keepers are promoted to the Provincial service, is not likely to be a success from a social point of view. In the "Local" service I also would suggest that a certain number of appointments should be reserved for Muhammadans.

I do not think a lodging allowance is necessary. The pay of these men is proposed to be increased, and the less they are interfered with as regards quarters, the better. So long as the light is properly maintained, a "Local" keeper may live anywhere within a reasonable distance (so long as a man turns up for his work regularly I should say he lived within a reasonable distance) and the local authorities should be required to see that the light is properly maintained. If rules are made laying down a certain minimum radius within which a keeper must live, respectable men who have houses of their own will not come forward. When once the local lights are in order, I would suggest that they should be handed over to local authorities, under certain conditions as to maintenance, as soon as possible, wherever such authorities exist.

(23) *Paragraph* 36.—Please see page 7, paragraph 16, of report. I only proposed to provide inspecting officers similar to the Trinity House Superintendents and would submit that the present lighthouse mechanic is competent for one of these appointments. If not, I should say that the sooner his services are dispensed with the better. His duties are proposed to be strictly limited and he will be better employed than spending half his time kicking his heels in Madras without any specified duties. I see no advantage in making the mechanic Superintendent of the

Madras light with another Superintendent to take his place when his services are required elsewhere. It would simply mean divided authority and no responsibility, as was apparently the case when I inspected the Madras light—see paragraph 20. It is necessary to have men constantly paying unexpected visits to lights in order to keep the keepers up to the mark.

26*th July* 1895. (Signed) F. W. ASHPITEL,
Executive Engineer.

Order—No. 245, Marine, dated 8th April 1896.

The question of improving the coast lights of this Presidency has engaged the attention of Government for some years past. In G.O. No. 318, Marine, dated 10th August 1895, Mr. F. W. Ashpitel, who had recently studied light-house construction and illumination in Europe, was deputed on special duty to inspect all the lights along the Madras Coast, and report on their suitability or otherwise, their position, and the structures from which they are displayed. His enquiries were to extend to the consumption of stores, and the organisation and housing of the establishment.

2. The report recorded above has been submitted in compliance with these orders. It is, in the opinion of His Excellency the Governor in Council, a very complete and exhaustive document, and merits the thanks of Government which will be conveyed to Mr. Ashpitel through the head of his department.

3. It embraces the following proposals :—

(1) The division of lights into "Sea" and "Port" with the object of—
(*a*) gradually handing over those lights which are not required for general navigation to local authorities, such as Conservancy Boards, Landing and Shipping Dues Committees, &c., under certain conditions as to maintenance ;
(*b*) levying dues on the shipping for those lights which are useful for purposes of general navigation.
(2) The complete re-organisation of the light-house establishments, the provision of proper training for the men, and suitable house accommodation where necessary.
(3) The improvement of existing lights and the introduction of new ones.

4. His Excellency the Governor in Council doubts the utility of the proposed classification of lights, and is not inclined to agree in the suggestion that their management should be handed over to local bodies. It is considered essential that the management and control should remain with the officers of the Marine Department.

5. The proposal for the levy of special dues on shipping for the use of the lights is also, in the opinion of His Excellency in Council, open to grave objection, and he does not at present see his way to taking the requisite steps to give effect to a measure of this kind.

6. The probable expenditure necessary for the improvement of existing and the construction of new lights is given as Rs. 8,80,000. Of this sum, the proposed "Sea" lights absorb Rs. 8,00,000, of which Rs. 2,08,000 are for eight new sets of apparatus, Rs. 4,55,000 for improvements to existing towers and for new constructions, and the balance for contingencies and Public Works supervision. The annual cost of interest, Sinking fund and maintenance for "Sea" lights is estimated at Rs. 1,30,000, and Rs. 15,000 is the cost of maintenance for "Port" lights, or a total of Rs. 1,45,000 per annum for the maintenance of a total of 32 lights. To meet the capital cost for "Sea" lights it is proposed to raise a loan of 8 lakhs of rupees bearing interest at 3½ per cent. and to meet the annual charges for interest, Sinking fund and maintenance by the levy of light-house dues on shipping. As stated above the proposal to raise funds in this manner does not commend itself to Government. It thus remains to consider how the requisite funds can be obtained.

7. It is observed that the annual surplus from the Madras Port fund is under existing orders, handed over to the Harbour Trust Board. As the harbour will shortly be completed, it may be possible to divert these monies to the light service. The contributions for the past five years have been as follows :—

	Rs.
1891–92	50,000
1892–93	65,000
1893–94	20,000
1894–95	1,74,862
1895–96	44,075
Total	3,53,937

or an average of Rs. 70,000 per annum. As however the contributions for 1894–95 and 1895–96 are liable to be disturbed by adjustments, which have not yet been decided on, they will be excluded in fixing the average and the figures for the previous three years alone taken into account. The average thus arrived at will be Rs. 45,000. In addition to this amount, Port funds already contribute Rs. 55,000 a year for the upkeep of lights. There would thus be available a sum of Rs. 1,00,000 as against Rs. 1,45,000 required. The distribution of the amount estimated for "Sea" lights would be as follows on the supposition that the money required for construction is raised by loan :—

	Rs.
Interest at 3½ per cent. on Rs. 8,00,000	28,000
Sinking fund	19,500
Maintenance of lights	82,500
Total	1,30,000

8. The question of raising the requisite funds will be considered hereafter in the Financial Department. It is observed that the total balance (Government securities and cash) at the credit of Port funds on the 31st March 1896 is estimated at Rs. 6,73,000. Of this amount, Rs. 2,39,000 appertain to the port of Madras and may be left intact. The accumulated balances of the Eastern and Western groups may therefore be taken at Rs. 4,34,000 which could, if the funds of these two groups were amalgamated, be utilised, if necessary, for starting Mr. Ashpitel's proposals for light-house construction and illumination. There will still be required a sum of Rs. 3,66,000 to complete the scheme. It will not be wanted at once and, meanwhile, it may be assumed that further accretions to the surplus balances of Port funds will continue. It may thus not be necessary either to raise any loan or impose light dues. At all events the matter is not one which requires immediate action. If no loan is raised there will be a saving of Rupees 47,500 * in the estimated annual expenditure of Rs. 1,45,000 for maintenance, &c., of both sea and port lights, and the sum remaining to be provided for maintenance alone will be Rs. 97,500 † only.

	Rs.
* Interest on proposed loan of 8 lakhs.	28,000
Sinking fund	19,500
Total	47,500

	Rs.
† Maintenance of sea lights	82,500
Do. of port lights	15,000
Total	97,500

9. His Excellency the Governor in Council now proceeds to pass orders on the detailed proposals made in Mr. Ashpitel's report.

Paragrpah 8 (*a*)—*Mulki Rocks.*—For the reasons advanced by the Presidency Port Officer it is considered that a somewhat stronger light on the main land must be better than a weaker one on the rocks.

(*b*) *Sacrifice Rock.*—For the same reasons, the proposal to place the light on Cotta Point will probably be best.

(*c*) *Aleppi.*—The proposal to increase the speed of this light so as to make one revolution in two minutes is approved.

(*d*) The light on Tangacheri Point is approved as part of the general scheme, and the question of addressing the Travancore Government again on the incidence of the charge will lie over for the present.

(*e*) *Point Muttum.*—An increase to the power of the Muttum light during thick weather should be made. The present four-wick burners can, as suggested by the Presidency Port Officer, be used with one of the new third order lights, but before doing this, the ventilation should be improved.

(*f*) *Manapaud.*—The installation of a third order flash light on Manapaud Point should be taken in hand at once. The requisite plans and estimates will be prepared by the Public Works Department in communication with the Presidency Port Officer and Mr. Ashpitel.

(*g*) *Pamban.*—The class and power of apparatus of this light are considered sufficient.

(*h*) *Point Calimere.*—The new light recommended at this position is considered suitable, but its installation is not a matter of urgency.

Negapatam.—The proposal to increase the power of the Negapatam light, which is a land-fall light for vessels from the Strait Settlements, is approved.

(*i*) *Seven Pagodas.*—The new eighteen mile triple flashing light proposed is approved. The details of height and position of the tower will be worked out by Mr. Ashpitel and the Presidency Port Officer, and an estimate submitted with the least possible delay. The matter is one of urgency.

(*j*) *Madras.*—No alterations are required here.

(*k*) *Pulict.*—The proposal to utilise the present Hope Island light at Pulicat is approved. The existing burners are, however, in the opinion of the Presidency Port Officer, sufficient, and this opinion is accepted. The question of porviding an occulting shutter can be deferred as proposed.

(*l*) *Armeghon.*—The present apparatus is reported to be sufficient, but it is recommended that the range be increased to 15 miles, when the weather is misty, by installing a three-wick burner. This recommendation is approved. The present clock work should be repaired at the Workshop of the College of Engineering, if possible. If not, it should be renewed.

(*m*) *Point Divi.*—The existing light is reported to be very inefficient owing to wrong location. A new light from the False Point near the sea is recommended. This is approved, but the choice of site will require very careful consideration by the Presidency Port Officer. The efficiency of the light as a guide to mariners should outweigh disadvantages of communication from the mainland.

(*n*) *Hope Island and Vakalapudi.*—The lights at these places have been installed to mark the dangers to navigation off the Sacramento Shoal and Gódávari Point, and to light the approaches to Cocanada. The existing light at Hope Island is said to be inefficient. It fails to cover the Sacramento Shoal, while that at Vakalapudi appears to be sufficient, but its range requires increasing to about 15 miles by installing a three-wick burner during misty weather. It is said that if a new eighteen mile light be installed on the mainland opposite Sacramento Shoal, the ranges of the two lights will cut in 30 fathoms off Coringa, and the approaches to Cocanada will be efficiently lighted. This proposal is approved. The question of the best site for the permanent light is under consideration and should receive careful and very early attention. Meanwhile, arrangements have been made for the exhibition of a temporary light opposite the Sacramento Shoal.

(*o*) *Santapilli Rock.*—The existing light is 6 to 7 miles from the shoal. The proposal to instal a more powerful burner is approved. The ventilation of the lantern should also be attended to. The Presidency Port Officer points out that any attempt to mark the shoal by a light would involve quite a prohibitive expenditure, having in view the tonnage of the shipping that could be expected to contribute.

(*p*) *Kalingapatam.*—This light marks a reef of rocks which extend about half a mile seaward. A new fourth order occulting light has recently been installed here, and nothing further is required.

Paragraph 9.—Mr. Ashpitel here gives his reasons for recommending lights of the flashing type in preference to fixed or occulting lights of a corresponding order. There seems no doubt that the flashing lights are to be preferred for landfall lights, if they can be afforded.

The suggestions made in Mr. Ashpitel's notes of inspection should be carefully considered by the Presidency Port Officer and, subject to the special orders given in these Proceedings, carried out in due course wherever practicable.

Paragraphs 10 *to* 21.—This portion of the report is taken up with discussing the present and proposed organization of establishment. The recommendations made may be thus summarised. The whole establishment to be re-organized, and two separate services formed for "Sea" and for "Port" lights, respectively,—the former to be a "Provincial" service and to consist of Eurasians on higher rates of pay; the latter a "Local" service with natives on lower rates. The men forming the Provincial service to be either carpenters or mechanics, and the men of both services to be specially trained for their duties. To supervise this establishment two inspecting officers are to be appointed—one for the East and the other for the West Coast; these men to be properly qualified mechanics, who have received a special training and have actually had charge of a light. As regards the educational qualifications of the light-keepers, it is not considered necessary to insist on more than a knowledge of reading, writing and arithmetic, sufficient to enable them to keep the requisite store-books and journals,—the great *desideratum* being reliable working men. Tables II and III give the rates of pay proposed for the two light-house services, and table IV shows the rates given in the Trinity House and Scotch Services.

10. His Excellency the Governor in Council is satisfied as to the necessity for an early re-organization of the light establishments of the Presidency and is willing to consider proposals based on Mr. Ashpitel's scheme. The Presidency Port Officer will accordingly submit a proposition statement in the prescribed form to show the financial effect. The question as to dividing the establishment into a Provincial and Local service cannot be accepted at present. Meanwhile the men can form one body of various grades, the higher of which would be posted to those lights which are most important and have the most complicated apparatus. There seems no reason to suppose that men of the requisite qualifications cannot be obtained. It is possible that suitable recruits can be drawn from the Lawrence Asylum, or the Industrial school; or that the President of the Eurasian and Anglo-Indian Association may be able to afford assistance in the selection of men. The Presidency Port Officer will institute further enquiry on this point and will carefully consider the measures requisite to give effect to the proposal for the training of the men in the duties which they will be expected to perform. Some latitude as regards examination rules will be allowed, but a certain educational standard is necessary to attend to correspondence and maintain the requisite forms and store accounts.

11. The Presidency Port Officer agrees generally with the adoption, as proposed by Mr. Ashpitel, of the Trinity House system of maintenance, altered to suit local conditions, but suggests alterations in detail, and is at variance with that officer on the proposed method of inspection.

12. The Presidency Port Officer's proposals as regards the inspecting officer are not considered feasible. The men to be appointed under Mr. Ashpitel's scheme would be superior mechanics only, and their inspections would be merely of a technical character, and would ensure this portion of the duty being properly attended to, instead of being much neglected as under the present system. But the existence of these inspectors would not interfere with the responsibility of the Port officers, which would continue *pari passu*. It is quite possible that a somewhat higher rate of pay than that proposed may have to be given for properly qualified inspectors, but on the other hand, if all the men, instead of being divided into two separate classes, are brought on one scale, it will be possible to secure a satisfactory flow of promotion on lower salaries than those proposed by Mr. Ashpitel. The question should be further considered by the Presidency Port Officer in drawing up the proposition statement.

Govt. of {1896} Madras.

MARINE.

Dated April, 8th.

Read. Encl.

G.O. No. 245, 8th April 1896.

APRIL.

Light-houses

Orders reviewing a report by Mr. F. W. Ashpitel on the — in this Presidency.

Govt. of {1896} Madras.

MARINE.

Dated April, 8th.

Read. Encl.

G.O. No. 245, 8th April 1896.

APRIL.

Light-houses

Orders reviewing a report by Mr. F. W. Ashpitel on the — in this Presidency.

(*d*) Ventilation at most towers is very defective. Mr. Douglass in his report recommended that the floors of the lanterns should be fitted with open gratings and the pedestals with larger hit and miss valves. He further recommended the improved circular ventilators now adopted by Trinity House, and that the tower windows should be of adequate size, well arranged, fitted with opening sashes and easily accessible from the stairlandings and steps. In carrying out these instructions all that has been done is to replace the close boarded floors of lanterns with open gratings and the necessity of glazing the existing loopholes and otherwise providing means of regulating the draughts has been entirely lost sight of, as also Mr. Douglass' remarks that all lighthouse towers and lanterns should be rendered, as far as possible, fire-proof. The result of the so-called improvement in ventilation has been, therefore, to admit draughts to the lantern which the keepers can only regulate by resorting to the objectionable practice of placing sacks on the floor. Every tower in the Presidency is now almost as badly ventilated as when Mr. Douglass made his inspection, and the alterations made have been partly responsible for the reported breakage of cylinders. At some stations wooden lantern floors are still retained. It will be noted that in his report Mr Douglass remarked that the want of provision for regulating the currents of air through the structures and lanterns for efficient ventilation and for the perfect combustion of the flame was one of the most noticeable features in the lights of this Presidency, and this is still the case.

(*e*) More care requires to be taken to determine the temperature inside a lantern. At present the thermometer is sometimes attached to the apparatus, sometimes to a lantern bar and sometimes to the lantern pedestal with the result that the readings obtained are very unreliable. I would suggest that the thermometers should be placed similarly in each lantern as otherwise any comparison of the temperature at different stations is impossible. The best place to attach a thermometer is, probably, near the top of the pedestal inside the lantern with another thermometer outside, so that the temperatures inside and outside the lantern can be compared.

Lights and Apparatus.

4. (*a*) The burner now generally in use is the Trinity House Douglass burner with a constant level lamp of the ordinary pattern. When I was in France I saw an improved lamp, now in use in the French service, a description of which will be found in the report which I submitted to Government some two years ago. I am inclined to think that it is a pity the French burners and lamps have not been given a trial in this Presidency as, owing to their facility of management, they are more suitable for use by native keepers. The French constant level lamp is so superior to the type now in use in this Presidency that I have no hesitation in recommending its adoption in future for use with all burners which do not require a large overflow. The old Duplex burners, of which there are a large number at the various stations, might be useful in the Government offices in Madras. They are of no use at the stations and only give the keepers additional work to keep them clean.

(*b*) The adjustment of the new burners has been left to the lighthouse mechanic who has fixed them at the same level as the old cocoanut oil burners. The difference is in some cases not very considerable, but he should be instructed to re-adjust them, according to the diagrams of flame, the next time he visits the lights. It was impossible to adjust the burners during the recent tour of inspection, as they are fixed in such a way that to alter them would take a considerable time, and also for want of tools and appliances. At every light the necessary tools should be kept and especially a spirit level for levelling the burner. Some of the ventilator tubes have been fixed out of plumb and should be rectified the next time the light is visited by the mechanic.

(*c*) The keepers do not understand how to trim their burners. They should be taught to burn them off after using the scissors or when much charred.

(*d*) In some lighthouses the keepers have complained that the cylinders often break in the early morning. This may be due to the flame being suddenly lowered and draughts of cool air admitted to the lantern. The flame should be gradually lowered and the cylinders, at all events the larger sizes, kept in a felt lined box when removed from the burner. The breakage, however, generally appears to be partly traceable to defective ventilation.

(*e*) The burners are cleaned with bath-brick, and in order to remove the discoloration and char from the tips without much trouble the bath-brick is not powdered finely enough, with the result is that the tips are rapidly wearing away. They should be cleaned every morning with oil as soon after the light has been extinguished as is possible, and, when much encrusted, may be boiled in water in which potash has been dissolved.

(*f*) The putty which holds the prisms and lenses of apparatus in position is, in many cases, shaken. The lighthouse mechanic should be instructed to repair all defects the next time he visits the lights. He should not, however, be allowed to remove and replace any of the glass.

(*g*) With regard to the consumption of oil, the chief thing noticeable is the great uniformity. The two wick burners apparently consume considerably more than the consumption laid down by Trinity House, and the four wick burners considerably less. Inspecting officers should carefully test the consumption, when they visit a station at night, with special reference

to the height of flame maintained. There is, however, no need to cut down the consumption of the two wick burners if it is found to be as stated. The great uniformity may be due to the system of calling for an explanation if the returns show variation in the nightly consumption of oil. The small consumption of the four wick burners is probably due to the flames being kept low, as was the case when I visited Santapilli. This is partly due to want of ventilation.

Service and Store-rooms.

5. The spare gear and stores at the various stations are not kept as carefully as they should be, and the keepers receive but little encouragement to keep their stores neatly. Mr. Douglass remarked in his report on the inadequate accommodation for storing spare burners, tips, &c., at the several establishments and recommended a glazed cup-board fitted with shelves, properly arranged for holding the burners in a vertical position. It is true that cup-boards have been provided but, as a rule, of the cheapest description and not arranged as recommended. The keepers are also not nearly careful enough in keeping the stock of wicks free from dust and damp; neither do they take sufficient care to keep the leathers and cloths, used for cleaning the apparatus, free from grit. They have not, in some cases, been instructed in the use of the various stores supplied to them.

Oil Store.

6. The oil store is generally a room at the base of a tower or in the block of buildings used as keeper's quarters. It is often also used as the watch room. The oil is partly stored in cisterns and partly in the tins in which it is received from Europe, and in many cases no attempt has been made to either ventilate the store-room or make it fire-proof. Mr. Douglass recommended that at least six months' supply of oil should be stored in iron or steel tanks, tinned internally, fitted with proper draw-off taps, with tight-fitting covers and mounted on stone or slate benches. Tanks have been provided to the extent recommended by Mr. Douglass, but in many cases the draw-off taps are at too high a level and, for slate or stone benches, wooden stands have been substituted. The wooden stands should be removed and stone benches substituted and means of ascertaining the quantity of oil in a tank provided. This may either be done by a tell-tale, a gauging rod, or by a glass gauge fixed to the side of the cistern. Mr. Douglass, used to the large consumption of oil at Trinity House stations, did not probably mean to be taken too literally in his recommendation to limit the capacity of oil tanks to six months' consumption of oil. To avoid the expense of constantly moving small quantities of oil, the capacity of tanks at most stations may be increased to 18 months' consumption. No oil should be stored in the tins in which it arrives from Europe.

Oil.

7. The price of oil used for light house purposes in this Presidency is said to be Rs. 1-3-0 per gallon against a price in Europe of $5\frac{3}{4}$ pence. The difference is so large that it may be worth inquiring whether, in the event of the proposed "Provincial" lights being constructed, oil cannot be procured at a cheaper rate elsewhere. At the time of my visit to Cuddalore two cases (20 gallons) of oil had just been received direct from Europe and I was informed that the freight alone on this small quantity amounted to £1-1-0, or to nearly Re. 1 per gallon. It may be, therefore, that the system of procuring oil in small quantities, separately for each light, is responsible for the high average cost. A system of obtaining 18 months' supply and distributing it from certain centres, say Madras and Cocanada on the East Coast and Cochin on the West coast, might prove more economical.

Forms.

8. The question of reducing the number of forms which a lightkeeper has to fill up may be considered. Weekly returns might be abolished.

Apparatus Coverings.

9. Mr. Douglass in his report recommended that in all lanterns the optical apparatus should invariably be covered between sunrise and sunset with a brown holland cover, and the lantern curtains properly hung. This recommendation has not been carried out as coverings and curtains of the cheapest white dungaree are still used. The object of specifying brown holland is that the smooth surface and light colour reflect the heat rays.

*Lightning Conductors.**

10. In 1889 Mangalore Lighthouse was struck by lightning and two men within the tower were struck, one being killed. This was attributed to faulty earth-connections and a large estimate was sanctioned to take the conductor to water distant $1\frac{1}{3}$ miles from the tower. It seems probable, however, that the accident was really due to a side flash from the conductor to a coil of wire in the building. In 1888 Professor O. J. Lodge delivered a series of lectures on lightning

* On the subject of Lightning conductors I have consulted Mr. R. St. Jones, Acting Government Astronomer, who has given me much assistance.

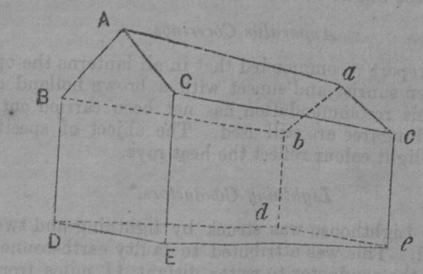
conductors and guards (which with other kindred matter he brought out in the form of a book in 1892) which appear to upset many of the accepted ideas regarding lightning conductors and to render a reconsideration of the method of protecting lighthouses from lightning advisable, not to say imperative.

According to the generally accepted theory, a lightning conductor is a conduit for conveying a certain quantity of electricity from clouds to the earth, and, in spite of accidents to protected buildings, its upholders maintain that all that is necessary is to provide a big enough channel, as it were, through which the discharge can take place and that a conductor will be efficient provided its resistance be small. Professor Lodge points out that these conclusions would be perfectly correct if the lightning discharge was steady. But, as a matter of fact, it is essentially a varying one and in the majority of cases oscillatory. The current rises from zero to a maximum, dies away to zero, reverses, and attains a maximum in the opposite direction, dies away to zero again, and so on several times before the whole energy is dissipated. All this may take place in an extremely small interval of time Now the behaviour of varying and oscillatory discharges is very different from the behaviour of a steady discharge, because, in the former, electrical inertia is a factor of the first importance. It is not therefore sufficient merely to consider the ohmic resistance of a lightning conductor. The effect of the various factors in determining the path and character of a lightning discharge is entered into fully by Professor Lodge in the volume mentioned above, and the conclusions which he draws are supported by experimental evidence, also fully given, and described in the volume. These conclusions are appended.

But one point to which he draws attention I would mention here. The function of a lightning conductor is to afford a safe and sure means of dissipating a certain amount of energy by providing a suitable path for the discharge. To do so suddenly is by no means the safest way and to provide the discharge with a path along a thick copper conductor may be a positive disadvantage on account of the violent surgings which may take place in it. As Professor Lodge remarks:—

"A thin iron wire is nearly as good as a thick copper rod; and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy and tends to damp out the vibrations sooner. Owing to this cause a side flash from a thin iron wire is actually less likely to occur than from a stout copper rod."

It is impossible to give in full the reasons Professor Lodge gives for his conclusions, but it appears that, in his opinion, so far as high towers are concerned, the best way to protect them from lightning is to fix four iron wire rope conductors, connected at intervals by horizontal bands of wire, each conductor being provided with a separate earth, as good as can be obtained at a reasonable cost, and not necessarily taken down to water. The lantern dome may also be studded with numerous small points. A lighthouse protected in this way, would, it is suggested, be comparatively safe and, even if there are considerable masses of metal within the tower, side flashes are improbable and separate earth connections inadvisable. This system of protecting buildings, with the exception that Professor Lodge shows that the use of copper is a needless expense, is practically the same as that advocated by Professor Clerk Maxwell who says: (*vide* Lightning Conductors by Richard Anderson, page 168) "my plan is to convert a building into a closed conducting vessel by a sufficient number of wires enclosing it. For an ordinary house a skeleton of its edge is quite enough. Aa may be a zinc ridge, Bb and Cc water gutters of zinc or iron; but the pieces ABD, ACE and the circuit DEed should be of stout copper wire or rope built into the wall as a security against theft, but connected to every other piece of metal on the outer surface of the house, and to every gas or water pipe which enters the house from without, but not to any masses of metal wholly within the whole, unless this is desirable for other purposes."



Professor Lodge arrives at certain conclusions from which the following are extracted to show what radical changes will be necessary in the method of protecting buildings from lightning if, as seems inevitable, his deductions are accepted. The subject is of considerable

importance as according to his conclusions none of the towers in this Presidency are, at present, efficiently protected.

Statements made by Professor Lodge regarding the protection of buildings by lightning conductors—

(1) "All parts of a lightning conductor, from points to roots, should be of one and the same metal to avoid voltaic action.

(2) Joints should be avoided when possible, and should be made substantially when necessary. Allowance for expansion and contraction must not be forgotten.

(3) Sharp bends, and corners, and curves, and round about paths to earth should be avoided as far as possible.

(4) The use of copper for lightning conductors is a needless extravagance.

(5) Iron has advantages over every other metal.

(6) The shape of cross section is but little matter, flat ribbon has a slight advantage over round rod, but not enough to override questions of convenience.

(7) Liability to be deflagrated by a powerful flash determines the minimum allowance for size of cross-section. No consideration of conductivity and greater ease of path has the least weight in this connection.

(8) It is hopeless to pretend to be able to make the lightning conductor so much the easiest path that all others are protected. All possible paths will share the discharge between them, and a lot of apparently impossible ones.

(9) A good and deep earth should in general be provided, independent of water and gas mains.

(10) If the conductor at any part of its course goes near water or gas mains, it is best to connect it with them.

(11) If the place to be protected has water or gas pipes inside it, the conductor should be connected to their mains under ground.

(12) At all places where water and gas pipes come near each other, and, in general, wherever one metal ramification approaches another, it is best to connect them metallically.

(13) The neighbourhood of small-bore fusible gas pipes and indoor gas-pipes in general should be avoided in erecting a lightning conductor.

(14) Into powder magazines and such like places no gas or water pipes should be permitted to enter, unless the whole building is made of metal, and they are elaborately connected to it at the point where they enter.

(15) It is not wise to erect very tall-pointed rods above the roof of a building.

(16) A number of points all along the ridge of a roof is better than only a few.

(17) Any part of a building is liable to be struck, and to make quite secure, every prominent part of the outside should have a rod running along it.

(18) Earth-connected as well as insulated bodies are liable to spit off sparks.

(19) No complete security can be attained unless the whole building be metal-lined, floor and all.

(20) In ordinary houses it may be well to try and insulate the lightning conductor from the walls so as to lessen the chance of side flash to metal stones and things inside.

(21) In chimneys it may be well to use insulators to protect the bricks from concussion.

(22) The cheapest way of protecting an ordinary house is to run common galvanized iron telegraph wire up all the corners, along all the ridges and eaves, and over all the chimneys; taking them down to the earth in several places, and at each place burying a load of coke. Rain-water spouts and other outside metal, if all well connected together, may likewise be utilized.

(23) Connecting a lead roof or other such expanse with a lightning conductor is not an unmixed good, for it virtually increases the dangerous proximity of the lightning conductor, and may inadvertently bring it near to many objects which else might have escaped.

(24) One of the most difficult thing is to know what to connect and what to avoid.

(25) The orthodox rule, "connect all pieces of metal to the lightning conductor" requires modification thus:—

Connect all pieces of metal to each other and to the earth, but not to the lightning conductor (?)

(26) It may be always reckoned safe to earth things independently. It is often not safe to connect them to the lightning conductor, *e.g.*, an inside lining of a chimney should be well earthed, but should not be used as lightning conductor nor connected with it. The same with rain-water pipes and gutters. The same also, probably, with lead roofs (?)

(27) In connecting pieces of metal to each other, if they happen to form a nearly closed circuit, the circuit should be metallically completed.

(28) Over the top of tall chimneys it is well to take a loop or arch of the lightning conductor made of any stout and durable metal.

(29) Lightning conductors should be always outside and easily visible.

(30) A conductor detached from the building to be protected is safer than one in close contact with it.

(31) For powder magazines and such-like, an outer cage surrounding the building, with sky points and earth roots, and an inner cage on the building, with independent earth terminals only, is the safest plan.

(32) If under these circumstances there be no gas-pipes nor much ramifying metal work inside the building, and no metal at all going near either cage, the interior may be considered perfectly safe.

(33) The inner cage may often be conveniently made of continuous sheet iron. The outer cage need not then be at all small-meshed; in fact, it need be little more than a dozen vertical conductors.

(34) The resistance of an earth may be tested in the customary way to guard against actual breaches of contact by rust or workmen; but no overweening confidence must be felt, however small the resistance turn out to be.

(35) A Wimhurst machine and couple of Leyden jars afford a convenient mode of testing a conductor for flagrant defects. The testing should be done in the dusk or in moonlight, so that there may be light enough to work by and yet sparks be visible.

(36) Telephones are the handiest things to detect electric surgings in conductors inside the house while discharges are being made to the conductor. But vacuum tubes, gas leaks, Abel's fuses, &c., &c., can also be employed.

(37) Another mode of testing can be carried out on an insolated rod, with an induction coil and spark gap after the manner of a great Hertz oscillator. This is probably the most searching plan. Sparks will then be probably obtained from all the gas-brackets, water-taps, and picture-rails in the house.

(38) Telegraph stations, and houses supplied with electricity from overhead wires, should have an efficient lightning protector at the place where the wires enter the house.

(39) When a number of houses are wired up together for lighting, even by underground wires, it may be well to disconnect them by means of intervening lightning protectors; on the principle of fire-proof doors.

(40) A central lighting station, having a tall chimney connected to its boilers and dynamos, should be, by a lightning protector, disconnected from the leads which carry the current from it; because a small fraction of a stroke getting into the leads might destroy a number of lamps, especially if they were already working at something like their full power.

(41) Telephone arrangements, and any long length of close-packed insulated wires (even underground), should be protected by lightning protectors, else the insulation is apt to be sparked through and spoiled."

Occulting Lights.

11 In the list of existing and proposed lights (Table I) red as a distinctive character has been retained at certain stations, but distinction by colour can be altogether avoided by converting these lights into occulting. The occulting system which is probably most suitable is the Lindberg Trotter as modified by Mr. Wigham. This system is self-acting, affords a variety of occultations and can be fixed to existing apparatus at small cost. I cannot, however, recommend the adoption of self-acting occulating apparatus until it has been subjected to a prolonged trial and its success is assured, as, under certain conditions, it has been known to fail.

Meteorological Observations.

12. It seems possible that lighthouse establishments might, with advantage, be made use of to record meteorological observations, especially at stations near a Post or Telegraph Office. The keepers might be trained for this duty before admission to the service and should submit their returns direct to the Meteorological Department. The reading of simple instruments, such as thermometers, barometers, anemometers and rain-gauges, would not entail much additional work and the results might be of considerable value.

Madras,
22*nd June* 1895.

F. W. ASHPITEL,
Executive Engineer,
on Special Duty, Marine Dept.

APPENDIX B.

Details of visits to Lighthouses.

Kundapur.

(*a*) The location, near the south boundary pillar of the port, is satisfactory. The light is wrongly described in the light list.

(*b*) The cabin and mast are well founded and maintained. A mark should be made on the hoisting chain to show when the apparatus is in position. A small drain is also required in the floor to get rid of water which may leak through the opening in the roof or which has been used for cleaning purposes.

(*c*) The optical apparatus is a sixth order port light (lenses only) with a silvered spherical mirror in rear of the flame. The height of focal plane above H.W.L. is said to be 56 feet and not as entered in the light list.

(*d*) Stores are kept at the Customs House distant $1\frac{3}{4}$ miles from the light. Oil and general store-rooms are required at the station.

(*e*) There are no quarters available for the establishment. Quarters should be provided as there is no village near.

(*f*) A well is required, but care must be taken when selecting a site, as most of the water in the neighbourhood is brackish. The fishermen obtain water from shallow surface wells and probably a deep well would be a mistake.

(*g*) A lightning conductor fixed to the foot of the mast and connected with the cabin is advisable.

Mulpy.

(*a*) The location answers sufficiently well for the present anchorage, but a better site would be on the beach near the north bounding pillar of the port or on one of the islands. The light is obstructed by trees between north through east to south and does not show over the anchorage marked on the chart which is, however, not used by the vessels which now visit the port; some trees near the light require trimming.

(*b*) The cabin and mast are well founded. A mark should be made on the hoisting gear to show when the apparatus is in position. The cabin has recently been painted, but care had not been taken to remove rust before applying the new coat. A drain is required in the floor.

(*c*) The optical apparatus is similar to that installed at Kundapur. The height of the focal plane is 53 feet above the cabin floor.

(*d*) The stores are kept in the Custom House and this arrangement is convenient and need not be interfered with.

(*e*) The light is near the village and no quarters are required. The keepers use the verandah of the Custom House as a watch-room.

(*f*) Water-supply is good.

(*g*) A lightning conductor is advisable as at Kundapur.

Barkur.

A light is required at this port, the trade of which is said to be considerable. The sixth order port light now at Point Calimere will answer well and may be located to the north of the bar (See also Point Calimere).

Mangalore.

(*a*) The tower is located on a hill above the town and the focal plane is 240 feet above high water-level. As previously remarked this elevation is much too great and the best part of the light is wasted on the sky and of no service to the mariner. With the proposed light at Mulki, it will be better to abandon the existing tower which is of very inconvenient design and to re-establish the light on a small tower near the sea and at a lower elevation. The change need not, however, be made until the scheme for the improvement of Mangalore harbour is sanctioned.*

(*b*) The tower is 65 feet high and only 4 feet internal diameter. Access to the lantern is by an extremely inconvenient arrangement of ladders. So inconvenient is this arrangement that if the Inspecting officer happened to be stout it would be extremely doubtful whether he could manage to climb up into the lantern. The lantern is carried on a wooden gallery which, as Mr. Douglass remarks, exposes too great an area to the wind during stormy weather, causing the lantern to vibrate and water to be driven through the glazing. Several of the lantern panes are now broken.

(*c*) The optical apparatus is efficient for a port light, but it is not of sufficient power for the height from which it is exhibited. It is in good order, but the burner requires adjusting.

(*d*) Stores are well maintained, but the arrangements are not satisfactory.

(*e*) Quarters have recently been constructed for the establishment, but the keepers refuse to live in them. The design and site are both, in my opinion, unsuitable, as a road runs close in front and there is no screen wall. If the light is moved, these buildings will no longer be required and can be used for some other purpose. It is unnecessary, therefore, to suggest alterations.

* It is presumed of course that a scheme will be sanctioned within a reasonable time.

(*f*) The water-supply is from a well about $\frac{1}{4}$ mile distant.

(*g*) An estimate amounting to Rs. 3,000 has been sanctioned for a lightning conductor with an earth connection $1\frac{1}{3}$ miles long. This estimate might be held in abeyance until the question of a new tower has been decided. In any case the value of an earth connection $1\frac{1}{3}$ miles long seems doubtful, and if, as was suggested, the idea is to connect all the Public buildings in the town to the lighthouse lightning conductor, it is not evident why Port Funds should bear the cost. The original cost of the tower was only Rs. 1,054-7-5 and to spend Rs. 3,000 on a lightning conductor seems out of all proportion. The existing conductor is of $\frac{1}{2}$ inch copper wire rope attached to the lantern pedestal and joined, at the foot of the tower, to a galvanized iron wire $1\frac{1}{2}$ inches diameter, the earth being buried in the ground 60 feet deep. This conductor was tested by an assistant in the Telegraph Department and condemned because the resistance was too high. It is said, however, that the joints were not separately tested and therefore the high resistance may be partly due to defective joints. It seems possible, however, that this high resistance is no great disadvantage and that the alterations to the conductor should not take the form of providing a better earth connection—*vide* Appendix A, paragraph 10.

(*h*) The ventilation is defective. It would be improved by inserting gratings in the floor with means of regulation.

(*i*) The oil cisterns provided have a total capacity of 120 gallons. It would be better to provide storage for at least one year's or, better still, 18 months' supply in order to avoid the necessity of frequent supplies of small quantities of oil. To store quantities of oil in the tins in which it arrives from Europe is not advisable.

Cannanore.

(*a*) The location is suitable, but the elevation is excessive. The light may be dipped if the existing apparatus is retained.

(*b*) The tower is a circular building on the fort rampart and could be easily improved. All that is required is to provide a light room and means of lowering the apparatus into it for cleaning and lighting. The lower part may be used as a watch-room with access to the light room.

(*c*) Stores and oil should be kept in one of the vacant buildings in the fort.

(*d*) The apparatus is a sixth order fixed port light (lenses only) with a spherical silvered mirror in rear. The lenses are damaged. The burner, a Hinks Duplex, is out of order. The light has a range of about six miles which is insufficient. One of the spare fourth order fixed apparatus which will become available may be installed at this station on the existing tower, the height of which may be reduced.

(*e*) Quarters for a signaller adjoin the tower. The light and signalling establishment may be amalgamated, as, with the proposed increased number of keepers required for the new light, there will be no necessity for extra establishment. A watch-room was recently constructed and proposals made for converting a part of the old fort jail into quarters. The old jail does not seem very suitable and quarters do not appear to be necessary as the light is close to the town.

(*f*) When the light is improved the number of oil cisterns should be increased to a total capacity of 18 months' supply.

Tellicherri.

(*a*) The location is suitable, but the elevation is too great for the power of the light which may, however, be dipped. The tower may also be lowered.

(*b*) The light is exhibited from the roof of a small square tower which is of very inconvenient design. The arrangements can be improved by providing means of lowering the apparatus into a service room for lighting and cleaning purposes. Access to this service room should be by a stair case inside the tower. The base of the tower can be used as a watch room.

(*c*) The apparatus is a sixth order port light (lenses only) and is protected by a wooden shelter. With the new light on Sacrifice Rock and the improved light at Kannanur the light at Tellicherri may be coloured red (See appendix A, paragraph 11) to prevent confusion with other lights on shore or with ships lights. The lenses are chipped. The burner is in good order.

(*d*) Stores are kept at present in the Port office and in the base of the tower. They should be moved to one of the vacant buildings in the fort as the room in the base of the tower will be required for a watch-room and the Port office is at a considerable distance from the station.

(*e*) Quarters for establishment consisting of two rooms, with cook-rooms in a separate building, have recently been constructed. The design is, in my opinion, unsuitable, and the keepers do not live in them. All that is required, however, is to add screen walls and as far as possible to assimilate the design to that ordinarily sanctioned for Police lines. Keepers of different castes will not live in single room dwellings with no privacy. It is doubtful whether quarters were really necessary at this station which is within the fort and close to the town. The cook-rooms may, if the dwellings are altered as suggested, be converted into oil and general store rooms.

(*f*) Water-supply is good.

(*g*) The capacity of oil tanks is sufficient.

Calicut.

(*a*) The location is on the beach and is satisfactory. The elevation is too great for the power of the light and when improved the tower may be lowered.

(*b*) The tower is 98 feet high and 4 feet internal diameter. Access to the light room is by a very inconvenient arrangement of ladders. An iron spiral stair case should be substituted. This will not cost much if the tower is lowered as suggested.

(*c*) The optical apparatus, a fourth order fixed apparatus, is efficient as a port light. The burner is a little low and the pipes are leaky. The ventilator tube is a little bent.

(*d*) Stores are kept in the Port office. They should be kept at the station.

(*e*) An estimate has been sanctioned for Rs. 2,350 for quarters for the light-keepers. The space available is very small and quarters do not appear to be necessary. The tower is in the town and it is doubtful whether the keepers would occupy quarters if constructed. There is a watch-room.

(*f*) Water-supply is good.

(*g*) There are two lightning conductors to this tower.

(*h*) The ventilation is bad. About a year ago gratings were fixed in the light room floor, but no means of regulating the draughts provided. This should be attended to.

(*i*) The capacity of oil cisterns should be increased.

Narakal.

(*a*) This light is exhibited from a flagstaff at the mouth of a creek, five miles north of Cochin, at a place where considerable quantities of goods were at one time landed and shipped during the south-west monsoon. Owing to the movement of the mud bank, which has necessitated the abandonment of the old landing place at Narakal, shipping operations are now carried on at Mallipuram, two miles from Cochin. The port of Narakal, in which Mallipuram is included, is, however, kept up as the anchorage for steamers calling at Cochin during the south-west monsoon, as, owing to the mud bottom, the sea is smooth when the Cochin anchorage is too rough for boats to lie alongside a ship. For the use of the port, the Cochin Government levy port dues which amount to a considerable sum, and, therefore, the light is, and should be, maintained by that Government.

The Cochin light is close by and all that is required is a small port light. A cabin and mast red light would answer well and may be located on the beach at Mallipuram. The existing light is exhibited from a flagstaff and consists of a duplex burner with an elliptical reflector in rear. The burner obstructs the greater part of the rays of light from the reflector below the centre of the ellipse, and the reflector scatters the light in all directions. A certain amount of correspondence has taken place with the Resident in Cochin and it is believed that the Cochin Government are quite prepared to improve the light. A range of six miles would be ample.

Cochin.

(*a*) The location is satisfactory, but the elevation is greater than is advisable for efficiency.

(*b*) The tower is 91 feet high and 6 feet internal diameter. The internal arrangement of ladders is very inconvenient and should be replaced by an iron spiral stair case which would not cost much if the tower is lowered to suit the power of the light.

(*c*) The optical apparatus is a fourth order fixed apparatus with a dioptric mirror in rear. It is efficient as a port light, but is damaged and not kept very clean. The burner is in good order. The lantern has been recently painted but, here as elsewhere, the old paint was not removed before applying the new coat.

(*d*) Oil and stores are kept in a detached building. The oil tanks have a capacity of only 120 gallons or about 6 months' consumption. Additional tanks should be provided.

(*e*) There are no quarters for establishment and as the light is in the town none are necessary. The existing watch-room is sufficient for all purposes.

(*f*) Water-supply is from a well $\frac{1}{4}$ mile distant.

(*g*) The ventilation is very imperfect and is not under regulation. The keepers attempt to moderate the draughts of cold air, which enter the lantern through the floor gratings, by placing sacks on the floor. This is a dangerous practice as if anything should happen to the burner and burning oil fall on the wooden floor covered with sacks, considerable damage might result.

Aleppi.

The lighthouse is well maintained by the Travancore Government and the power of the light sufficient. The state of the apparatus and machinery indicate evident careful treatment. The light gives one flash every minute which makes the interval of darkness much too long. It is advisable to increase the speed so as to make one revolution in two minutes.

Muttum.

(*a*) The location is suitable.

(*b*) The tower is built of granite and is 72 feet high and 12 feet internal diameter. It is in good order but requires better windows.

(*c*) The optical apparatus is a 1st-order fixed apparatus with a dioptric mirror in rear. The arc of illumination appears to be wrongly given in the light list. The apparatus and mirror are both damaged but are efficient. The light could easily be given a distinctive character by converting it into occulting, but as there are no other lights in the neighbourhood, this does not seem very necessary. The range may be increased to 18 miles by installing a 6-wick burner during misty weather. The light will then show well over Cape Comorin.

(*d*) Stores are kept in a room in a block of buildings which include the head keeper's quarters and the watch-room. The storage capacity of the oil cisterns is 400 gallons which is insufficient and should be increased.

(*e*) Quarters are available for the head keeper, but if the scheme for establishment for the proposed provincial lights is sanctioned, additional quarters will be required for the assistant keepers. The floors of existing buildings require repair.

(*f*) Water-supply from well; the supply does not appear to be very plentiful.

(*g*) The ventilation at this station is very indifferent and the temperature in the lantern high. Mr. Douglass recommended that the lantern floor should be ventilated and that an improved roof ventilator should be provided. This recommendation has been misunderstood and all the landings as well as the lantern and service room floors have been replaced by iron gratings. The result is that, when the tower door is open, the draught cannot be regulated and, when it is closed, the ventilation is often insufficient. The service room should be floored with Cuddapah slabs or other convenient material and the windows enlarged and properly framed and glazed. An improved roof ventilator is also probably necessary. If these alterations are carried out the ventilation will be sufficient and under control. Muttam is one of the stations at which a heavy breakage of burner cylinders is reported. This breakage, in my opinion, is readily traceable to ill-regulated ventilation and to want of care on the part of the establishment.

(*h*) The consumption of oil at this station is 823 gallons per annum, while it should be accordingly to the consumption laid down by Trinity House 982 gallons. It seems probable, therefore, that the light is not always properly maintained.

(*i*) The tower is painted in black and white horizontal bands and is very difficult to distinguish when viewed from seaward owing to the dark back ground. It would be better to paint it white.

(*j*) The steps, cleaning path and apparatus platform have been painted white which gives the lantern a dirty appearance as the white colour cannot be maintained.

Manapaud Lighthouse.

(*a*) The installation at this station is similar to that at Tellicherry. Owing to rough weather, landing was not considered to be safe and, consequently, this light was not inspected. The S.S. *Margarita* anchored for the night some 3 miles from the light without it being visible; the reason for this is that the light does not show in every direction seaward. The inefficiency of this light has already been noticed in paragraph 4 (*b*) of the report.

(*b*) To guard the dangers an 18 mile flashing light has been proposed—*vide* paragraph 8 (*f*) of the report.

(*c*) The existing tower is said in the light list to be painted white. It is very difficult to distinguish, however, and appeared from the sea to be grey. The White Church near the lighthouse was clearly visible.

Tuticorin Lighthouse.

(*a*) The location is satisfactory.

(*b*) The tower is of brown sand-stone 5 feet internal in diameter and 71 feet high. The focal plane is 85 feet above high water level, whereas a height of 55 feet would be ample for the class of light. Mr. Douglass remarks that the upper part of the structure appears to be too heavy, and that the stones forming the gallery course are too light, and are being seriously shaken during stormy weather. An attempt has been made to stiffen the upper part of the tower by iron framing, but is said not to have succeeded. It would be better to lower the tower as the design is altogether too slight. The lantern glazing has been broken by the vibrations. The stone of which the tower is constructed is weathering a good deal. The bad parts should be cut out and replaced.

(*c*) The optical apparatus is of the fourth order, fixed, and is much damaged; one ring is missing and should be replaced. The lighthouse mechanic is said to have damaged the apparatus when fixing the new burner. One of the prisms was evidently chipped to make way for the feed pipe which could, however, have easily been bent and fitted without damaging the apparatus.

(*d*) Stores are still kept at Tuticorin on the mainland, one mile distant, instead of at the station. This should not be permitted.

(*e*) The quarters for establishment are occupied by the keepers and are in fair order. The head-keeper's quarters require cleaning and the floors plastering with cement. A chimney is required to the cook room. The building would be much improved by an additional verandah.

(*f*) Water for drinking is brought from Tuticorin and is stored in iron tanks. It would be better to provide masonry under ground tanks cemented.

(*g*) The ventilation is bad and is not under regulation.

Pambam.

(*a*) The location is satisfactory.

(*b*) The tower is circular 5′ 2″ diameter, with a spiral stair case and has been raised to show over the trees in the neighbourhood. The upper part is badly constructed being of larger diameter than lower down.

(*c*) The apparatus is of the 4th order fixed and is not properly cleaned. The light-keeper uses his supply of rouge powder to clean the burner cylinders instead of the optical apparatus for which purpose it was supplied. He also does not properly powder the bath brick used for cleaning the metal work. The lantern has no pedestal and the whole arrangements are as inconvenient as it is possible to conceive. The lantern floor being at the level of the bottom of the apparatus, it is impossible for the keeper to tend the light without obstructing it. A new lantern is absolutely necessary. The light is badly served and maintained. A lantern will be available from one of the lights proposed to be abandoned and, when it is fixed, the whole of the lighthouse and its buildings require to be thoroughly overhauled and repaired.

(*d*) Stores are kept in a room at the base of the tower.

(*e*) There are no quarters for establishment and none appear to be necessary. The two small rooms at the base of the tower are used for stores, and by the Port office clerk who records the meteorological observations. The latter should be evicted and the room used as a watch-room.

(*f*) The water-supply from a well near lighthouse is good.

(*g*) The ventilation is thoroughly bad and it is probable that the flame is never properly maintained. The only ventilation is up the stair case and through the door in the lantern glazing.

Tondi.

This light was not inspected. It is merely a small 6th-order cabin and mast port light.

Point Calimere.

(*a*) The location is satisfactory.

(*b*) The light is 6th-order port light (red) exhibited from a mast. The whole arrangements are very indifferent and if this apparatus is transferred to Barkur, the cabin and mast and their fittings will require a thorough overhaul which can probably be effected at the South Indian Railway Workshops at Negapatam. The apparatus is hoisted by a rope; the mast stays are very roughly fixed and secured by string, and the apparatus guides are of insufficient section. The iron work is not properly painted and before applying the new coat, the rust was not cleaned off. The burner is a Hinks Duplex and the reservoir is not large enough. It will be advisable to procure burners similar to those at Kundapur when the light is moved. The burners are dirty and do not fit the apparatus.

(*c*) The apparatus is in fair order but not properly cleaned. The hinge of the dome is broken.

(*d*) Stores are kept in a slovenly way and the keepers do not know the use of some of the gear which has been supplied. Chamois skins for cleaning the apparatus are in stock, but have never been used. The head-keeper appears to know nothing of his duties and to be entirely dependant on his assistants.

(*e*) Temporary quarters for establishment were constructed, but none of the keepers live in them. They live at a village three miles off and it is doubtful whether the head-keeper ever keeps a watch or attends regularly at this station. When the proposed new tower is built, permanent quarters will be required and accommodation for the inspecting officer.

(*f*) Water is brought from a village three miles distant and stored in an iron tank. The water tank is not kept clean.

(*g*) There are two rooms in a separate building, one of which is used as an oil-store, general store-room and as a watch-room; the other is reserved for inspecting officers. The oil should not be kept in a room which is also used as a watch-room. The mud floors should be concreted.

(*h*) It is proposed to establish an eighteen-mile light at this point—*vide* table I and paragraph 8 (*b*) of the report.

Negapatam.

(*a*) The location is sufficiently good as the shoal will be covered by the proposed eighteen-mile light at Point Calimere (visible nineteen-miles from a steamer's bridge) and by the existing light at Negapatam.

(*b*) The tower is five feet diameter with a spiral staircase. The loop-holes should be fitted with properly glazed windows. The building is in fair order, but requires painting and cleaning.

(*c*) The optical apparatus is of 4th order fixed; one prism is missing. It is otherwise in fair order. The burner is in good order.

(*d*) The oil and stores are kept in a room at the base of the tower. The number of oil-cisterns should be increased. The oil-store is used as a watch-room which should not be permitted.

(*e*) There are no quarters for establishment and none appear to be necessary. The signal and light establishments may probably be amalgamated.

(*f*) Water-supply good.

(*g*) Ventilation is through gratings in the light-room floor and through the lantern door which faces the sea, and is not under regulation. This defective ventilation probably accounts for the reported excessive breakage of cylinders.

Cuddalore.

(*a*) The location is suitable, but the elevation excessive.

(*b*) The light is exhibited from the cross trees of a flagstaff and is well maintained. The trade of the port is said to be considerable and a better light would be an advantage. The existing light (red) has a range of about six miles, while the elevation is suitable for a range of 17¾ miles, so that the light only reaches the horizon under very exceptional atmospheric conditions. One of the 4th-order fixed apparatus which will become available may be installed on the roof of a small building. The range will then be twelve miles.

(*c*) The opticial apparatus is a 6th-order port apparatus and is in good order.

(*d*) Stores are well maintained.

(*e*) Establishment quarters are in fair order. Screen walls are required not only for privacy, but also to keep out drifting sand. The roofs are covered with pantiles without flat tiles and sand finds its way through in large quantities. The cook-room requires a small porch or shelter over the door as, during wet weather, the rain beats in.

(*f*) Water-supply good.

(*g*) The land occupied has just been acquired and may be demarcated by a casuarina fence which the keeper should be required to maintain. The remains of old huts recently acquired should be removed and the place tidied up.

(*h*) The building in rear of the flagstaff requires painting.

(*i*) The Deputy Conservator of the Port who looks after this light evidently takes a great interest in it. The light is well maintained.

Seven Pagodas.

(*a*) The location is unsuitable being at too great an elevation for the existing very feeble light. A better site can easily be found on one of the rocks near the existing tower.

(*b*) The light is exhibited on the top of a pagoda and the whole arrangement is very unsuitable. The building is dark, ill-ventilated and very inconvenient. It will be better, and probably just as cheap eventually, to install the proposed eighteen-mile flash light on a new tower where sufficient drop can be obtained for the weight and the ventilation properly provided for. The store cupboard is in a chamber without windows or ventilation of any sort. It is not surprising if cylinders are broken when kept in such a place.

(*c*) The apparatus is a 4th-order fixed apparatus with a silvered spherical mirror in rear. The light is coloured by a red cylinder and, even if converted into white occulting, would be of insufficient power. The feed pipe to the burner is cracked and leaks badly. The burner is out of adjustment and the ventilator tube bent.

(*d*) Stores are partly kept in the chamber mentioned above and partly in a spare light-keeper's dwelling. The room is not ventilated and not properly fitted up. The number of cisterns for the storage of oil should be increased. The draw-off cocks of the cisterns now in use are at too high level.

(*e*) The establishment quarters are in good order and suitable for the present establishment. The keepers live in them.

(*f*) Water-supply is good. The well requires petty repairs.

(*g*) The ventilation is very bad at this station being absolutely insufficient. The keeper maintains a higher flame than is the custom at many stations.

(*h*) An eighteen-mile flash light is proposed for this station.

(*i*) The white paint supplied for the use of the keepers is of bad quality or badly mixed. It has changed colour.

Madras.

(*a*) The location is suitable.

(*b*) The tower is in good order. The gallery railing is not strong enough. The windows are not properly cleaned.

(*c*) The apparatus is not kept clean. The revolving machine is in good order. The burner is in adjustment. A strainer is required to keep insects out of the oil-cup of the burner. The ventilators should be fitted with wire-gauge to keep out insects. The spare burners are not kept clean.

(*d*) The lantern is in good order. The astragals are not kept clean. The damper indicator requires shortening to clear the drip pan.

(*e*) Stores are kept in a slovenly way. The glazed cupboard supplied should have been made to fit close to the wall. All the spare wicks should be kept in this cupboard properly wrapped up. The stores now kept in the oil-store should be removed to the main tower.

(*f*) The oil-store is suitable. The oil-cisterns appear to sweat a good deal. They rest on wooden benches which should be removed and masonry substituted. The dangerous practice of spreading saw-dust on the floor to soak up accidental drippings of oil should be put a stop to—*vide* paragraph 12 (*e*) of report.

(*g*) Quarters for establishment are much needed.

(*h*) A supply of water for the use of the keepers is required.

Pulicat.

(*a*) The location is satisfactory.

(*b*) The tower is well founded. One of the window frames is missing, and all are of very poor design. The lantern has been made rigid by the addition of horizontal iron bars, but is still not sufficiently rigid as a pane of glass has recently cracked. The glass in the panels in the dark arc might be removed and iron plates substituted screwed to the bars.

(*c*) The optical apparatus is of the 4th order fixed with spherical mirror in rear. The illuminated arc does not cut the land towards the north. The apparatus from Hope Island might be installed with a three-wick burner for use in misty weather and the light converted into occulting if considered necessary. The range will then be thirteen miles. The burner is out of focus and the cone damaged.

(*d*) Stores are kept in a room at base of tower which has no ventilation at night. Rain beats in at the windows which are not protected with shades.

(*e*) The quarters are sufficient for the existing establishment, but will have to be improved when the proposed new establishment is entertained. The floor of the verandah of the Superintendent's quarters requires concreting.

(*f*) Water-supply good.

(*g*) The lantern door faces the sea and there is a great draught when the entrance door or windows in the watch-room are opened. It would be better to fit the lantern door with a bolt so that it could be kept opened at any angle and to provide a door with ventilators in the archway at the foot of the stairs in order to cut off the watch-room from the tower. A few of the windows should also be improved and made to open to any extent required. The faulty ventilation accounts for the large breakage of cylinders at this station.

(*h*) The capacity of oil-cisterns should be increased.

Armeghon.

(*a*) The location is satisfactory.

(*b*) The tower is 107 feet above H.W.L. and is of much the same design as Pulicat light-house. The inside was originally polish chunam, but repairs are being carried out in a very rough way with cement. The vibration in the lantern is said to be considerable. The glass in the dark arc may be removed and replaced by iron plates as at Pulicat. The lantern requires painting. The paint recently put on by the light-keepers has turned yellow as at Seven Pagodas.

(*c*) The apparatus is of the 4th order revolving and is efficient. The range may be increased to fifteen miles by substituting a three-wick burner in misty weather. The revolving apparatus is worn and requires seeing to. The rack supplied by the Public Works Department in 1891 has just been fixed; the teeth are very roughly formed and the light does not revolve steadily. This should be seen to. The apparatus is not fixed in the centre of the lantern owing to the small diameter of the tower, which does not provide sufficient space for the entrance to the light-room. The drip pan and ventilator tube are both fixed eccentrically. It would be better to make a bend in the ventilator tube so as to terminate it in the centre of the roof ventilator.

(*d*) Stores are well maintained. The spare wicks are wrapped up in oily paper.

(*e*) The existing quarters are sufficient for the establishment, but will require to be improved when the proposed new establishment is entertained. They are in good order except the roof of the assistant keeper's quarters which is leaky. A few tiles require to be replaced. The woodwork requires painting.

(*f*) Water-supply good. The guard walls of the wells require plastering.

(*g*) Ventilation is through hit and miss valves in the lantern pedestal and through the trapdoor. The loop-holes of the tower are provided with shutters. The ventilation is insufficient and should be improved. Gratings may be substituted for the present light-room floor and a few of the windows near the top of the tower enlarged and improved so as to open to any extent required. The archway at the foot of the stairs should also be fitted with a door with a ventilator in it.

(*h*) The capacity of oil-cisterns should be increased.

Point Divi.

(*a*) The location is unsuitable. The light is two miles from the sea and is of little or no use to the mariner who does his best to avoid sighting it when coming from the south. A new light is proposed at False Point.

(*b*) The existing tower is circular, five feet diameter, the inside being occupied by wooden ladders. It is now being repaired. The tower is painted white but the heavy lantern gallery is tarred, with the result that the building is difficult to distinguish from the surrounding cocoanut trees when viewed from a distance. On the occasion of my inspection the tower was most difficult to distinguish from the sea though we sailed within three miles from it, and, by land, there was the same difficulty. A great deal more attention requires to be paid to the background when deciding on the colour a tower is to be painted.

(*c*) The apparatus is a 4th-order fixed and is in fair order. The burner is out of adjustment and the tips worn by careless cleaning with bath brick. The ventilator tube is not vertical. The bass stand of one of the spare burners is used for other purpose.

(*d*) The establishment quarters are unsuitable but are not regularly occupied, as the keepers apparently live at Masulipatam.

(*e*) Water is stored in a fresh-water tank for domestic purposes; and in nine iron cisterns for drinking purposes.

(*f*) The Superintendent at this station appears to be past his work and should be retired.

Masulipatam.

(*a*) The location is unsatisfactory being too far from the sea. The light is said to be often invisible at the anchorage. A new light is required near the beach to the south of the bar to cut the light proposed to be installed at False Point Divi. The 4th-order fixed apparatus from Point Divi will be available for this purpose.

(*b*) The existing light is a 6th-order port light exhibited from a mast. It is well looked after.

(*c*) The basement of the flagstaff is plastered with chunam which is said to require renewal annually; cement plaster would be better.

Hope Island.

(*a*) The location is unsuitable and a new tower has been ordered to be constructed. The site suggested is opposite Sacramento Shoal—*vide* paragraph 8 (*n*) of report.

Vakalapudi Lighthouse.

(*a*) The light is located $4\frac{3}{4}$ miles north of Cocanada and is intended as a guide to vessels approaching Cocanada anchorage. If the proposed light opposite Sacramento Shoal is established and the range of Vakalapudi is increased to fifteen miles by installing a three-wick burner during misty weather, the dangers off Gódávari Point will be efficiently marked.

(*b*) The tower is six feet diameter and has a spiral wooden staircase. A service room could easily be constructed, but is not absolutely necessary. The building requires to be either painted or white-washed. The loop-holes should be enlarged and fitted with glazed window frames, especially near the top of the tower.

(*c*) The apparatus is a 4th-order six-sided revolving apparatus and is much damaged. The light is said to be always visible at Hope Island distant twelve miles. The revolving machine is much worn and requires to be thoroughly overhauled as the period of revolution cannot be maintained. The burner is in adjustment, but the wick in use did not fit properly between the tips, which have been worn by cleaning with bath brick.

(*d*) Stores are well maintained. The capacity of oil-cisterns is sufficient for the present burner, but it would be better to increase the storage to eighteen months' supply.

(*e*) The quarters are sufficient for the existing establishment. When the new establishment is sanctioned, the dwellings will have to be modified. The keepers' quarters have recently been repaired, but the Superintendent's house requires further extensive repairs, including a new roof. Additional quarters are said to be required for a flag lascar, but it seems possible that the proposed establishment can do the signalling without prejudice to their other duties.

(*f*) The water-supply is said to be bad and the Superintendent asked for a new well near his house. It is not evident that this would improve the quality of the supply.

(*g*) The ventilation is fair, but the wooden light-room floor should be removed and iron gratings substituted.

Vizagapatam.

A new light is said to be required as a guide to the anchorage and a site on the Dolphin's Nose where a light was formerly installed, was first suggested. Captain Powell has suggested a light near the Port office to the north of the bar and no doubt this will be the best site if the light is not required to show to the southward. A light on the Dolphin's Nose would be very inaccessible. It is suggested that one of the 4th-order fixed apparatus which will become available may be installed here with a range of eleven miles.

Bimlipatam.

A port light is said to be required here and can be exhibited from the roof of a small building or from the flagstaff. One of the port light apparatus which will become available can be installed. The light can be occulting on the Sindberg system if that system is adopted (*vide* appendix A, paragraph 11).

Santapilli.

(*a*) The light is exhibited at much too great a distance from the danger and at too great an elevation for its power.

(*b*) The light is installed on the basement of a building and the ventilation is very indifferent. Much trouble is caused by insects at this station. The ventilators in the pedestal should be covered with gauze and a wire gauze door fitted. The steps, cleaning path, and apparatus platform, have been painted white which gives the lantern a dirty appearance, as the white colour cannot be maintained.

(*c*) The apparatus is of the 2nd-order fixed, with a dioptric mirror in rear. Nine lenses and six prisms of the apparatus and one prism of the mirror are damaged. The new burner is said to have given a good deal of trouble at first, but now is better managed. The flame appears to be kept rather low, but this may be owing to defective ventilation. A strainer is required to keep insects out of the overflow basin of the burner.

(*d*) Stores are kept in a building close to the light and are well maintained.

(*e*) Permanent quarters for the Superintendent and head keeper have been built. The Superintendents' bungalow consists of two rooms 16′ × 13′, two dressing and two bath rooms with open verandahs in front and rear. The floors are all in bad order, and the roof leaky and full of white ants. Another room is said to be required. A room should also be built for the accommodation of inspecting officers. The cook and store rooms require repairs. The head light-keeper's quarters consist of one room 15′ × 12′, with two small rooms at either end. The accommodation is not sufficient. The floors are all in bad order and should be concreted. General repairs such as painting should be executed and a tree which is damaging the roof cut back. The cook-room is in good order. The assistant keepers are housed in mud huts. If the proposed establishment (*vide* table V) is entertained, additional quarters will be required for the two assistant keepers, the present head light-keeper's quarters being converted into cook-rooms. The Superintendent's quarters can also be brought up to whatever standard is determined on. The Superintendent has built a fowl house and two cattle sheds which he should be required to keep neat and tidy.

(*f*) The light-house property requires to be fenced, and as the keepers have to keep stock owing to their isolated position, grazing ground should be provided. The southern boundary may be moved back to the second palmyrah hedge and continued towards the east to include the land now rented by the Superintendent. The western and northern boundaries should include the hill on which the light-house stands. Two new gates will be required and prickly-pear and jungle should be cleared and the whole property fenced with milk plant with demarcation stones at angles. The cost of fencing and gates will not exceed Rs. 250, and the value of the additional land required, which belongs to His Highness the Maharajah of Vizianagaram, cannot be much.

Calingapatam.

(*a*) A new 4th-order occulting light is now being established.
(*b*) Quarters for establishment are required.

Gopalpore.

(*a*) The location is suitable, but the light is exhibited from a higher elevation than is advisable.

(*b*) The flagstaff is in good order and has recently been repaired. The basement is said to be annually plastered with chunam, but it would be better and cheaper in the long run to plaster it with cement.

(*c*) The apparatus is a 4th-order port apparatus and is efficient. The breakage of burner cylinders is considerable, but is probably due to the difficulty in lighting or tending the burner during bad weather. It would be better to construct a platform at a lower elevation with a shelter into which the apparatus could be drawn during the day and for lighting and cleaning purposes. An alternative would be to exhibit the light from the roof of the Custom House.

(*d*) The light-keeper's quarters require screen and compound walls. A good deal of sand is said to be blown into them.

Madras,
22*nd June* 1895.

F. W. ASHPITEL,
Executive Engr. on Special Duty.

No. 1493.

Referred to the Presidency Port Officer for early remarks. The appointment of Superintendent of the Madras Light should not be *permanently* filled, pending further orders.

Ootacamund,
28*th June* 1895.

(Signed) J. F. PRICE,
Chief Secretary.

From Commander W. J. POWELL, R.I.M., Presidency Port Officer, to the Chief Secretary to Government, dated Madras, 15th July 1895, No. 1271—183-G.

In returning Mr. Ashpitel's report on the lights of this Presidency (received with endorsement, No. 1493, of 28th June 1895, on Marine Current No. 470), I have the honour to state that I agree generally with Mr. Ashpitel's proposals; but many of them require modifying.

2. To take them in detail from Kundapur to Gopalpur will be the simplest way of expressing my views thereon.

Kundapur, Malpe, Barkur.

3. Lights at *Kundapur*, *Malpe* and *Barkur* (Hangarkotta) approved.

Mulki Rocks.

4. Class of light approved but the proposal to establish it on the rock itself I do not support for the following reasons:—No communication for at least four months in the year; great expense in construction; keepers will have to be provisioned; difficulties and expense of inspection greatly increased involving hire of a steamer or the upkeep of a boat on the mainland. The danger can be effectively guarded by a light on the mainland, four miles distant, as a single cast of the lead would at once settle a ship's position after sighting the light. The above remarks apply equally to the proposal to place a light on the Sacrifice Rock. On Cotta Point is the position I propose for the latter light.

Mangalore.

5. Light to be removed to a lower elevation approved if a suitable site can be found. Casuarina plantations have grown up in recent years and it may not be possible to provide an unobstructed view of the light except at great expense; as the light will only be classed as a port light it had better remain as it is unless the change can be effected cheaply.

Cannanore and Tellicherry.

6. Proposals approved. Each light should be in a properly-sheltered light-room.

Sacrifice Rock.

7. Not approved; light should be on Cotta Point for reasons already given.

Calicut.

8. Light to be lowered, &c., approved.

Beypore.

9. There should be a small anchoring light at *Beypore*.

Cochin.

10. Alterations to port light at *Cochin* approved; also provision of small anchoring light at Mallipuram.

Tangacherri.

11. Light on *Tangacherri Point* approved.

Muttum.

12. An increase in the power of the *Muttum* light during thick weather is approved. The present four-wick burners can be used with one of the new 3rd-order lights. Before carrying out this proposal the ventilation at Muttum should be improved.

Manapaud.

13. The installation of a 3rd-order flash light on *Manapaud Point* is very necessary and I would recommend very early sanction to this proposal.

Tuticorin.

14. The *Tuticorin* column should be altered as proposed by Mr. Ashpitel as soon as provision can be made for a temporary light.

Pamban.

15. *Pamban* light is sufficient for present requirements.

Calimere Point.

16. The new light recommended for *Calimere Point* is suitable.

Negapatam.

17. The proposal to increase the power of *Negapatam* light, which is a land-fall light for vessels from the Straits Settlements, is approved. This light should, in my opinion, be classed as a sea light.

Cuddalore.

18. The present light is sufficient.

Seven Pagodas.

19. The alteration of the *Seven Pagodas* light to a 3rd-order triple flashing should also receive very early sanction. The tower for the new light should be built on a site which provides room for storage of oil, &c., close to the tower. The necessary range can be obtained with a less height than that proposed by Mr. Ashpitel, as the only vessels likely to make use of the light frequently will be steamers of large tonnage. An elevation of 120 feet will give them a view of the light when 18 miles distant, *e.g.*—

	MLS.
118 feet elevation gives a range of	12·4
Height of eye from steamer's bridge 25 feet (average) gives a range of	5·5
Total ..	17·9

I would here remark that the towers of all the new sea lights proposed by Mr. Ashpitel may be slightly reduced in height.

Madras.

20. *Madras* light is in all respects suitable, but it will be convenient here to offer a few remarks on Mr. Ashpitel's report thereon. I will just mention that the lighthouse mechanic who was in temporary charge of the light had been for some weeks absent on duty at Calingapatam and no person was available to take his place. The hour of Mr. Ashpitel's inspection was the early morning while the men were cleaning

the lantern and apparatus. During the night the windows swarm with insects which get into the corners of the astragals, and naturally the windows do not appear clean until the cleansing has been carried out. No notice of his intention to visit the light was given to this office and his remarks strike me as somewhat captious. It would have been fairer to have remarked on the absence of the person responsible. The other points alluded to at this and other lighthouses will receive attention.

Pulicat.

21. The proposal on page 36 of the report to utilize the present Hope Island light at *Pulicat* is a good one, but I think the existing burners are sufficient; it is not worth while going to the expense of new burners to gain one additional mile in range as the existing range is sufficient. The question of providing an occulting shutter can be considered after experience with the Calingapatam light.

Armeghon.

22. At *Armeghon* new clock-work is required and the three-wick burners suggested by Mr. Ashpitel might also be provided at the same time.

False Point Divi.

23. As regards the proposal to instal a 3rd-order triple flashing light at *False Point Divi* great care in the choice of a site will be necessary, owing to the branches of the Kistna river. Given a suitable and safe site and facilities of communication superior to those existing with the present light on Point Divi, I consider the light should be sanctioned as soon as funds are available.

Masulipatam.

24. The present Divi light is suitable as a port light for *Masulipatam*.

Sacramento Shoal.

25. This light as proposed by Mr. Ashpitel should be installed as soon as possible. Separate correspondence on the subject is now passing between this office and Government.

Godavari Point.

26. Should Pinstch's system of lighting railway carriages by compressed gas be adopted by the East Coast Railway, endeavours should be made to establish a gas buoy off Gódávari Point.

Vizagapatam and Bimlipatam.

27. If available, one of the 4th-order fixed lights might be established at *Bimlipatam* and 4th-order port lights at *Vizagapatam*.

Pending the adoption of some occulting system, these lights should be red at Bimlipatam and *two* white at Vizagapatam, or *vice versâ*. It will not be safe to have another fixed white light within thirty miles of the Santopilly light.

Santopilly.

28. I agree with Mr. Ashpitel's proposal to increase the burner power of this light. Any attempt to mark the shoal by a light involves quite a prohibitive expenditure, having in view the tonnage of the shipping that could be expected to contribute.

Calingapatam.

29. This light has already been improved and an establishment sanctioned.

Gopalpur.

30. This light might be installed under one keeper in a small masonry room on top of the Port Office.

31. The dues proposed to be levied for the construction and maintenance of these lights appear suitable and the estimated revenue therefrom correctly calculated.

32. While practically accepting most of Mr. Ashpitel's proposals, I would remark that, however desirable it may be to have a really well lighted coast, shipping should not be too heavily taxed to attain this result, and in my proposals contained in this office No. 1271—169 G., dated 5th May 1894, I refrained from suggesting more lights than were absolutely necessary to the navigation of the East Coast. My reasons for adding to the number of necessary lights are fully set forth in my No. 1271—271 G., dated 19th July 1894. The new lights proposed for the West Coast I would describe as facilities to safe navigation, but not absolutely essential; still, time is becoming of more importance yearly in sea traffic, and provided that ships are willing to contribute to their maintenance, many and good lights should be provided.

Establishment.

33. I fully agree with Mr. Ashpitel as to the adoption, as far as possible, having regard to local conditions, of the Trinity House system at our lighthouses with the provision of three keepers as against two in English shore lighthouses.

(1) I take exception to the statement in paragraph 15 of his report, viz., "For lights, such as the majority of the proposed sea lights, the number of keepers in England, Scotland or France would be two." Many of the proposed stations for the new lights will be far more isolated than rock stations in the United Kingdom as regards facilities for obtaining supplies and visiting home when relieved.

(2) There will be no steamers to bring the supplies or land the men near a railway. In some cases under the proposed scheme of engaging Eurasians the men will be employed at places a week's journey from their homes; at isolated rock stations four keepers are entertained by the Trinity House; at other rock stations, with which might well be classed many of our proposed sea lights, three keepers.

(3) Mr. Ashpitel has omitted to mention that at a rock station an addition at the rate of £25 per annum is made to the pay of each keeper while on duty there.

(4) Also that in calculating the pensions payable to a keeper £18 per annum is added to his pay, being the estimated allowance for house-rent.

(5) I consider that at all sea lights a provision allowance should be given and that free conveyance of stores should also be granted.

(6) With these additions the present rates of pay might be tried; the present Superintendents to receive their old rates of pay and in specially recommended cases to be allowed to rise to the maximum present pay of Rs. 100 per mensem.

(7) At most sea lighthouses it will be necessary to maintain a scavenger and waterman. These latter are not provided for in Mr. Ashpitel's scheme.

34. As regards the local light service, I agree with the suggestion made in the enclosed memorandum* (drawn up by Mr. Baddeley, Personal Assistant to the Presidency Port Officer, during his recent visit to Australia on privilege leave), viz., that the charge of a port light should be

* Paragraph 10.

the probationary service for promotion to a sea light, and that Eurasians be employed. The only exception to this would be in the case of mast and cabin lights at which a moderately-paid native keeper, with a cooly to assist in hoisting the light up and down, should be entertained. The keeper should receive a small lodging allowance on the understanding that he lives as near as possible to the light, and in the case of lights only exhibited during the fine weather he might be required to sleep near the cabin in a temporary hut. These proposals are, of course, conditional on the establishment of the superior class of lights, from which lights a very efficient check on the maintenance of the smaller lights can be carried out.

35. Pending the final settlement of the question of lights and establishment I would suggest that sanction be accorded to filling up all future vacancies at tower lights by the appointment of an Eurasian, if possible with some mechanical training, on the scale of pay proposed by Mr. Ashpitel for the lowest class of provincial keeper and exempted from the examination rules in the case of unpassed men. When funds admit, all lights except fine-weather lights should be located in light-rooms.

Supervision and Inspection of Lights.

36. As regards the method of inspecting the lights I totally disagree with Mr. Ashpitel. In the first place, mechanics on the pay proposed by him are not suitable persons to exercise the necessary control or to submit reliable reports. It is quite out of the question to entertain an expert from England, nor is one required. There is already on the establishment a lighthouse mechanic who has performed his duties satisfactorily. He has gone through a three months' training under Trinity House keepers in Ceylon and, though there may perhaps be petty details in which he has failed to come up to Mr. Ashpitel's standard, he is for all practical purposes the best man available *as a mechanic*, and I recommend his retention in that capacity; also as Principal Keeper of the Madras lighthouse with an increase of pay. He should also be employed as instructor of the keepers engaged from time to time. To assist him I would propose, for the present (pending the introduction of the new scheme), an Assistant Superintendent; subsequently, three keepers would be appointed.

37. As Inspector of Lights for the Presidency I would strongly recommend Mr. H. D. Baddeley, Personal Assistant to the Presidency Port Officer. Mr. Baddeley was deputed to accompany Mr. Douglass when that gentleman inspected the lights of this Presidency and has for the past five years taken a very keen interest in all matters connected with lights. He has on various occasions, at home and abroad and at his own expense, visited lighthouses. It will not be necessary that Mr. Baddeley should give up his duties as Agent for Government Consignments or as Personal Assistant, though his duties in the latter appointment will principally be confined to lighthouse work. It will be necessary to relieve him of the duties of Government Surveyor, which might be performed, and consistently, by the Deputy Conservator, who is in a similar position to the Port Officers at Karachi, Aden and similar ports, by whom this duty is performed. Mr. Baddeley intends applying for the furlough (leave on private affairs) due to him (six months) next year. I would recommend that Government should allow him to remain at home for three additional months on the usual allowances granted to officers on duty in England, to go through a practical course of instruction in lighthouse inspection and management under the Trinity House. This he is willing to do at his own expense. The financial result of the above proposals does not involve much more expenditure than would be entailed by Mr. Ashpitel's scheme, and the inspection would be much more satisfactory. With the extension of railway communication in this Presidency, recently carried out and projected, there would be no difficulty in the proposed Inspector making at least four visits per annum to each lighthouse without a very prolonged absence from head-quarters. The lighthouse mechanic would accompany him on these inspections. The Inspector should communicate with Government through the Presidency Port Officer and still remain subordinate to that officer, but should be allowed considerable freedom of action and full powers in dealing with all minor matters. He should, in fact, be the head of the lighthouse service under the administrative control of the Presidency Port Officer. The transfer of the duties of Government Surveyor would deprive the Agent for Government Consignments of certain emoluments and the inspection duties would

involve a great deal of travelling, and to compensate him for loss of fees, increased duties and responsibilities, and also to bring him under first-class travelling rules, his substantive salary should be increased. An increase of salary would result in the withdrawal of his personal allowance (*vide* Article 77 of the Civil Service Regulations), and thus unless increased to an appreciable extent would not be of any material advantage. The average emoluments of his present post are approximately Rs. 500 + 45 (personal allowance) + 45 (representing fees for private surveys)—say, Rs. 600 per mensem. When this appointment was originally proposed the salary without fees was fixed at Rs. 600 per mensem and this amount was on two * occasions recommended to the Government of India, who were on the first representation willing to grant the higher salary if the matter had been pressed by the Government of Madras. On the second occasion the recommendation was mixed up with a general scheme for improvement of salaries which was rejected. I would recommend a consolidated salary of Rs. 700 with a Presidency allowance of Rs. 100 per mensem.

* *Vide* G.O., Marine, Nos. 365, 366, of 1st August 1888, also Commander Street's letter, No. 474—474 G., of 22nd October 1889, printed in Marine Proceedings, Nos. 51, 52, of 11th February 1890.

38. As for some years to come Mr. Ashpitel's opinion and advice will be required if his scheme be adopted, I would suggest the desirability of granting him either a lump sum annually or a monthly allowance. All plans for new lighthouses should be revised by him and his opinion called for on technical matters.

39. The Inspector of Lights would be responsible for the cleanliness and efficiency of the lights and the discipline of the establishment. He should grant leave, award punishment and deal with all correspondence and returns. Punishments other than petty ones to be open to appeal to the Presidency Port Officer. An incentive to good work might take the shape of a bonus to every keeper who has a clean defaulter sheet for a certain period.

40. In proposing this additional expenditure I have taken into consideration the fact that a very large initial outlay and yearly expenditure is involved amounting to Rs. 10,00,000 and Rs. 1,50,000, respectively; therefore expense should not be spared in ensuring by efficient inspection and reliable advice the disbursement of these sums to the best advantage.

41. I beg that a copy of Mr. Ashpitel's report may be supplied for record and future reference.

MEMORANDUM ON LIGHTS ON AUSTRALIAN COAST.

During my recent trip to Australia I availed myself of the opportunity of enquiring into the Lighthouse systems of New South Wales and Queensland, and through the courtesy of the Marine authorities of the respective colonies, facilities for so doing were granted me.

2. Having in view the proposed re-organization of the Madras Lighthouse service on the basis of Provincial and local lights, I devoted my attention to the smaller class of lights used as port and leading lights, especially with reference to the establishments maintained and the system of making such lights to a great extent automatic, *i.e.*, the maintenance of a moderate intensity without the presence of a keeper on watch.

3. On the Queensland Coast, there are about 100 minor lights termed secondary coast, and port, and river lights, the majority of which are in charge of only one keeper; in some cases one man supervises two lights. Several of these lights are of the 4th order.

4. The principle adopted is to abolish the damper to exclude all draughts of air not absolutely necessary, and to maintain the flame at a moderate intensity, and the results have been most satisfactory. The smoke-tube is also in two pieces, and the glass cylinder does not enter the lower portion of the tube. This effectually prevents flaring up and depression of the flame from down draughts. On the introduction of the Douglass burner in the smaller lighthouses of this Presidency, stress was laid on the necessity of maintaining a good draught and a maximum intensity of flame, and rightly so, for the lights were performing duties for which the optical apparatus was inadequate, viz., those of coast and land-fall lights. Under the system proposed by Mr. Ashpitel these lights will be relegated to their proper functions as port lights, and guides to anchorages, and a small reduction in their atmospheric range will not only cause no inconvenience to the mariner (who will be guided to the vicinity of the port and warned off outlying dangers by the large and powerful coast lights), but will result in a considerable saving in salaries, oil and chimneys.

5. The burner used for these lights by the Queensland Government is known as the Farquhar, but there seems to be no reason why the small Douglass burner should not be equally efficient. The experiment is worth trying. It was under consideration to supply the Farquhar burner with an overflow tube to increase its efficiency. The oil used is common kerosine of 125° test and many of these lights are situated in the tropics, one of them lying nearer to the equator than is Madras. This oil is used in *all* the lighthouses, heavy mineral being reserved for the light ships. Excellent kerosine of 150° test is procurable in this presidency at about half the cost of heavy mineral oil and, no doubt, a local firm would be prepared to supply the same with a guarantee of its quality.

6. I do not of course advocate using this oil in the larger and more important lights where great heating of the lantern may occur.

7. At the Pile lighthouse at the entrance to the Brisbane river (a most important station), in addition to the 4th-order occulting light are two 6th-order subsidiary lights which show during the nights, by means of coloured shades, the height of tide on the bar. This light with tide guage is maintained by a superintendent and two keepers, whose duties in connection with the guage could only be carried out by the adoption of the system detailed above which relieves them from watching the flame of the light. The fact that this light has a mean range of 12 miles and is used nightly by steamers of large tonnage entering the Brisbane river, seems a very strong argument in support of my proposals. The superintendent informed me that he had removed the damper altogether, and that the flame had never given any trouble. The oil used was common kerosine with a Farquhar burner. The Lighthouse Engineer and Secretary to the Marine Board accompanied me on this trip.

8. Mr. Ashpitel in his report admits the necessity of three keepers at light towers where a perpetual watch is to be kept, and for port lights it is still proposed to employ native keepers. From past experience it has been found difficult to ensure an intelligent use of the damper by native keepers, and continual "flare up" smoking chimneys, and drowsiness on watch have been the result, and this under the supervision of a moderately-paid superintendent who, under the new system, will disappear.

9. I submit that a somewhat reduced range of light, but constant, is better than the higher intensity subject to the vagaries and negligence of low-paid keepers. As a matter of fact, it is extremely doubtful if the three native keepers will maintain any better flame than under the other system.

10. The keeper in the Queensland lighthouses is a well-paid man receiving from £ 90 to £ 200 per annum with quarters, lights and fuel; but all labour there is expensive, and if the minor light appointments on this coast were made the stepping-stones to appointments in the provincial lights, suitable persons would be procurable at moderate salaries.

11. At some of the stations at which only one keeper is entertained, only £ 25 per annum is paid; but, then, the person is a fisherman or boatman residing on the spot and does not devote his whole time to the work.

12. At the large lighthouses superintendents are entertained, and where three keepers are also entertained the superintendent keeps no watch. There are only two lighthouses under these conditions, the usual complement being a superintendent and two keepers who keep watch in turn.

13. The accompanying statement will show the rates of pay obtaining in Queensland and New South Wales. In the latter colony gratuities and pensions are given, but I was unable to obtain particulars of these as the statement was only given to me just before leaving. At Brisbane (Queensland) the question of granting pensions and leave is now under consideration.

14. In the colonial lighthouses a large amount of discretion is given to superintendents and principal keepers, and they are not hampered with numerous petty instructions and preparation of superfluous returns. They are expected to maintain their lights, apparatus and buildings in a clean and efficient condition and to use their discretion as to time of lighting, provided that the light is always exhibited before darkness sets in, and during dark, stormy or hazy weather that it is exhibited, if necessary, before sunset.

Statement showing lights on the coast of Queensland.

Name of light.	Description of structure.	Description of light.	By whom managed.	Salaries of light-keepers * per annum.	Remarks.
Cape Moreton	Circular stone tower ..	1st order catoptric, revolving every minute, white.	Superintendent and 3 light-keepers.	£ 200. 1 at £ 108, 2 at £ 96.	
Yellow Patch	Square wooden light room ..	4th order dioptric, fixed, red and white sectors.			
Comboyuro	Wooden tower	Do. do. do. ..	1 light-keeper ..	£ 118.	
Cowan Cowan	Do.	Do. do. do. ..	Do. ..	£ 118	Part light.
Tangaluma	Square wooden light room ..	Three 4th order holophotes, white	Do. ..	£ 118	Do.
Cleveland Point	Hexagonal wooden tower ..	6th order dioptric, fixed, white	Do. ..	£ 25	Do.
Pile Lighthouse	Hexagonal, on piles ..	4th order dioptric, occulting, red and white sectors.	Superintendent and 2 light-keepers .	£ 150 .. .. .. 1 at £ 118, 1 at £ 16 ..	Do. Has tidal gauge and two subsidiary 6th-order lights for tidal signals.
Fisherman's Island (Front)	Iron tower	5th order holophote, red	2 light-keepers ..	1 at £ 118, 1 at £ 96 ..	One keeper for each light. Light situated about ¼ mile apart. No watch maintained.
Do. (Back) and *twenty-five* smaller lights on beacons in the Brisbane river and Moreton Bay.	Do.	5th order dioptric, red and white sectors ..			
Double Island Point	Circular tower	3rd order dioptric, revolving every 30 seconds, white.	Superintendent and 2 light-keepers.	£ 160. 1 at £ 118, 1 at £ 106.	
Woody Island (Middle)	Hexagonal tower	4th order dioptric, fixed, red and white sectors.			
Do. (North)	Do.	Do. do. do. ..	Superindendent and 1 keper.	£ 175. £ 108.	
and *twenty-six* smaller lights in Somdy strait and Mary river.	....	....	2 light-keepers.	£ 160 and £ 108.	
Sandy Cape	Iron tower	1st order dioptric, revolving every 2 minutes, white.	Superintendent and 3 light-keepers.	£ 200. 1 at £ 108, 2 at £ 96.	
Lady Elliot Island	Do.	4th order dioptric, white, flash every 30 seconds.	2 light-keepers.	1 at £ 150, 1 at £ 118.	
Burnett Heads and *fourteen* smaller lights on beacons in the Burnett river.	Hexagonal tower	5th order dioptric, white, fixed	Pilot boat's crew.		
Bustard Head	Iron tower	2nd order dioptric, fixed, and flash, white and red.			
Do.	Square tower	5th order dioptric, white, fixed	Superintendent and 2 light-keepers.	£ 200. 1 at £ 118, 1 at £ 96.	
Do.	Mast	Catoptric, white, fixed			
Gatacombe Head	Hexagonal tower	5th order dioptric, fixed, red and white ..	1 *Light-keeper* † ..	£ 130	† This keeper controls three lights.
Oyster Rock and two small lights in Port Curtis.	....	Two 6th order holophotes	1 Light-keeper ..	£ 25	Does not devote all his time to the light.
Cape Capricorn	Iron tower	3rd order dioptric, revolving every minute ..	Superintendent and 2 keepers.	£ 150. At £ 108 and 96.	
Do. (2)	Light-rooms	Reflectors			
Pilot station, Keppel Bay	....	6th order catoptric, fixed, white	Pilot crew.		
Sea Hill and twenty smaller lights on beacons in Fitzroy river.	....	5th order dioptric, white and red sectors ..	1 *Light-keeper*.	£ 118	Port light.
North Reef	Iron tower	2nd order dioptric, fixed and flash	Superintendent and 2 light-keepers.	£ 200. At £ 130 and 108.	
Pine Islet	Do.	Do. do.	Do. do.	Do. do.	
Flat-top Islet and thirteen smaller lights in the Pionur river.	Do.	4th order dioptric, fixed, red and white sectors	1 *Light-keeper* ..	£ 150	Secondary coast light.
Dent Island	Do.	4th order dioptric, revolving every 30 seconds, white.	Superintendent and 1 light-keeper.	£ 150. £ 108.	

* All have quarters and are supplied with light and fuel. One month's leave is granted to each light-keeper yearly. Light-keepers provide their own provisions which are conveyed in Government vessel once a month. Light ships are partly supplied with provisions.

Statement showing lights on the coast of Queensland—cont.

Name of light.	Description of structure.	Description of light.	By whom managed.	Salaries of lightkeepers * per annum.	Remarks.
North Head, Bowen and six smaller lights in Bowen Harbour.	Hexagonal tower	5th order dioptric, fixed, red and white	1 Light-keeper ..	£ 25	Does not devote all his time to the light.
Cape Bowling Green	Iron tower	3rd order dioptric, revolving every minute, white.	Superintendent and 2 light keepers.	£ 200. At £ 120 and 108.	
Cape Cleveland and eight other small lights, Cleveland Bay.	Do.	4th order dioptric, revolving every 20 seconds, red and white.	Superintendent 1 light-keeper.	£ 140. £ 108.	
Bay Rock and fourteen smaller lights in Hinchinbrook channel and Cairns Harbour.	Circular tower	4th order dioptric, fixed, red and white	1 *Light-keeper* ..	£ 120	This is a secondary coast light.
Island Point	Circular tower	5th order dioptric, fixed, white	Pilot crew ..	....	
Low Island	Do.	3rd order dioptric, revolving every minute	Superintendent and 3 light-keepers.	£ 200. 1 at £ 130 and 2 at £ 108.	
Archer Point	Do.	4th order holophote, white, red and green	2 light-keepers	At £ 160 and 140.	
Rocky Islet	Do.	4th order holophote, white	1 light-keeper	£ 150	Secondary coast light.
Grassy Hill and two small lights in Cook Harbour.	Do.	4th order dioptric, white, fixed	Master and 3 men.	£ 175. 1 at £ 120 and 2 at £ 108.	
Channel Rock	Light ship	6th order dioptric, white, fixed	Do.	Do. do.	
Claremont Island	Do.	6th order dioptric, white, fixed	Do.	Do. do.	
Piper Island	Do.	4th order dioptric, fixed, red and white sectors.	1 light-keeper ..	£ 180	Secondary coast light.
Goode Island	Circular tower	2nd order dioptric, revolving, flash	Superintendent and 2 light-keepers.	£ 200. At £ 130 and 108.	
Booby Island	Do.	5th order dioptric, occulting, every 14 seconds.	Master and 3 men.	£ 175. 1 at £ 120 and 2 at £ 108.	
Proudfoot Shoal and one getty light at Thursday Island and six small lights at entrance to the Norman River.	Light ship	Dioptric, fixed, white	Master and 2 men.	£ 150. At £ 120 and 108.	
Norman Bar	Do.	Dioptric, fixed, white	.. .. ..	.. .. ..	

* All have quarters and are supplied with light and fuel. One month's leave is granted to each light-keeper yearly. Light-keepers provide their own provisions which are conveyed in Government vessel once a month. Light ships are partly supplied with provision.

Classification and Pay of Keepers in New South Wales.

Minimum Salary.	Maximum Salary.	Value of Quarters, Fuel and Light.	Total amount of Salary and Allowances, maximum obtainable.	Annual Increment.
Principal Light-keepers.				
£.	£.	£.	£.	£.
157	250	50	300	10
1st Assistant Light-keepers and Principal Light-keepers in Subordinate Lights.				
120	157	30	187	7
2nd Assistant Light-keepers.				
96	120	30	150	5

A deduction of 4 per cent. per annum is made from the salaries of all persons employed in the service of the Marine Board to entitle them to the allowances and gratuities provided under Parts 5 and 6 of the Civil Service Act.

All the smaller lights used in the navigation of Sydney Harbour by night are without keepers and are under supervision of the light-ship. The master of the light-ship states that he knows of no occasion during the past five years of failure of the lights.

The leading lights at the entrance guiding through the dredged channel are maintained without a perpetual watch.

(Signed) H. D. BADDELEY,
Personal Assistant to the Presidency Port Officer.

Note on Mr. Baddeley's Memorandum on Lights on the Australian Coast.

As I understand Mr. Baddeley's Memorandum, he recommends Government—

(*a*) to reduce the power of (Port) "Local" lights in this Presidency in order to make them more or less automatic and thus save establishment;

(*b*) to effect a saving in the cost of oil by using ordinary 150° kerosine purchased in the local market.

2. It is not quite clear what Mr. Baddeley means by Port lights. In my report on lighthouse illumination, &c., the general principles which should determine the distribution of lights on a coast, as laid down by Monsieur Reynaud, are given. The proposed "Provincial" lights correspond, to a certain extent, to Monsieur Reynaud's system of landfall lights and the majority of "Local" lights to the "Lights of less power" which are necessary to provide a mariner with means of proceeding to his destination. Finally there are the Port lights, such as the lights on the ends of the Madras harbour arms and at Barkur, Mulply, Tellicherry and possibly Mangalore, Cannanore and Calicut. These are the only lights at which Mr. Baddeley's proposal could be adopted, and the saving by making them automatic would be as small as at Madras; owing to the small importance of the lights no special establishment will be required, and at the other stations the possible saving would not exceed Rs. 100 per mensem and might be *nil* if any accident occurred.

3. It is all very well to say that the proposed "Provincial" lights will permit of the "Local" lights being relegated to their proper position as port lights, but it should be observed that, in the proposed scheme, it is not suggested to light the coast to the extent customary in Europe, viz., so that a mariner cannot approach land without seeing at least one of the landfall lights, and, therefore, "Local" lights, though used as port lights, must continue to fill up the gaps in the primary illumi-

nation. For this purpose the existing or proposed ranges are none too great and cannot be reduced without inconvenience and, in some cases, risk to shipping which is not justified by the possible saving in maintenance.

4. Supposing, for the sake of argument, that it is decided to reduce the ranges of the lights mentioned in paragraph 2.

In the case of Barkur (6 miles), Mulply (8 miles), Tellicherry (6 miles), Bimlipatam (10 miles), the burners are of the ordinary, circular, single-wick type, very similar to a table lamp, and it is just as easy to burn them at full power as to keep the wicks low. The only attention (barring accidents) which these lights now require is to change the burner at midnight, and even this would probably be unnecessary if the keepers were trained to trim their burners properly and if a proper shelter for lighting purposes was provided. In any case, however, I do not think a constant watch can be avoided as the lights are liable to be obscured by insects which cannot be removed automatically.

In the case of Mangalore (12 miles), Cannanore (12 miles), Calicut (12 miles), the burners are of the two-wick Douglass type and the apparatus is in good order. If it is thought that the range admits of reduction, the simplest course is, not to put the Douglass burner to a use for which it was never intended, but to instal a single-wick burner of the type in use at the other small stations. This would at once reduce the cost of maintenance, if that is the only object in view. I do not think, however, that this would be justifiable in view of the small saving effected, as the utility of the lights would be much impaired by night and of the tower as a day mark, owing to the necessary reduction in the height.

5. *Paragraphs* 1, 2, 3.—The question of lights burning without attention has been closely investigated by the French and English Engineers during recent years with the result that the former have produced a lamp which, with ordinary light-house oil, will burn for two months without attention (*vide* page 35 of Report on lighthouse construction and illumination) and the latter have found an oil (*vide* page 24 of the same report) which, with an ordinary lighthouse burner, will burn for a considerable time without attention. In Sweden, Norway, &c., the Engineers have invented a light apparatus which will run for ten consecutive days without attention, but in this case the oil used is very volatile and is unsuited for use in India.

To adopt any of these systems might save establishment but would more than double the cost of oil.

6. To adopt Mr. Baddeley's proposal to burn the light at half power would not, I think, be a success, as I do not think Sir James Douglass would have experimented with a special oil if his burner was adapted to run, even at half power, without attention with ordinary oil. To adopt his special oil and provide the necessary special arrangement of automatic valves would mean greater responsibility and require more intelligent keepers on higher pay. Sufficiently trustworthy men may at some future time be available, but, at the present time, it has been thought necessary to provide extra establishment at lighthouse stations because men of the class employed in the Trinity House service are not forthcoming. I may here mention that, from the first, I have been of the opinion that, owing to the greater difficulty in management of the Douglass burner, it would have been better, in the first instance, to have adopted the French burner of 1889 for stations in charge of Native keepers. The Douglass burners have, however, been adopted and the difficulty in management is not such as to justify a change.

7. *Paragraph* 4.—The form of smoke-tube mentioned by Mr. Baddeley was originally introduced by Messrs. Saulter Lemonnier and was, I believe, at one time used in England. The annular spaces between the various lengths were designed to introduce air and, by cooling the smoke, render the combustion more complete. These smoke-tubes were used with the Farquhar and other old forms of burner. Messrs. Saulter only claimed that this arrangement was the best for the old burners with five, four or three wicks and never claimed that it was indispensable for burners of one or two wicks. Since then lantern roof ventilators have been much improved with a view to

prevent down-draughts and lighthouse burners perfected. I have not the papers with me, but I believe that Professor Tyndall demonstrated at Whitby that this form of smoke-tube is prejudicial to the light.

8. *Paragraph* 5.—I fancy that, if enquiries were made, it would be found that the apparatus at lighthouses visited by Mr. Baddeley was supplied by Messrs. Saulter Lemonnier as they are, or were, the sole proprietors of the Farquhar burner. This firm claimed that the Farquhar burner was (many years ago) superior to all others, in that it gave a whiter and higher flame of greater intensity caused by the fact that the tubes for the supply of air to the concentric flames were specially arranged. This burner is, I believe, no easier to manage than the new French burners (*vide* page 34, Report on light-house illumination, &c.) or than the old pattern, Trinity House burner.

In not recommending the Farquhar burner, I am supported by Messrs. Saulter Lemonnier, who in a note written in 1889 say—

> "The burner which we recommend is the Vie Étagé (burner with wick easings in stages) of the type adopted by the French Administration. The burner is furnished with a stand pipe designed to maintain a constant flow of oil and conceived by Monsieur Denechaux, of the French Administration. Lastly this burner is adapted for the consumption of either mineral or vegetable oil."

The Farquhar burner was never intended for use with mineral oil and is in the same undeveloped state as it was many years ago. Seeing that the proprietors do not now recommend its use, I do not think any one else need.

9. To try the Douglass burner with 150° kerosine oil without a permanent watch is a proposal which I cannot recommend. As pointed out in paragraph 4, Sir James Douglass would not have experimented with special oils if there was any prospect of success. This oil might do for the smaller Douglass burners with a permanent watch, but the risk of fire must, in this climate, be considerable and the change could not be made without careful preliminary experiments. It might be used with the single-wick burners with lower reservoir, but in this case the saving would be very small. If any change in oil is made, I suggest a return to cocoanut oil for all lights with Douglass burners (*vide* paragraph 13).

10. *Paragraph* 7.—Calls for no remark.

11. *Paragraphs* 8 *and* 9.—Personally I consider that Native keepers will do excellently for the small "Local" lights and do not admit that they would find any difficulty in manipulating the damper if properly instructed; I do not, in fact, see where the difficulty comes in. Mr. Baddeley is mistaken in saying that these have been Superintendents in charge of any of the proposed "Local" lights (see also paragraphs 2 to 5 of this note).

12. *Paragraph* 10.—See paragraph 22 of Note on Presidency Port Officer's letter, No. 1271—183-G., of 15th July 1895.

13. *Paragraph* 11.—Boatmen and fishermen in this country are not likely to be satisfactory in sole charge of a light.

14. *Paragraphs* 12, 13, 14.—Call for no remark.

15. As Mr. Baddeley has raised the question of reducing the cost of maintenance of lights in this Presidency, I would suggest that, among other ways, this can be done by going back to cocoanut oil. When I was at Alippi I enquired into the cost of this oil and found that the Travancore Governments were purchasing it for the light in their territory at As. 8 * per gallon. There is no objection to the use of this oil, and unless the price of heavy mineral oil can be considerably reduced, I recommend its use, as I do not think Mr. Douglass would have recommended the use of heavy mineral oil had he known that the fall in the value of the rupee would be so great and that the price generally would be so high. I enclose a translation of an extract from a book written by Messrs. Saulter Lemonnier from which it will be observed that Monsieur Reynaud, the French Lighthouse Engineer, considers cocoanut oil to be excellent for lighthouse purposes, its only defect being that it commences to become viscous at 76° Fahr.

* I have not my note-book here, so cannot be certain that this figure is correct.

This does not matter in India as the oil will not be exposed to this temperature. This change would not necessitate any modification of existing apparatus, as the Douglass burners are adapted for use with vegetable oil. I would not, however, recommend any change until it has been ascertained that the present price of heavy mineral oil cannot be reduced. Under no circumstances do I recommend the use of 150° kerosine oil with Douglass burners, as this oil is no cheaper than cocoanut which has the great advantage of being perfectly safe.

Vegetable and Mineral Oils.

[*Translation.*]

Vegetable Oils.—Colza, Arachide (*a*), Olive, Linseed, Cocoanut :—

These different oils have been compared from the following points of view :—

1*st.*—The mean intensity given by the consumption of an equal quantity of oil in lamps of one or several wicks.

2*nd.*—The period of burning, *i.e.*, the time during which the lamp burns without trimming and without apparent reduction in the intensity of the flame.

3*rd.*—The resistance to freezing.

4*th.*—The price.

This last element of comparison varies according to the locality and the season.

Comparison between Vegetable Oils.—Colza oil according to Monsieur Reynaud has many advantages over all the other oils in two very essential respects, viz., intensity in a lamp of several wicks (*excepting cocoanut oil*), and non-liability to become viscous when the temperature falls.* *Olive oil* is a little better for burning in a single-wick lamp and very inferior for burning in a lamp with several wicks; it appears to undergo a rapid change in passing through the burner, and, getting very hot there, necessitates frequent trimming. *Cocoanut oil is excellent*, but commences to become viscous at 24° † degrees above zero. *Linseed oil* is very bad; it produces much char and cannot be used in lighthouses.

* This does not matter in India.

† 76° Fahrenheit.

Mineral Oils.—The essential difference between these oils and vegetable or animal oils is that the former are volatile while the latter are fixed, that is to say, that heat decomposes them without rendering them volatile.

The quantity of colza oil which it is necessary to burn per hour and per unit of light obtained in a burner, of the type adopted in lighthouses before the introduction of mineral oil, having two three or four wicks, varies from 37 to 33 grammes, the smallest consumption being obtained with the largest burner. The quantity of mineral oil which it is necessary to burn per hour in a burner having two, three, four, five or six wicks per unit of light obtained varies from 25 to 29 grammes, the smallest consumption being obtained with the smallest burner. At the same price there is therefore ‡ an advantage in using mineral instead of colza oil. The smaller price of the former makes the advantage still more marked and in all French lighthouses the old colza-oil burners have been replaced by burners with mineral oil with an extra concentric wick without increasing the cost of lighting.

‡ With the old burners.

At the present time perfected § *colza-oil burners are constructed in which* the consumption of oil per unit of light obtained is not greater (*b*) than in mineral oil burners.

§ The Douglass burner or new French burner.

(*a*) I cannot find the meaning of this word.

(*b*) This being the case, the choice between cocoanut and heavy mineral oil depends solely on price.

Note on letter, No. 1271-183 G., dated 15th July 1895, from the Presidency Port Officer.

(1) *Paragraphs* 1, 2, 3.—Call for no remark.

(2) *Paragraph* 4.—It will be observed—page 3, paragraph 8 (*a*), pages 13 and 14, Table I, page 22, Table VIII, and page 19, Table V, of report—that the difficulties brought to notice by the Presidency Port Officer were not lost sight of and only one rock lighthouse was included in the approximate estimate, viz, Sacrifice Rock. Lights on Mulki and Sacrifice Rocks must necessarily be more efficient than on the mainland and the choice of site in both cases merits further consideration. The towers are not likely to be built for a few years and the state of the sea during the monsoon might be observed, as, if a landing can be made about once a fortnight throughout the year, it will be sufficient. I doubt whether the state of the sea alongside either of the rocks is anything like as bad as at the Bishop Rock lighthouse, off the Scilly Isles, which is exposed to the full force of the Atlantic. This question does not affect the scheme to any material extent and need not be decided at once.

(3) *Paragraphs* 5 *and* 6.—Call for no remark.

(4) *Paragraph* 7.—*Vide* remarks, paragraph 4.

(5) *Paragraphs* 8, 9, 10, 11, 12, 13 *and* 14.—Call for no remark.

(6) *Paragraph* 15.—This remark is probably only intended to apply to the class and power of apparatus (*vide* page 34 of report).

(7) *Paragraph* 16.—Calls for no remark.

(8) *Paragraph* 17.—The light at Negapatam is of the same description as at other ports. I see no objection to the Presidency Port Officer's proposal*, neither do I see any advantage except further relief to Port funds. The light can perfectly well be looked after by the local authorities and the proposed "local" keepers (see page 11, paragraph 29, of report).

* Except that "Provincial" establishment will cost more.

(8-A) *Paragraph* 18.—The present light at Cuddalore is at much too great an elevation and the power is very small (red light). To instal one of the 4th-order fixed apparatus, which will, if the scheme is carried out, become available, and to convert it into occulting, is, in my opinion, advisable as the trade is considerable.

(9) *Paragraph* 19.—I do not think that the Presidency Port Officer realizes that to reduce the range at Seven Pagodas would probably result in no saving in cost. The tower is only proposed to be about 50 feet high and this height is required for the falling weight which drives the revolving apparatus. The general question of reducing the ranges of the proposed lights can be considered when the designs are prepared, but the saving would not be very great, as only one light would be affected for certain, viz., Point Calimere, and the saving at this station would be small, as the expense is chiefly in foundations. The usual practice is to enter the ranges in the light list on the assumption that the height of the observer's eye is 12 feet above water level, and this practice should not, I think, be altered in Madras without very good reason. Up to date the custom in this Presidency has been to place lights at excessive elevations and the advantage of now going to the other extreme is not apparent. It should be noted that at Point Divi and Sacramento Shoal I have already suggested that the heights of the towers should be reduced, but this is because a difficulty about foundations is anticipated and the less weight there is in superstructure, consistent with stability, the better.

(10) *Paragraph* 20.—I regret that the Presidency Port Officer should consider that my remarks on the Madras Lighthouse were captious, but I fancy that he is under the impression that the remark "the windows are not properly cleaned" referred to the lantern glazing. This is a mistake, as the remarks, Item B, page 35, Madras Lighthouse, refer solely to the *tower* windows. When I inspected the light the apparatus framing and lantern astragals had evidently not been cleaned for some time, though they would, no doubt, have been perfectly clean had the keepers been aware that I intended to inspect the light. I was not aware that the light was not in charge of a responsible person.

(11) *Paragraph* 21.—If the present Hope Island apparatus is moved to Pulicat, the large two-wick burners may just as well be transferred with it. There is, however, no urgency about this. This may be sufficient, at all events, for the present. I do not think any change is very necessary unless the light is converted to occulting, except perhaps as regards burner.

(11-A) *Paragraph* 22.—The existing clock-work can, I think, be repaired, as the Civil Engineering College has recently imported a machine for cutting teeth. The apparatus does not, at present, revolve properly because the teeth on the pinion, &c., were cut locally by hand and are not uniform.

(12) *Paragraph* 23.—Calls for no remark except that the efficiency of the light as a guide to mariners should, it is suggested, outweigh facilities of communication.

(13) *Paragraph* 24.—Point Divi light is a long way (10 miles) from Masulipatam and difficult to get at. The Presidency Port Officer does not say whether he proposes to maintain also the existing port light at Masulipatam (*vide* page 37 of report). This would be extravagant and neither of the lights would be in the best position for the purpose. A considerable expenditure would also have to be incurred on quarters for establishment if the present light at Point Divi is maintained. My proposal is in accordance with Mr. Douglass' recommendation. I do not see any advantage in maintaining the existing light at Point Divi.

(14) *Paragraph* 25.—Calls for no remark.

(15) *Paragraph* 26.—Need not be considered at present. Gas buoys are expensive—*vide* page 77 of my report on lighthouse construction and illumination.

(16) *Paragraph* 27.—The Presidency Port Officer has transposed the lights proposed by me. I suggested a 4th-order fixed light at Vizagapatam as the East Coast Railway are developing this port and a decent light should, in my opinion, be provided in the first instance. I would suggest that nothing be done towards providing temporary lights at these ports. Associated lights are always expensive and new apparatus would be required.

(17) *Paragraphs* 28 *and* 29.—Call for no remark.

(18) *Paragraph* 30.—If this is the case * the other similar port lights might be in charge of a single keeper. It won't do to suddenly rush to the other extreme. If the proposed scheme is sanctioned there will be plenty of changes in establishments without making more. At many of these ports the keepers are required for signalling and there are keepers available who will otherwise have to be pensioned.

* See note on Mr. Baddeley's Memorandum.

(19) *Paragraph* 31.—This statement should, I think, be received with caution. The necessary information from the Board of Revenue has not yet been received.

(20) *Paragraph* 32.—If the proposed lights on the West Coast are not provided, the scheme practically falls through. It is quite possible that reductions can be made in the estimate when prepared in detail.

(21) *Paragraph* 33.—The statement to which the Presidency Port Officer takes exception is, nevertheless, true. I don't think any lighthouse on the Madras coast can be placed in the same class as the Bishop Rock, Eddystone, Wolf Rock, Bell Rock, &c., where the rocks are covered at high water and the keepers have no place to take exercise except the lantern gallery or pedestal platform.

2. I don't understand the remark about steamers to land men near a railway, as with one, or possibly two, exceptions the proposed stations are on land. There are several steamers a week all round the coast and, as the Presidency Port Officer remarks in paragraph 37, railways are being rapidly extended in this Presidency.

3. The additional allowance of £25 for keepers while on duty at a rock station was not mentioned, as it does not seem necessary to adopt every detail of the Trinity House, Scotch and French Service Regulations; I also do not believe that any such allowance is given except in very special cases. The allowances in Scotland are very much less than £25 and no allowances at all are given for keepers employed at island stations such as Ailsa Craig.

4. I did not go into details regarding pensions but merely entered the contribution at the ordinary rate. The Presidency Port Officer probably alludes to an allowance of £18 per annum which is added to a light-keeper's pay in the Trinity House Service when calculating pensions, as, if not provided with quarters, this additional allowance would have been made for house-rent.

Whether any addition of this sort should be made is a matter for Government to decide. It does not seem necessary, however, to adopt every detail of the Trinity House Regulations as they have not been followed in other respects. Some addition might possibly be made to pensions in the case of men who have a clean defaulter's sheet at the time of retirement.

5. Please see page 9, paragraph 20, and page 22, Table VIII, from which it will be observed that compensation for dearness of provisions has been included at varying rates for all stations except Madras and Calingapatam, where no allowances seem necessary.

6. I also see no reason to give the present Superintendents anything beyond a personal allowance to prevent actual loss of pay. They might, however, be allowed to draw an increased pension. This would tend to make them more contented without upsetting the newly-recruited men.

7. Scavengers and water-men should not, I believe, be pensionable. Their pay may be charged to works or the keepers may provide their own scavengers and water-men and then there will be no probability of too many of these men being employed. In this case, the keepers should receive an allowance on the understanding that menial servants are not to enter the tower or store-rooms connected with it.

(22) *Paragraph* 34.— Please see page 11, paragraph 29. To carry out the suggestion made by Mr. Baddeley would complicate matters considerably and interfere with the proposed gradual handing over of port lights to local authorities. Besides, I do not think that it would increase the attractions of the proposed Provincial service to make men serve for some years on the pay proposed for "Local" keepers, while it would be manifestly unfair to allow Eurasian recruits for the Provincial service to absorb the better-paid appointments in the "Local" service. It should be remembered that it is not, as a rule, proposed to provide quarters for "Local" (native) keepers, while the Eurasian recruits for the Provincial service would have to be provided with quarters or granted an allowance while employed in the Local service. This would be a source of discontent among the native members of the Local service. The importance of reserving one service for Eurasians and the other for natives should also, I think, not be lost sight of. The men in the Provincial service have to live at somewhat isolated stations, and to mix up two classes of keepers, which would be the case if Local keepers are promoted to the Provincial service, is not likely to be a success from a social point of view. In the "Local" service I also would suggest that a certain number of appointments should be reserved for Muhammadans.

I do not think a lodging allowance is necessary. The pay of these men is proposed to be increased, and the less they are interfered with as regards quarters, the better. So long as the light is properly maintained, a "Local" keeper may live anywhere within a reasonable distance (so long as a man turns up for his work regularly I should say he lived within a reasonable distance) and the local authorities should be required to see that the light is properly maintained. If rules are made laying down a certain minimum radius within which a keeper must live, respectable men who have houses of their own will not come forward. When once the local lights are in order, I would suggest that they should be handed over to local authorities, under certain conditions as to maintenance, as soon as possible, wherever such authorities exist.

(23) *Paragraph* 36.—Please see page 7, paragraph 16, of report. I only proposed to provide inspecting officers similar to the Trinity House Superintendents and would submit that the present lighthouse mechanic is competent for one of these appointments. If not, I should say that the sooner his services are dispensed with the better. His duties are proposed to be strictly limited and he will be better employed than spending half his time kicking his heels in Madras without any specified duties. I see no advantage in making the mechanic Superintendent of the

Madras light with another Superintendent to take his place when his services are required elsewhere. It would simply mean divided authority and no responsibility, as was apparently the case when I inspected the Madras light—see paragraph 20. It is necessary to have men constantly paying unexpected visits to lights in order to keep the keepers up to the mark.

(Signed) F. W. ASHPITEL,
Executive Engineer.

26*th July* 1895.

Order—No. 245, Marine, dated 8th April 1896.

The question of improving the coast lights of this Presidency has engaged the attention of Government for some years past. In G.O. No. 318, Marine, dated 10th August 1895, Mr. F. W. Ashpitel, who had recently studied light-house construction and illumination in Europe, was deputed on special duty to inspect all the lights along the Madras Coast, and report on their suitability or otherwise, their position, and the structures from which they are displayed. His enquiries were to extend to the consumption of stores, and the organisation and housing of the establishment.

2. The report recorded above has been submitted in compliance with these orders. It is, in the opinion of His Excellency the Governor in Council, a very complete and exhaustive document, and merits the thanks of Government which will be conveyed to Mr. Ashpitel through the head of his department.

3. It embraces the following proposals :—

(1) The division of lights into "Sea" and "Port" with the object of—
(*a*) gradually handing over those lights which are not required for general navigation to local authorities, such as Conservancy Boards, Landing and Shipping Dues Committees, &c., under certain conditions as to maintenance ;
(*b*) levying dues on the shipping for those lights which are useful for purposes of general navigation.
(2) The complete re-organisation of the light-house establishments, the provision of proper training for the men, and suitable house accommodation where necessary.
(3) The improvement of existing lights and the introduction of new ones.

4. His Excellency the Governor in Council doubts the utility of the proposed classification of lights, and is not inclined to agree in the suggestion that their management should be handed over to local bodies. It is considered essential that the management and control should remain with the officers of the Marine Department.

5. The proposal for the levy of special dues on shipping for the use of the lights is also, in the opinion of His Excellency in Council, open to grave objection, and he does not at present see his way to taking the requisite steps to give effect to a measure of this kind.

6. The probable expenditure necessary for the improvement of existing and the construction of new lights is given as Rs. 8,80,000. Of this sum, the proposed "Sea" lights absorb Rs. 8,00,000, of which Rs. 2,08,000 are for eight new sets of apparatus, Rs. 4,55,000 for improvements to existing towers and for new constructions, and the balance for contingencies and Public Works supervision. The annual cost of interest, Sinking fund and maintenance for "Sea" lights is estimated at Rs. 1,30,000, and Rs. 15,000 is the cost of maintenance for "Port" lights, or a total of Rs. 1,45,000 per annum for the maintenance of a total of 32 lights. To meet the capital cost for "Sea" lights it is proposed to raise a loan of 8 lakhs of rupees bearing interest at $3\frac{1}{2}$ per cent. and to meet the annual charges for interest, Sinking fund and maintenance by the levy of light-house dues on shipping. As stated above the proposal to raise funds in this manner does not commend itself to Government. It thus remains to consider how the requisite funds can be obtained.

7. It is observed that the annual surplus from the Madras Port fund is under existing orders, handed over to the Harbour Trust Board. As the harbour will shortly be completed, it may be possible to divert these monies to the light service. The contributions for the past five years have been as follows :—

	Rs.
1891–92	50,000
1892–93	65,000
1893–94	20,000
1894–95	1,74,862
1895–96	44,075
Total ...	3,53,937

or an average of Rs. 70,000 per annum. As however the contributions for 1894–95 and 1895–96 are liable to be disturbed by adjustments, which have not yet been decided on, they will be excluded in fixing the average and the figures for the previous three years alone taken into account. The average thus arrived at will be Rs. 45,000. In addition to this amount, Port funds already contribute Rs. 55,000 a year for the upkeep of lights. There would thus be available a sum of Rs. 1,00,000 as against Rs. 1,45,000 required. The distribution of the amount estimated for "Sea" lights would be as follows on the supposition that the money required for construction is raised by loan :—

	Rs.
Interest at $3\frac{1}{2}$ per cent. on Rs. 8,00,000	28,000
Sinking fund	19,500
Maintenance of lights	82,500
Total ...	1,30,000

8. The question of raising the requisite funds will be considered hereafter in the Financial Department. It is observed that the total balance (Government securities and cash) at the credit of Port funds on the 31st March 1896 is estimated at Rs. 6,73,000. Of this amount, Rs. 2,39,000 appertain to the port of Madras and may be left intact. The accumulated balances of the Eastern and Western groups may therefore be taken at Rs. 4,34,000 which could, if the funds of these two groups were amalgamated, be utilised, if necessary, for starting Mr. Ashpitel's proposals for light-house construction and illumination. There will still be required a sum of Rs. 3,66,000 to complete the scheme. It will not be wanted at once and, meanwhile, it may be assumed that further accretions to the surplus balances of Port funds will continue. It may thus not be necessary either to raise any loan or impose light dues. At all events the matter is not one which requires immediate action. If no loan is raised there will be a saving of Rupees 47,500 * in the estimated annual expenditure of Rs. 1,45,000 for maintenance, &c., of both sea and port lights, and the sum remaining to be provided for maintenance alone will be Rs. 97,500 † only.

	Rs.
* Interest on proposed loan of 8 lakhs.	28,000
Sinking fund	19,500
Total ...	47,500

	Rs.
† Maintenance of sea lights	82,500
Do. of port lights ...	15,000
Total ...	97,500

9. His Excellency the Governor in Council now proceeds to pass orders on the detailed proposals made in Mr. Ashpitel's report.

Paragrpah 8 (*a*)—*Mulki Rocks.*—For the reasons advanced by the Presidency Port Officer it is considered that a somewhat stronger light on the main land must be better than a weaker one on the rocks.

(*b*) *Sacrifice Rock.*—For the same reasons, the proposal to place the light on Cotta Point will probably be best.

(*c*) *Aleppi.*—The proposal to increase the speed of this light so as to make one revolution in two minutes is approved.

(*d*) The light on Tangacheri Point is approved as part of the general scheme, and the question of addressing the Travancore Government again on the incidence of the charge will lie over for the present.

(*e*) *Point Muttum.*—An increase to the power of the Muttum light during thick weather should be made. The present four-wick burners can, as suggested by the Presidency Port Officer, be used with one of the new third order lights, but before doing this, the ventilation should be improved.

(*f*) *Manapaud.*—The installation of a third order flash light on Manapaud Point should be taken in hand at once. The requisite plans and estimates will be prepared by the Public Works Department in communication with the Presidency Port Officer and Mr. Ashpitel.

(*g*) *Pamban.*—The class and power of apparatus of this light are considered sufficient.

(*h*) *Point Calimere.*—The new light recommended at this position is considered suitable, but its installation is not a matter of urgency.

Negapatam.—The proposal to increase the power of the Negapatam light, which is a land-fall light for vessels from the Strait Settlements, is approved.

(*i*) *Seven Pagodas.*—The new eighteen mile triple flashing light proposed is approved. The details of height and position of the tower will be worked out by Mr. Ashpitel and the Presidency Port Officer, and an estimate submitted with the least possible delay. The matter is one of urgency.

(*j*) *Madras.*—No alterations are required here.

(*k*) *Pulict.*—The proposal to utilise the present Hope Island light at Pulicat is approved. The existing burners are, however, in the opinion of the Presidency Port Officer, sufficient, and this opinion is accepted. The question of porviding an occulting shutter can be deferred as proposed.

(*l*) *Armeghon.*—The present apparatus is reported to be sufficient, but it is recommended that the range be increased to 15 miles, when the weather is misty, by installing a three-wick burner. This recommendation is approved. The present clock work should be repaired at the Workshop of the College of Engineering, if possible. If not, it should be renewed.

(*m*) *Point Divi.*—The existing light is reported to be very inefficient owing to wrong location. A new light from the False Point near the sea is recommended. This is approved, but the choice of site will require very careful consideration by the Presidency Port Officer. The efficiency of the light as a guide to mariners should outweigh disadvantages of communication from the mainland.

(*n*) *Hope Island and Vakalapudi.*—The lights at these places have been installed to mark the dangers to navigation off the Sacramento Shoal and Gódávari Point, and to light the approaches to Cocanada. The existing light at Hope Island is said to be inefficient. It fails to cover the Sacramento Shoal, while that at Vakalapudi appears to be sufficient, but its range requires increasing to about 15 miles by installing a three-wick burner during misty weather. It is said that if a new eighteen mile light be installed on the mainland opposite Sacramento Shoal, the ranges of the two lights will cut in 30 fathoms off Coringa, and the approaches to Cocanada will be efficiently lighted. This proposal is approved. The question of the best site for the permanent light is under consideration and should receive careful and very early attention. Meanwhile, arrangements have been made for the exhibition of a temporary light opposite the Sacramento Shoal.

(*o*) *Santapilli Rock.*—The existing light is 6 to 7 miles from the shoal. The proposal to instal a more powerful burner is approved. The ventilation of the lantern should also be attended to. The Presidency Port Officer points out that any attempt to mark the shoal by a light would involve quite a prohibitive expenditure, having in view the tonnage of the shipping that could be expected to contribute.

(*p*) *Kalingapatam.*—This light marks a reef of rocks which extend about half a mile seaward. A new fourth order occulting light has recently been installed here, and nothing further is required.

Paragraph 9.—Mr. Ashpitel here gives his reasons for recommending lights of the flashing type in preference to fixed or occulting lights of a corresponding order. There seems no doubt that the flashing lights are to be preferred for landfall lights, if they can be afforded.

The suggestions made in Mr. Ashpitel's notes of inspection should be carefully considered by the Presidency Port Officer and, subject to the special orders given in these Proceedings, carried out in due course wherever practicable.

Paragraphs 10 *to* 21.—This portion of the report is taken up with discussing the present and proposed organization of establishment. The recommendations made may be thus summarised. The whole establishment to be re-organized, and two separate services formed for "Sea" and for "Port" lights, respectively,—the former to be a "Provincial" service and to consist of Eurasians on higher rates of pay; the latter a "Local" service with natives on lower rates. The men forming the Provincial service to be either carpenters or mechanics, and the men of both services to be specially trained for their duties. To supervise this establishment two inspecting officers are to be appointed—one for the East and the other for the West Coast; these men to be properly qualified mechanics, who have received a special training and have actually had charge of a light. As regards the educational qualifications of the light-keepers, it is not considered necessary to insist on more than a knowledge of reading, writing and arithmetic, sufficient to enable them to keep the requisite store-books and journals,—the great *desideratum* being reliable working men. Tables II and III give the rates of pay proposed for the two light-house services, and table IV shows the rates given in the Trinity House and Scotch Services.

10. His Excellency the Governor in Council is satisfied as to the necessity for an early re-organization of the light establishments of the Presidency and is willing to consider proposals based on Mr. Ashpitel's scheme. The Presidency Port Officer will accordingly submit a proposition statement in the prescribed form to show the financial effect. The question as to dividing the establishment into a Provincial and Local service cannot be accepted at present. Meanwhile the men can form one body of various grades, the higher of which would be posted to those lights which are most important and have the most complicated apparatus. There seems no reason to suppose that men of the requisite qualifications cannot be obtained. It is possible that suitable recruits can be drawn from the Lawrence Asylum, or the Industrial school; or that the President of the Eurasian and Anglo-Indian Association may be able to afford assistance in the selection of men. The Presidency Port Officer will institute further enquiry on this point and will carefully consider the measures requisite to give effect to the proposal for the training of the men in the duties which they will be expected to perform. Some latitude as regards examination rules will be allowed, but a certain educational standard is necessary to attend to correspondence and maintain the requisite forms and store accounts.

11. The Presidency Port Officer agrees generally with the adoption, as proposed by Mr. Ashpitel, of the Trinity House system of maintenance, altered to suit local conditions, but suggests alterations in detail, and is at variance with that officer on the proposed method of inspection.

12. The Presidency Port Officer's proposals as regards the inspecting officer are not considered feasible. The men to be appointed under Mr. Ashpitel's scheme would be superior mechanics only, and their inspections would be merely of a technical character, and would ensure this portion of the duty being properly attended to, instead of being much neglected as under the present system. But the existence of these inspectors would not interfere with the responsibility of the Port officers, which would continue *pari passu*. It is quite possible that a somewhat higher rate of pay than that proposed may have to be given for properly qualified inspectors, but on the other hand, if all the men, instead of being divided into two separate classes, are brought on one scale, it will be possible to secure a satisfactory flow of promotion on lower salaries than those proposed by Mr. Ashpitel. The question should be further considered by the Presidency Port Officer in drawing up the proposition statement.

Govt. of {1896} Madras.

MARINE.

Ro. 1397 dt 2nd May 1896

Communicated to Sub. Engineers for information and for necessary action where necessary.

Dated April, 8th.

Recd. *Encl.*

G.O. No. 245, 8th April 1896.

APRIL.

J. Es
CA. to Govt.

Light-houses

Orders reviewing a report by Mr. F. W. Ashpitel on the — in this Presidency.

APPENDIX A.

Remarks on Lighthouse construction and management in the Madras Presidency.

Local Inspections.

These inspections, so far as is possible to judge, are carried out much too hurriedly. The Inspecting officer should, as a rule, halt at least 24 hours at the station and visit the light at night. The present system of rushing out to a light and returning to head-quarters with the least possible delay is, to a large extent, a waste of time and money.

Construction of Towers.

2. (*a*) The existing towers have been located and designed without due regard to efficiency. The idea that a light, however feeble, has only to be exhibited from a sufficiently high elevation to secure a great range, has been systematically followed in spite of the fact that the relation, which should exist between elevation and range, has been more or less accurately determined. The result is that many of the towers, such as Mangalore and Seven Pagodas, are much too high for the power of the apparatus and, when the atmosphere is impaired, the light has no chance of reaching the horizon. To place a light at too great an elevation is to defeat the whole object of the dioptric system for, as the Commissioners appointed in 1861 to report on the condition and management of lights, buoys, and beacons, remark in their report :—

"A beam of given divergence, with its axis in the plane of the geometrical horizon, or at "right angles to a vertical line, must become invisible from the sea if the light is raised to a "sufficient height above the earth whose surface is curved, and the more nearly it approaches that "height the less serviceable it will be, because the greater will be the amount of light thrown on "the sky." On this account I recommend that, when certain lights (*vide* Table I) are improved, the height of the towers shall be reduced.

In addition to excessive height, towers have been constructed of much too small internal diameter without service rooms, proper means of access to the lantern or proper ventilation. Their repairs are not attended to in a systematic way and the fittings are in many cases very indifferent. Cement might with advantage be used to a greater extent for plastering where the work is exposed to the sea air.

(*b*) Many of the towers are very badly lighted owing to the small size of the loopholes. Proper glazed windows of sufficient size should be fixed particularly in the interest of ventilation.

(*c*) Suitable designs for quarters for the different classes of establishment are much required. The needs of different stations are very similar, and if the accommodation to be provided is once laid down, type designs could be prepared. It is suggested that for the proposed "Provincial" establishment the accommodation shown on the design which accompanies this report, is suitable. For "Local" establishments, the standard design for police lines might be adopted, but the buildings should be constructed in a more substantial way than is generally the case with police lines.

(*d*) Painting lighthouse towers and buildings requires to be given much more attention, both as regards workmanship and colour. Towers are generally required to serve as a mark by day and the colour with reference to the background is a matter of great importance. Several instances have been brought to notice in Appendix B regarding the difficulty in distinguishing towers by day. In India white appears to be the most suitable colour, but vertical stripes or diamond pattern may be found useful in some localities where a distinctive character is necessary. Dark colours and black and white horizontal bands do not seem suitable for towers on land as there are generally trees in the background.

Lanterns.

3. (*a*) The type of lantern generally installed in India is the old Trinity House pattern with vertical bars. This type has been practically abandoned in England owing to its want of rigidity and for other reasons. This want of rigidity is very apparent as at nearly all stations a large number of panes of glass are broken. This breakage may be partly due to faulty glazing and to the glass fitting too tight, but it is advisable to stiffen those lanterns where the light is not required to be shown all round the horizon. In future indents for lanterns, helical or inclined framing, should be specified. Care must also be taken when fixing a lantern to place the door facing the direction from which least wind is expected, as otherwise the keepers find a difficulty in maintaining the light properly when the door is opened at night to give access to the gallery. Lantern doors should also be fitted so that they may be fixed open at any angle that may be required. It is a question whether lanterns of larger diameter than the usual standard size should not be obtained in future as, owing to the climate and confined space in which the keepers have to move, the heat is very great.

(*b*) The painting of lanterns is now done by the keepers who do not scrape the old paint properly nor apply the new paint in sufficiently thin coats. Some of the paint supplied does not appear to be of good quality or has been improperly mixed.

(*c*) Communication in the shape of a telephone or speaking-tube should, in the case of sea lights, always be provided in order that the keeper on duty may summon help if necessary.

(*d*) The light on Tangacheri Point is approved as part of the general scheme, and the question of addressing the Travancore Government again on the incidence of the charge will lie over for the present.

(*e*) *Point Muttum.*—An increase to the power of the Muttum light during thick weather should be made. The present four-wick burners can, as suggested by the Presidency Port Officer, be used with one of the new third order lights, but before doing this, the ventilation should be improved.

(*f*) *Manapaud.*—The installation of a third order flash light on Manapaud Point should be taken in hand at once. The requisite plans and estimates will be prepared by the Public Works Department in communication with the Presidency Port Officer and Mr. Ashpitel.

(*g*) *Pamban.*—The class and power of apparatus of this light are considered sufficient.

(*h*) *Point Calimere.*—The new light recommended at this position is considered suitable, but its installation is not a matter of urgency.

Negapatam.—The proposal to increase the power of the Negapatam light, which is a land-fall light for vessels from the Strait Settlements, is approved.

(*i*) *Seven Pagodas.*—The new eighteen mile triple flashing light proposed is approved. The details of height and position of the tower will be worked out by Mr. Ashpitel and the Presidency Port Officer, and an estimate submitted with the least possible delay. The matter is one of urgency.

(*j*) *Madras.*—No alterations are required here.

(*k*) *Pulict.*—The proposal to utilise the present Hope Island light at Pulicat is approved. The existing burners are, however, in the opinion of the Presidency Port Officer, sufficient, and this opinion is accepted. The question of porviding an occulting shutter can be deferred as proposed.

(*l*) *Armeghon.*—The present apparatus is reported to be sufficient, but it is recommended that the range be increased to 15 miles, when the weather is misty, by installing a three-wick burner. This recommendation is approved. The present clock work should be repaired at the Workshop of the College of Engineering, if possible. If not, it should be renewed.

(*m*) *Point Divi.*—The existing light is reported to be very inefficient owing to wrong location. A new light from the False Point near the sea is recommended. This is approved, but the choice of site will require very careful consideration by the Presidency Port Officer. The efficiency of the light as a guide to mariners should outweigh disadvantages of communication from the mainland.

(*n*) *Hope Island and Vakalapudi.*—The lights at these places have been installed to mark the dangers to navigation off the Sacramento Shoal and Gódávari Point, and to light the approaches to Cocanada. The existing light at Hope Island is said to be inefficient. It fails to cover the Sacramento Shoal, while that at Vakalapudi appears to be sufficient, but its range requires increasing to about 15 miles by installing a three-wick burner during misty weather. It is said that if a new eighteen mile light be installed on the mainland opposite Sacramento Shoal, the ranges of the two lights will cut in 30 fathoms off Coringa, and the approaches to Cocanada will be efficiently lighted. This proposal is approved. The question of the best site for the permanent light is under consideration and should receive careful and very early attention. Meanwhile, arrangements have been made for the exhibition of a temporary light opposite the Sacramento Shoal.

(*o*) *Santapilli Rock.*—The existing light is 6 to 7 miles from the shoal. The proposal to instal a more powerful burner is approved. The ventilation of the lantern should also be attended to. The Presidency Port Officer points out that any attempt to mark the shoal by a light would involve quite a prohibitive expenditure, having in view the tonnage of the shipping that could be expected to contribute.

(*p*) *Kalingapatam.*—This light marks a reef of rocks which extend about half a mile seaward. A new fourth order occulting light has recently been installed here, and nothing further is required.

Paragraph 9.—Mr. Ashpitel here gives his reasons for recommending lights of the flashing type in preference to fixed or occulting lights of a corresponding order. There seems no doubt that the flashing lights are to be preferred for landfall lights, if they can be afforded.

The suggestions made in Mr. Ashpitel's notes of inspection should be carefully considered by the Presidency Port Officer and, subject to the special orders given in these Proceedings, carried out in due course wherever practicable.

Paragraphs 10 *to* 21.—This portion of the report is taken up with discussing the present and proposed organization of establishment. The recommendations made may be thus summarised. The whole establishment to be re-organized, and two separate services formed for "Sea" and for "Port" lights, respectively,—the former to be a "Provincial" service and to consist of Eurasians on higher rates of pay; the latter a "Local" service with natives on lower rates. The men forming the Provincial service to be either carpenters or mechanics, and the men of both services to be specially trained for their duties. To supervise this establishment two inspecting officers are to be appointed—one for the East and the other for the West Coast; these men to be properly qualified mechanics, who have received a special training and have actually had charge of a light. As regards the educational qualifications of the light-keepers, it is not considered necessary to insist on more than a knowledge of reading, writing and arithmetic, sufficient to enable them to keep the requisite store-books and journals,—the great *desideratum* being reliable working men. Tables II and III give the rates of pay proposed for the two light-house services, and table IV shows the rates given in the Trinity House and Scotch Services.

10. His Excellency the Governor in Council is satisfied as to the necessity for an early re-organization of the light establishments of the Presidency and is willing to consider proposals based on Mr. Ashpitel's scheme. The Presidency Port Officer will accordingly submit a proposition statement in the prescribed form to show the financial effect. The question as to dividing the establishment into a Provincial and Local service cannot be accepted at present. Meanwhile the men can form one body of various grades, the higher of which would be posted to those lights which are most important and have the most complicated apparatus. There seems no reason to suppose that men of the requisite qualifications cannot be obtained. It is possible that suitable recruits can be drawn from the Lawrence Asylum, or the Industrial school; or that the President of the Eurasian and Anglo-Indian Association may be able to afford assistance in the selection of men. The Presidency Port Officer will institute further enquiry on this point and will carefully consider the measures requisite to give effect to the proposal for the training of the men in the duties which they will be expected to perform. Some latitude as regards examination rules will be allowed, but a certain educational standard is necessary to attend to correspondence and maintain the requisite forms and store accounts.

11. The Presidency Port Officer agrees generally with the adoption, as proposed by Mr. Ashpitel, of the Trinity House system of maintenance, altered to suit local conditions, but suggests alterations in detail, and is at variance with that officer on the proposed method of inspection.

12. The Presidency Port Officer's proposals as regards the inspecting officer are not considered feasible. The men to be appointed under Mr. Ashpitel's scheme would be superior mechanics only, and their inspections would be merely of a technical character, and would ensure this portion of the duty being properly attended to, instead of being much neglected as under the present system. But the existence of these inspectors would not interfere with the responsibility of the Port officers, which would continue *pari passu*. It is quite possible that a somewhat higher rate of pay than that proposed may have to be given for properly qualified inspectors, but on the other hand, if all the men, instead of being divided into two separate classes, are brought on one scale, it will be possible to secure a satisfactory flow of promotion on lower salaries than those proposed by Mr. Ashpitel. The question should be further considered by the Presidency Port Officer in drawing up the proposition statement.

13. His Excellency in Council has also considered Mr. Baddeley's notes of his tour in some of the Australian Colonies. As summarised by Mr. Ashpitel the recommendations made are as follows:—

(*a*) to reduce the power of (Port) "Local" lights in this Presidency in order to make them more or less automatic and thus save establishment;

(*b*) to effect a saving in the cost of oil by using ordinary 150° kerosine purchased in the local market.

14. Seeing that the proposals made under (*a*) are not generally in consonance with those brought forward by Mr. Ashpitel which have already been approved, it is not necessary to discuss them. As regards (*b*), however, it seems worthy of consideration whether, as suggested by Mr. Ashpitel, some economy cannot be effected by the use of cocoanut oil, which is said to be not only safe but suitable. The question thus resolves itself into one of cost. The Presidency Port Officer will cause a series of experiments to be carefully made at Madras with both cocoanut and mineral oil, and report the result as to (1) illuminating power and (2) cost.

15. The general question as to the supply and distribution of oil is also one of great importance, and should be considered by the Presidency Port Officer, whose attention is called to the remarks in paragraph 7, appendix A of Mr. Ashpitel's report.

16. There are several other useful suggestions for improvement scattered through appendix A. They cannot be dealt with in detail at present, but they should be kept in view, particularly when the estimates which have to be prepared come forward for consideration. Meanwhile, Mr. Ashpitel will be requested to compile a Manual for the guidance of the mechanic inspectors and light-keepers. This, if translated into the vernaculars, cannot fail to be of great use to the light establishments generally, and will tend to secure a more methodical and intelligent performance of duty for the future.

17. The question of lightning conductors raised in paragraph 10 of appendix A is one upon which further information seems desirable. Mr. Ashpitel's remarks will be communicated to the Secretary of State in view to the highest authorities on the subject at Home being consulted.

18. The question of meteorological observations referred to in paragraph 12, though important, is not pressing. A few simple instructions for the guidance of the light establishments may be embodied in the Manual Mr. Ashpitel has been asked to prepare.

19. In G.O. No. 1000, Financial, dated 17th November 1894, the powers of the Presidency Port Officer to sanction "new works" and "repairs" were raised from Rs. 500 to Rs. 1,000 in each case. His Excellency the Governor in Council considers that, until the lights have been placed on a proper footing, it is undesirable that any local sanctions for new light-house works should be accorded. The Presidency Port Officer's power in this respect will therefore be held in abeyance, but he will still be authorized to sanction petty repairs up to a limit of Rs. 500. Care will, however, be taken that no work is carried out that contravenes the general principles approved in the present Proceedings. Orders will issue in the Financial Department modifying the Presidency Port Officer's powers of sanction accordingly.

20. The proposal to adopt suitable designs for quarters for the different classes of establishment is approved. The design recommended for the proposed "Provincial" establishment is the same as that adopted for bandsmen's quarters. It will be forwarded to the Presidency Port Officer for opinion as to its suitability for the better class of light-keepers. A copy of the standard design for police lines will also be forwarded for remarks as to its suitability for the lower classes of establishment. It will be necessary that in exposed situations, the buildings should be constructed with substantial materials. There seems no reason why the prohibition * in regard to alterations to existing buildings should be maintained any longer. It will accordingly be withdrawn, but no new buildings should be provided until a final decision has been arrived at as to standard plans.

* *Vide* G.O., No. 318, Marine, dated 10th August 1894.

21. As regards the agency by which the work in connection with light-houses is to be carried out, there seems to be no reason why the ordinary Public Works establishments should not undertake it if proper working drawings, which Mr. Ashpitel will see to, are supplied.

22. In a separate letter Mr. Ashpitel brings to notice the inadequacy of the allowance granted to him, while engaged in the special duty of which the report recorded above is the outcome. Considering how thoroughly this duty has been performed, and the important results to Government likely to follow, His Excellency the Governor in Council is of opinion that a substantial recognition of Mr. Ashpitel's labours should be granted. An honorarium of Rs. 1,000 from Port funds will accordingly be recommended for the sanction of the Government of India.

[Here enter No. 246, Marine, dated 8th April 1896.]

(True Extract.)

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
Joint Secretary to Government.

To the Presidency Port Officer, with plans.
„ the Chairman, Harbour Trust Board.
„ the Accountant-General.
„ F. W. Ashpitel, Esq., through the Chief Engineer, Public Works Department.
„ the Public Works Department.
„ the Financial Department.
„ the Educational Department.

Exd. T. K. Narayana Aiyangar.
Spare Copies

Govt. of {1896} Madras.

MARINE.

No. 1397 & 2nd May 1896

Communicated to Sanitary Engineer for information and for necessary action when necessary.

Dated April, 8th.

Recd. Encl.

G.O. No. 245, 8th April 1896.

APRIL.

J. Es
C.A. Genl.

Light-houses

Orders reviewing a report by Mr. F. W. Ashpitel on the — in this Presidency.

APPENDIX A.

Remarks on Lighthouse construction and management in the Madras Presidency.

Local Inspections.

These inspections, so far as is possible to judge, are carried out much too hurriedly. The Inspecting officer should, as a rule, halt at least 24 hours at the station and visit the light at night. The present system of rushing out to a light and returning to head-quarters with the least possible delay is, to a large extent, a waste of time and money.

Construction of Towers.

2. (*a*) The existing towers have been located and designed without due regard to efficiency. The idea that a light, however feeble, has only to be exhibited from a sufficiently high elevation to secure a great range, has been systematically followed in spite of the fact that the relation, which should exist between elevation and range, has been more or less accurately determined. The result is that many of the towers, such as Mangalore and Seven Pagodas, are much too high for the power of the apparatus and, when the atmosphere is impaired, the light has no chance of reaching the horizon. To place a light at too great an elevation is to defeat the whole object of the dioptric system for, as the Commissioners appointed in 1861 to report on the condition and management of lights, buoys, and beacons, remark in their report :—

"A beam of given divergence, with its axis in the plane of the geometrical horizon, or at "right angles to a vertical line, must become invisible from the sea if the light is raised to a "sufficient height above the earth whose surface is curved, and the more nearly it approaches that "height the less serviceable it will be, because the greater will be the amount of light thrown on "the sky." On this account I recommend that, when certain lights (*vide* Table I) are improved, the height of the towers shall be reduced.

In addition to excessive height, towers have been constructed of much too small internal diameter without service rooms, proper means of access to the lantern or proper ventilation. Their repairs are not attended to in a systematic way and the fittings are in many cases very indifferent. Cement might with advantage be used to a greater extent for plastering where the work is exposed to the sea air.

(*b*) Many of the towers are very badly lighted owing to the small size of the loopholes. Proper glazed windows of sufficient size should be fixed particularly in the interest of ventilation.

(*c*) Suitable designs for quarters for the different classes of establishment are much required. The needs of different stations are very similar, and if the accommodation to be provided is once laid down, type designs could be prepared. It is suggested that for the proposed "Provincial" establishment the accommodation shown on the design which accompanies this report, is suitable. For "Local" establishments, the standard design for police lines might be adopted, but the buildings should be constructed in a more substantial way than is generally the case with police lines.

(*d*) Painting lighthouse towers and buildings requires to be given much more attention, both as regards workmanship and colour. Towers are generally required to serve as a mark by day and the colour with reference to the background is a matter of great importance. Several instances have been brought to notice in Appendix B regarding the difficulty in distinguishing towers by day. In India white appears to be the most suitable colour, but vertical stripes or diamond pattern may be found useful in some localities where a distinctive character is necessary. Dark colours and black and white horizontal bands do not seem suitable for towers on land as there are generally trees in the background.

Lanterns.

3. (*a*) The type of lantern generally installed in India is the old Trinity House pattern with vertical bars. This type has been practically abandoned in England owing to its want of rigidity and for other reasons. This want of rigidity is very apparent as at nearly all stations a large number of panes of glass are broken. This breakage may be partly due to faulty glazing and to the glass fitting too tight, but it is advisable to stiffen those lanterns where the light is not required to be shown all round the horizon. In future indents for lanterns, helical or inclined framing, should be specified. Care must also be taken when fixing a lantern to place the door facing the direction from which least wind is expected, as otherwise the keepers find a difficulty in maintaining the light properly when the door is opened at night to give access to the gallery. Lantern doors should also be fitted so that they may be fixed open at any angle that may be required. It is a question whether lanterns of larger diameter than the usual standard size should not be obtained in future as, owing to the climate and confined space in which the keepers have to move, the heat is very great.

(*b*) The painting of lanterns is now done by the keepers who do not scrape the old paint properly nor apply the new paint in sufficiently thin coats. Some of the paint supplied does not appear to be of good quality or has been improperly mixed.

(*c*) Communication in the shape of a telephone or speaking-tube should, in the case of sea lights, always be provided in order that the keeper on duty may summon help if necessary.

GOVERNMENT OF MADRAS.

MARINE DEPARTMENT.

Read—the following papers:—

From F. W. ASHPITEL, Esq., Executive Engineer, Public Works Department, lately on Special Duty, Marine Department, to the Chief Secretary to Government, dated Madras, 22nd June 1895, No. 20 W.

With reference to G.O., No. 318, dated 10th August 1894, I have the honour to forward herewith a report on the lighthouses in the Madras Presidency.

Enclosures.

REPORT ON LIGHTHOUSES IN THE MADRAS PRESIDENCY.

1. In 1890 Mr. W. T. Douglass, the present Consulting Engineer to Trinity House, inspected the lights of this Presidency and his opinion regarding their condition and state of efficiency may be gathered from the following extracts from his report:—

"As a subject of first importance, I would beg to suggest the desirability of "improving generally the coast lights, on which the safety of shipping so much "depends" . . . "With the exception of Aleppi, Madras, Armeghon, and Vakalapudi, "the lights have no distinctive character, hence great danger is incurred by mariners "from the possibility of mistaking one light for another, or a shore or a vessel's light for "a coast light. The object in establishing a coast signal light is either to indicate to "the mariner the landfall he has made—and with as much certainty by night as by "day—or to reliably mark some hidden danger. It therefore becomes a matter of the "utmost importance to impress upon each coast signal light such a trustworthy dis-"tinctive character as to effectually prevent the possibility of its being mistaken for "any other light, either ashore or afloat" . . . . . "The coast signal "lights of this Presidency are very inadequate in penetrating power for the service of "their respective stations; this is due, not only to the small quantity of oil sanctioned "for each establishment and insufficiency of ventilation, but to the restricted dimen-"sions of the optical apparatus" . . . "In very clear weather the better lights "are frequently visible at the limit of the range due to their height above the sea-"level, but when the atmosphere is slightly impaired by rain, haze or fog, and con-"sequently when they would prove of the utmost service to the navigator, they are "obscured at a distance of from two to three miles" . . . . . "With "a view to increasing the intensity of the lights, and giving to the existing stations "a power and character suited to the ever increasing demands of coast navigation, I "would suggest, in addition to improved burners, increased ventilation and the use "of heavy mineral oil, the adoption of illuminating apparatus of larger dimensions at "stations where the light is to be maintained throughout the year, and where it is of "direct service to steamers and other vessels passing up and down the coast during "the south-west monsoon. I am decidedly of opinion that a flashing or occulting dioptric "apparatus of the 2nd order or 700 m.m. focal distance, is the smallest that should "be adopted for such lights. For some of the more important landfalls an apparatus "of 1330 m.m. focal distance should be adopted. The 4th order apparatus of "250 m.m. focal distance is an efficient size for the illumination of ports and "entrances of small rivers where the light is not directly required for the navigation "of the coast."

2. This condemnation of the system of placing port lights on high columns and calling them sea-lights, in spite of the fact that, when the atmosphere is impaired, their rays have no chance of reaching the horizon, is nothing new, for, in P.M.G., No. 36, dated 14th November 1867, Marine Department, a letter from Messrs. Chance Brothers is printed from which the following is extracted :—

"We are of opinion that the range of visibility respectively appropriated to the "proposed lights by the Superintendent of Marine at page 15 of the printed docu- "ments, are in general considerably too great. The extreme distance at which fixed "dioptric apparatus of the 4th and 6th orders can be seen, in a mean state of the "atmosphere, is respectively eleven miles and eight miles. The greater and lesser "distances of visibility under exceptional atmospheric conditions of clearness or "mistiness ought not to be taken into account in determining the order of the "apparatus to be employed."

"We therefore request to know whether, on the one hand, the stipulations as to "the range can be reduced to suit the mean power of the apparatus proposed, or "whether, on the other hand, apparatus of larger dimensions can be selected to give "effect to the stipulations."

3. As regards the desirability of generally improving the lights of this Presidency it seems unnecessary to make further remarks. Thirty years ago Messrs. Chance Brothers brought to notice the inexpedience of installing 4th order fixed apparatus as sea-lights and Mr. Douglass reiterated Messrs. Chance's remarks in 1890. If the opinions of Messrs. Douglass and Chance, which have not been accepted, have needed any proof, it has been signally afforded by the disastrous wreck of the *Lanark*,—and I can but echo those opinions.

4. It may be worth while, however, to give a few typical instances in which lights of insufficient power have been installed :—

(*a*) The present light at Hope Island was installed as recently as 1893, when a new 4th order fixed apparatus was obtained from England. The Sacramento Shoal, one of the dangers this light is supposed to mark, is distant some 14 miles from the light which, unless the weather is very clear, has a range of only 12 miles. As happened in the case of the *Lanark*, therefore, a ship may be ashore on the Shoal before sighting the light. This apparatus was installed in direct opposition to Mr. Douglass' recommendation with the idea that two dangers could be guarded by one light of insufficient power exhibited from a tower whose location is unsuitable for either.

(*b*) Another instance is at Manapaud Point, where a small port light apparatus with a range of about 7 miles is supposed to guard dangers which extend from 10 to 12 miles from the point. In this case the light does not even show over the whole sea-horizon and a ship might be ashore near the point without the light being seen.

(*c*) Mangalore light is an instance of a port light with a range of about 12 miles installed at an elevation of 240 feet, corresponding to a range of 22 miles. This light is one of those against the installation of which Messrs. Chance protested thirty years ago, as it is only under exceptional atmospheric conditions that the light reaches the horizon. The brightest part of the beam, in an ordinary state of the atmosphere, is of no service to the mariner, being wasted in the air (See also Appendix A, paragraph 2).

5. Assuming that the necessity of improving the sea-lights in this Presidency does not admit of further argument, the question of what new lights are required for the efficient lighting of the coast has to be determined. Fortunately, on the coasts of Madras the atmosphere is very much clearer than in Europe and there is no necessity for the installation of lights of great power. Some two years ago a 3rd order double flashing apparatus (lenses only) was obtained from England for the new Madras lighthouse ; before this apparatus was placed in position, its intensity was determined and, after its exhibition, the light-keepers at Pulicat were instructed to note in their log book whether the new light was always visible from that station. The result of these observations was that the new light, with its intensity of 18,000 candles, was, during the months October to March 1894, visible at Pulicat every night except at intervals of a few hours, and, in many cases, of only a few minutes at a

time. Pulicat is distant 20½ miles from Madras and the observations were made during the most unfavourable months in the year over land where there is occasional haze, which does not necessarily extend seawards ; and, therefore, for all practical purposes, it seems perfectly safe to assume that the new Madras light has a range of 19 miles in all weathers and at all seasons of the year. Enquiries made at other stations during the recent tour of inspection appear to confirm this assumption, and, in the absence of any evidence to the contrary, it seems probable that, if this standard of efficiency is worked up to, the lights in this Presidency will be seen, throughout the year, at the extreme limits of their ranges. The fact must not be lost sight of that, in India, it is not necessary to go to the expense of lights of great power, as the atmospheric conditions are totally different from those obtaining in England, where frequent fogs render the installation of lights which will be always visible at their extreme ranges an impossibility, and all that can be done is to provide the maximum power within reason available, and, when the weather is foggy, to start a sound signal.

6. In any scheme for the efficient lighting of the coasts of the Madras Presidency it appears to be advisable to distinguish between sea and port lights. The former are exhibited for the benefit of the general navigation to indicate to the mariner his position, and to warn him of his approach to the coast line or to some hidden danger, while the latter are merely required to provide him with the means of proceeding safely to his destination after his position has been indicated by the sea-light. For the sea-light service complicated apparatus of considerable power is necessary and a more-highly trained establishment of keepers is required than for the service of simple port lights, which only benefit a particular port and are, comparatively speaking, not of so much importance. It is suggested, therefore, that the lights of this Presidency should be divided into two services : the one a "Provincial" service (sea lights) for the benefit of general navigation and maintained by dues collected from the shipping ; the other a "Local" service (port lights) maintained from the funds of the port at which the light is exhibited. This division of lights will relieve some of the ports, especially in the Eastern group, of the expense of maintaining sea lights which do not exclusively benefit them, and will render possible the construction of the additional lights required for general navigation which have, so far, been held in abeyance for want of funds.

7. The lights, existing and proposed, which appear to be absolutely necessary for the efficient lighting of the coast, are shown in Table I and are marked on chart No. I which accompanies this report. At the present time, the only lights which have a distinctive character are Aleppi, Madras, Armeghon, Vakalapudi and Kalingapatam : the rest, with the exception of Muttum and Santapilli, are merely small port lights exhibited from towers which are, as a rule, of very inconvenient design, badly ventilated, and quite unsuitable for anything but port lights. These lights are, moreover, of but little use to general navigation, being, in many cases, exhibited at ports where no special dangers to navigation exist (see chart No. II).

8. The chief dangers to navigation along the coasts of this Presidency, commencing on the west, are —

(*a*) Mulki Rocks and St. Mary's Isles with several rocky patches between and adjacent to them. An 18-mile triple flashing light, on the mainland opposite Mulki Rocks, or, better still, on the rocks, if sufficiently smooth water can be found alongside, would guard these dangers and would form an efficient landfall light for direct steamers from Europe, and for steamers from Bombay which make Mangalore a first port of call. The Mulki Rocks stand some 50 feet out of the water and are of sufficient size for a tower and the necessary quarters for establishment. It would be a pity if, owing to the difficulty in landing stores, the light has to be placed on the mainland where it will not be nearly so efficient.

(*b*) South of Mulki the next danger to navigation is the Sacrifice Rock 40 feet high and with deep water all round. This rock is 4½ miles from Cotta Point and is in the direct track of steamers from Bombay. An 18-mile double flashing light, on

the rock, would guard this danger and be useful as a landfall light for the ports of Tellicherri and Calicut, the existing lights at these stations being relegated to their proper duty as port lights.

(*c*) South of Sacrifice Rock the existing light at Aleppi, maintained by the Travancore Government, is of sufficient power. It guards no danger but is useful as a guide to the natural harbour or refuge south of the lighthouse.

(*d*) The next danger to navigation, south of Sacrifice Rock, is the Tangacheri Reef distant $\frac{3}{4}$ mile south-east from the point of the same name. This reef and the detached rocks near it, stretch from the south of the point 3 miles to seaward and 7 miles north, and is a distinct danger to navigation. An 18-mile triple flashing light, which would also serve as a landfall light for the important port of Quilon, is required. A light here is much needed as, in its absence, ships are likely to pass the port owing to the necessity of giving the rocks a wide berth. There has been correspondence with the Travancore Government about a light at this point and, when I visited the Aleppi lighthouse, the Commercial Agent informed me that the British India Agents had recently complained that, for want of a light, steamers making for Quilon at night have great difficulty in finding the place and often miss it altogether, going 10 to 20 miles beyond and having to return at a loss of time and money. The question of a light at Quilon (Tangacheri) has previously been raised (*vide* G.O., dated 13th November 1894, No. 443, Marine), but was dropped as the Travancore Government wished the British Government to construct and maintain the lighthouse as being more likely to benefit Imperial navigation than the shipping of any port in the State. From the information given by the Commercial Agent, however, it seems evident that a light on Tangacheri Point would benefit the shipping at Quilon, but, as a sea-light is required in the interests of general navigation and the cost of construction and maintenance can be met from the proposed light dues, any difficulty regarding funds is removed. This question of funds, apparently, was the real cause why the proposal was dropped, and, as this objection will be met if the proposed light dues are collected, there seems to be no reason why the exhibition of the light should be postponed.

(*e*) South of Tangacheri there is no special danger to navigation up to the Crocodile Rocks off Point Muttum and the existing light there is sufficient. It would be better, however, to increase the range to 18 miles so as to show beyond Cape Comorin, and this can be done by using a 6-wick burner in misty weather.

(*f*) Between Cape Comorin and Pambam the chief danger to navigation is the shoal off Manapaud Point. As mentioned in paragraph 4 (*b*) the existing red light on Manapaud Point is very unsatisfactory; it does not show over the whole sea horizon, and has not sufficient power to reach the dangers it is supposed to guard, except in very clear weather. An 18-mile double flashing light is suggested to guard the dangers and to serve as a landfall light for the port of Tuticorin.

(*g*) The existing light at Pambam can be retained as a port light; vessels are said not to attempt to pass Pambam during the night.

(*h*) Between Pambam and Negapatam the shoals off Point Calimere and Negapatam are dangers to navigation which are not properly guarded by the existing lights at Point Calimere and Negapatam. The former is a 6th-order (red) port light exhibited from a mast, and a glance at the chart will show how insufficient its range of 6 miles is. An 18-mile revolving light at Point Calimere will, with the existing light at Negapatam, efficiently light this part of the coast. The new light will be of great service to steamers from Ceylon and to the small craft which navigate Palk Straits. From a steamer's bridge the range of the proposed light will be 19 miles.

(*i*) Between Negapatam and Madras no sea-lights appear to be necessary except to guard the Tripalur Reef off Seven Pagodas. The present light at Seven Pagodas is a 4th-order fixed red light of small power, exhibited at an elevation of 119 feet corresponding to a range of 17 miles. The light is very inefficient and the building unsuitable. An 18-mile triple flashing light is suggested and would be most useful to coasting and other steamers, especially the direct line from Negapatam to Burma.

(*j*) The existing light at Madras requires no alteration.

(*k*) North of Madras the first danger to navigation is the Pulicat Shoal, which the existing light, with the new Madras light, guards sufficiently well. It would be better, however, to increase the range to 13 miles by substituting a 3-wick burner when the atmosphere is impaired. The present light has a range of only 12 miles.

(*l*) North of Pulicat is the Armeghon Shoal, which is guarded by the existing 4th-order revolving light with a range of 14 miles. The present apparatus is sufficient, but the range may be increased to 15 miles by installing a 3-wick burner when the weather is misty.

(*m*) North of Armeghon no lights are necessary up to the mouth of the Kistna river. The existing light at Point Divi is very inefficient, being wrongly located and at too great a distance from the sea, thereby rendering the light liable to be obscured by the haze which often hangs over the land. The range of 12 miles does not cover the False Point, and vessels coming from the south are liable to be set in by the strong and variable current and might be ashore before the light is seen. This, apparently, often happens in the case of native craft. A new light should be exhibited from the False Point near the sea. The height of the tower need only be sufficient for a range of 16 miles, when viewed from a height of 15 feet above the water, as this will be sufficient for native craft, but the power should be sufficient for a range of 18 miles when viewed from a steamer's bridge. With the proposed new light on False Point, the existing light at Point Divi can be discontinued, as the approaches to Masulipatam will, with the proposed port light at that place, be efficiently lighted.

(*n*) North of Masulipatam the next dangers to navigation are the Sacramento Shoal and the dangers off Gódávari Point. To mark these dangers and to light the approaches to Cocanada, the lights at Hope Island and Vakalapudi were installed. As pointed out in paragraph 4 (*a*), the existing light at Hope Island is very inefficient as its range of about 12 miles is insufficient to cover the Sacramento Shoal. The existing revolving light at Vakalapudi is sufficient, but its range may be increased to about 15 miles by installing a 3-wick burner during misty weather. If a new 18-mile light (from a vessel's bridge) is installed on the mainland opposite Sacramento Shoal the ranges of the two lights will cut in 30 fathoms off Coringa and the approaches to Cocanada will be efficiently lighted. The new light can be exhibited from a pile lighthouse if sufficiently good foundations cannot be obtained for a masonry tower. The height may be sufficient for a range of 16 miles when viewed from a vessel's deck, but the power should be sufficient for a range of 18 miles when viewed from a steamer's bridge. The Presidency Port Officer originally suggested a site for the new tower at Thirtlamundi, distant some six miles from Sacramento Shoal. This site is, however, very inaccessible and there is no good water available. The Executive Engineer, Gódávari Western Division, on a further reference, reports that the proposed site, opposite the shoal, is infinitely superior and more accessible, but, before anything is settled, further information on this point is necessary.

(*o*) North of Vakalapudi the next danger to general navigation, along the coast of the Madras Presidency, is the Santapilli Rock lying some 6 to 7 miles from the existing light. This rock is described as one of the most dangerous shoals which the mariner has to avoid in the Bay of Bengal; there is deep water close alongside and, during fine weather, the sea is said not to break on the shoal. The existing 2nd-order apparatus is barely sufficient and, as it is exhibited from a great elevation, it would be better, in misty weather, to install a more powerful burner so as to ensure that the light shall reach the horizon as often as possible. If a 6-wick burner is installed the range will be increased to 17 miles, except perhaps in extraordinary weather when a mariner should be extremely cautious in approaching the coast. The ventilation of the existing lantern requires to be considerably improved, as at present the light-keepers find great difficulty in maintaining the light at more than $\frac{1}{2}$ power of the existing burner.

(*p*) The only other light proposed to be classed as a sea-light is at Kalingapatam, where a new 4th-order occulting light has been recently installed. This light is said to be useful for steamers from Madras or Ceylon to Calcutta, and marks a reef of rocks which extends about $\frac{1}{2}$ a mile to seaward.

9. It will be observed that the new lights proposed to be installed are all of the flashing type as recommended by Mr. Douglass. To install any other class of light would mean a needless waste of light and money, as these lights are about eight times more powerful than fixed or occulting lights of a corresponding order, with the same cost of maintenance. The flashing system has now been universally adopted as being the most efficient, easily maintained and easily identified, and, as Mr. Douglass remarked in a paper read at a meeting of the International Maritime Congress, "the language of numbers is a universal one and 4 to 14, indicated by flashes, "conveys an identical meaning to the master of a Chinese junk, the captain of a "French chasse marée, or the skipper of a North country whaler." If he had thought of India, he would no doubt have included the British India skipper and the masters of the native craft which navigate these waters, as there is no reason to suppose that they are one whit inferior in intelligence to those he did mention. It is proposed that the new lights shall have three characteristic distinctions, viz., one, two, or three flashes, separated by intervals of darkness, a group being followed by a comparatively long eclipse; they are all of the same description as the new Madras light and are at such distances apart as to fulfil the condition fixed by the French Administration that no two lights of the same character should recur at intervals of less than 80 miles. To identify one of these lights, the mariner will only have to count the number of flashes forming a group, and need not attempt to time the duration of light and darkness,—a matter of considerable difficulty in bad weather.

10. A difficulty in the efficient management of the lights of this Presidency is the absence of a properly trained establishment, capable of taking charge of any light and having a practical knowledge of matters relating to a light-keeper's duty. At present, light-keepers appear to be selected at random; clerks, fishermen, or even the ordinary cooly, are considered to be quite good enough to take charge of a light with its valuable appurtenances, and, with the exception of the Superintendents, the scale of pay is, apparently, fixed on this assumption. There is no central place where expectant light-keepers can be trained as is the case in Europe, and the result is, badly managed lights and a staff of keepers who have no idea of discipline and who fail to appreciate the importance of keeping their light at the maximum service intensity. The whole establishment is, in my opinion, wrongly organized, without proper training and in many cases far too numerous. The employment of a large number of cooly keepers does not compensate for the want of individual efficiency.

11. The system now in force in the Madras Presidency is to make the Port officers ex-officio inspecting officers of the lights near their ports; if the light is within the port limits the Port officer is the ex-officio Superintendent; but if the light is at a distance, a Superintendent is appointed, who is expected to live at the station, and is under the orders of the local Port officer, who visits the light at stated intervals. The whole working establishment consists of cooly-keepers on small pay, whose numbers, apparently, depend on no recognized rule. This system of managing lights might have some chance of being efficient had either the Port officers or the Superintendents received any special training; but, as a matter of fact, Port officers are recruited from the officers of merchant service and have not necessarily been inside a lighthouse up to the time they are called upon to take charge of, and supervise, the lights in their district. With a supervising establishment not necessarily acquainted with the practical working of lights, Superintendents who have had no proper training, who take no watch and do no actual work, and a number of ill-paid light-keepers who practically form the working establishment, the lights in this Presidency cannot be expected to be efficient, and any attempt to materially improve the lighthouse service must be unsatisfactory unless the establishment is reorganized. There is, in the English lighthouse service, no one who corresponds to the Madras Superintendent and the appointment might well be abolished.

12. The following instances appear to support the above condemnation of the Madras lighthouse establishment:—

(*a*) At Muttum, an important landfall light, the establishment consists of one Superintendent on Rs. 100, one head-keeper on Rs. 15, one assistant keeper on Rs. 9, one assistant keeper on Rs. 8 and two assistants on Rs. 7,—a total establishment of six persons, costing Rs. 1,752 per annum, at a station where, in England, two men would suffice. Of this establishment only four men, at the time of my inspection, were in the habit of keeping a watch or doing any actual work. The Superintendent considered it to be "derogatory to his dignity" to either take a watch or to do any work, and the head light-keeper followed the lead of his superior. This important light was, therefore, practically in the hands of cooly keepers throughout each night.

(*b*) At Point Calimere the establishment consists of one head-keeper on Rs. 12, and two assistants on Rs. 8 and Rs. 7, respectively. This light is a 6th-order port light and does not require an expensive establishment, but, owing to the necessity of filling up certain forms and returns, a head-keeper who can read and write English is considered a necessity. A boat overseer's clerk, a young Brahmin who has had no previous training, and who is plainly ignorant of his work, has been appointed. The result is that the cabin and mast is very badly maintained and the apparatus is not kept clean.

(*c*) At Point Divi, an important light about which there are frequent complaints, the establishment consists of one Superintendent on Rs. 70, one head keeper on Rs. 12 and four assistants. The establishment, therefore, numbers six persons whose total annual pay amounts to Rs. 1,356, of which one man, who does no work, and who is apparently often absent from the station, takes Rs. 840. None of the men live regularly at the station, and judging from the log book the light is often in charge of three men only, the rest being absent in Masulipatam where their families live. Three men, properly trained, are no doubt sufficient for the service of this light, but, in that case, the advantage of maintaining an establishment of six light-keepers is not evident.

(*d*) At Mangalore the establishment consists of a head light-keeper on Rs. 12, and two assistants on Rs. 8 and 7 respectively. None of the keepers live in the quarters which have been provided for them, and, on one occasion, when I visited the light at night, the head light-keeper was absent without leave. He explained that his uncle had died suddenly and he had attended the funeral, and the acceptance of this explanation seemed necessary as no better man could be obtained for the small pay sanctioned. The proceedings of the acting Port officer at Mangalore, dated 21st January 1895, forming an appendix to this report, are instructive as showing the result of obtaining men, to fill the important post of light-keeper, on the pay of an ordinary cooly. It will be observed that light-keeper Fakeera was suspended no less than five times before he was finally dismissed, and this leniency was necessary because an ordinary cooly can, at Mangalore, obtain wages which compare favourably with a light-keeper's pay without any of the disadvantages of a light-keeper's life.

(*e*) At Madras a new oil store has recently been constructed and is suitable, being fire-proof and provided with an impermeable floor. The oil is, however, stored in cisterns resting on wooden benches. The cisterns sweat a good deal, and the accidental spilling of oil appears to be considerable, with the result that the wooden benches are saturated with oil which also spreads over the floor. To soak up this oil, saw-dust has been thrown down and the oil store in Madras is, therefore, a source of considerable danger. In this instance the object of providing a suitable oil store is, to a great extent, defeated owing to the ignorance of the establishment.

13. The abovementioned instances are some of those which were brought to my notice during my inspection and appear to show—

(*a*) that the present establishment is not efficient;

(*b*) that the working keepers are underpaid and, in some cases, of the wrong class;

(*c*) that the policy of increasing the number of keepers, to make up for want of individual efficiency, is not successful.

14. I recommend that the whole establishment be reorganised and that two separate services be formed for "sea" and for "port" lights. The former—a "Provincial" service—may consist of Eurasians on pay which will attract good men for the service of the important and somewhat complicated sea lights; the latter, of natives on comparatively lower pay. The men forming the "Provincial" service should be either carpenters or mechanics, and both services should be specially trained for their duties.

9. It will be observed that the new lights proposed to be installed are all of the flashing type as recommended by Mr. Douglass. To install any other class of light would mean a needless waste of light and money, as these lights are about eight times more powerful than fixed or occulting lights of a corresponding order, with the same cost of maintenance. The flashing system has now been universally adopted as being the most efficient, easily maintained and easily identified, and, as Mr. Douglass remarked in a paper read at a meeting of the International Maritime Congress, "the language of numbers is a universal one and 4 to 14, indicated by flashes, "conveys an identical meaning to the master of a Chinese junk, the captain of a "French chasse marée, or the skipper of a North country whaler." If he had thought of India, he would no doubt have included the British India skipper and the masters of the native craft which navigate these waters, as there is no reason to suppose that they are one whit inferior in intelligence to those he did mention. It is proposed that the new lights shall have three characteristic distinctions, viz., one, two, or three flashes, separated by intervals of darkness, a group being followed by a comparatively long eclipse; they are all of the same description as the new Madras light and are at such distances apart as to fulfil the condition fixed by the French Administration that no two lights of the same character should recur at intervals of less than 80 miles. To identify one of these lights, the mariner will only have to count the number of flashes forming a group, and need not attempt to time the duration of light and darkness,—a matter of considerable difficulty in bad weather.

10. A difficulty in the efficient management of the lights of this Presidency is the absence of a properly trained establishment, capable of taking charge of any light and having a practical knowledge of matters relating to a light-keeper's duty. At present, light-keepers appear to be selected at random; clerks, fishermen, or even the ordinary cooly, are considered to be quite good enough to take charge of a light with its valuable appurtenances, and, with the exception of the Superintendents, the scale of pay is, apparently, fixed on this assumption. There is no central place where expectant light-keepers can be trained as is the case in Europe, and the result is, badly managed lights and a staff of keepers who have no idea of discipline and who fail to appreciate the importance of keeping their light at the maximum service intensity. The whole establishment is, in my opinion, wrongly organized, without proper training and in many cases far too numerous. The employment of a large number of cooly keepers does not compensate for the want of individual efficiency.

11. The system now in force in the Madras Presidency is to make the Port officers ex-officio inspecting officers of the lights near their ports; if the light is within the port limits the Port officer is the ex-officio Superintendent; but if the light is at a distance, a Superintendent is appointed, who is expected to live at the station, and is under the orders of the local Port officer, who visits the light at stated intervals. The whole working establishment consists of cooly-keepers on small pay, whose numbers, apparently, depend on no recognized rule. This system of managing lights might have some chance of being efficient had either the Port officers or the Superintendents received any special training; but, as a matter of fact, Port officers are recruited from the officers of merchant service and have not necessarily been inside a lighthouse up to the time they are called upon to take charge of, and supervise, the lights in their district. With a supervising establishment not necessarily acquainted with the practical working of lights, Superintendents who have had no proper training, who take no watch and do no actual work, and a number of ill-paid light-keepers who practically form the working establishment, the lights in this Presidency cannot be expected to be efficient, and any attempt to materially improve the lighthouse service must be unsatisfactory unless the establishment is reorganized. There is, in the English lighthouse service, no one who corresponds to the Madras Superintendent and the appointment might well be abolished.

12. The following instances appear to support the above condemnation of the Madras lighthouse establishment:—

(*a*) At Muttum, an important landfall light, the establishment consists of one Superintendent on Rs. 100, one head-keeper on Rs. 15, one assistant keeper on Rs. 9, one assistant keeper on Rs. 8 and two assistants on Rs. 7,—a total establishment of six persons, costing Rs. 1,752 per annum, at a station where, in England, two men would suffice. Of this establishment only four men, at the time of my inspection, were in the habit of keeping a watch or doing any actual work. The Superintendent considered it to be "derogatory to his dignity" to either take a watch or to do any work, and the head light-keeper followed the lead of his superior. This important light was, therefore, practically in the hands of cooly keepers throughout each night.

(*b*) At Point Calimere the establishment consists of one head-keeper on Rs. 12, and two assistants on Rs. 8 and Rs. 7, respectively. This light is a 6th-order port light and does not require an expensive establishment, but, owing to the necessity of filling up certain forms and returns, a head-keeper who can read and write English is considered a necessity. A boat overseer's clerk, a young Brahmin who has had no previous training, and who is plainly ignorant of his work, has been appointed. The result is that the cabin and mast is very badly maintained and the apparatus is not kept clean.

(*c*) At Point Divi, an important light about which there are frequent complaints, the establishment consists of one Superintendent on Rs. 70, one head keeper on Rs. 12 and four assistants. The establishment, therefore, numbers six persons whose total annual pay amounts to Rs. 1,356, of which one man, who does no work, and who is apparently often absent from the station, takes Rs. 840. None of the men live regularly at the station, and judging from the log book the light is often in charge of three men only, the rest being absent in Masulipatam where their families live. Three men, properly trained, are no doubt sufficient for the service of this light, but, in that case, the advantage of maintaining an establishment of six light-keepers is not evident.

(*d*) At Mangalore the establishment consists of a head light-keeper on Rs. 12, and two assistants on Rs. 8 and 7 respectively. None of the keepers live in the quarters which have been provided for them, and, on one occasion, when I visited the light at night, the head light-keeper was absent without leave. He explained that his uncle had died suddenly and he had attended the funeral, and the acceptance of this explanation seemed necessary as no better man could be obtained for the small pay sanctioned. The proceedings of the acting Port officer at Mangalore, dated 21st January 1895, forming an appendix to this report, are instructive as showing the result of obtaining men, to fill the important post of light-keeper, on the pay of an ordinary cooly. It will be observed that light-keeper Fakeera was suspended no less than five times before he was finally dismissed, and this leniency was necessary because an ordinary cooly can, at Mangalore, obtain wages which compare favourably with a light-keeper's pay without any of the disadvantages of a light-keeper's life.

(*e*) At Madras a new oil store has recently been constructed and is suitable, being fire-proof and provided with an impermeable floor. The oil is, however, stored in cisterns resting on wooden benches. The cisterns sweat a good deal, and the accidental spilling of oil appears to be considerable, with the result that the wooden benches are saturated with oil which also spreads over the floor. To soak up this oil, saw-dust has been thrown down and the oil store in Madras is, therefore, a source of considerable danger. In this instance the object of providing a suitable oil store is, to a great extent, defeated owing to the ignorance of the establishment.

13. The abovementioned instances are some of those which were brought to my notice during my inspection and appear to show—

(*a*) that the present establishment is not efficient;

(*b*) that the working keepers are underpaid and, in some cases, of the wrong class;

(*c*) that the policy of increasing the number of keepers, to make up for want of individual efficiency, is not successful.

14. I recommend that the whole establishment be reorganised and that two separate services be formed for "sea" and for "port" lights. The former—a "Provincial" service—may consist of Eurasians on pay which will attract good men for the service of the important and somewhat complicated sea lights; the latter, of natives on comparatively lower pay. The men forming the "Provincial" service should be either carpenters or mechanics, and both services should be specially trained for their duties.

9. It will be observed that the new lights proposed to be installed are all of the flashing type as recommended by Mr. Douglass. To install any other class of light would mean a needless waste of light and money, as these lights are about eight times more powerful than fixed or occulting lights of a corresponding order, with the same cost of maintenance. The flashing system has now been universally adopted as being the most efficient, easily maintained and easily identified, and, as Mr. Douglass remarked in a paper read at a meeting of the International Maritime Congress, "the language of numbers is a universal one and 4 to 14, indicated by flashes, "conveys an identical meaning to the master of a Chinese junk, the captain of a "French chasse marée, or the skipper of a North country whaler." If he had thought of India, he would no doubt have included the British India skipper and the masters of the native craft which navigate these waters, as there is no reason to suppose that they are one whit inferior in intelligence to those he did mention. It is proposed that the new lights shall have three characteristic distinctions, viz., one, two, or three flashes, separated by intervals of darkness, a group being followed by a comparatively long eclipse; they are all of the same description as the new Madras light and are at such distances apart as to fulfil the condition fixed by the French Administration that no two lights of the same character should recur at intervals of less than 80 miles. To identify one of these lights, the mariner will only have to count the number of flashes forming a group, and need not attempt to time the duration of light and darkness,—a matter of considerable difficulty in bad weather.

10. A difficulty in the efficient management of the lights of this Presidency is the absence of a properly trained establishment, capable of taking charge of any light and having a practical knowledge of matters relating to a light-keeper's duty. At present, light-keepers appear to be selected at random; clerks, fishermen, or even the ordinary cooly, are considered to be quite good enough to take charge of a light with its valuable appurtenances, and, with the exception of the Superintendents, the scale of pay is, apparently, fixed on this assumption. There is no central place where expectant light-keepers can be trained as is the case in Europe, and the result is, badly managed lights and a staff of keepers who have no idea of discipline and who fail to appreciate the importance of keeping their light at the maximum service intensity. The whole establishment is, in my opinion, wrongly organized, without proper training and in many cases far too numerous. The employment of a large number of cooly keepers does not compensate for the want of individual efficiency.

11. The system now in force in the Madras Presidency is to make the Port officers ex-officio inspecting officers of the lights near their ports; if the light is within the port limits the Port officer is the ex-officio Superintendent; but if the light is at a distance, a Superintendent is appointed, who is expected to live at the station, and is under the orders of the local Port officer, who visits the light at stated intervals. The whole working establishment consists of cooly-keepers on small pay, whose numbers, apparently, depend on no recognized rule. This system of managing lights might have some chance of being efficient had either the Port officers or the Superintendents received any special training; but, as a matter of fact, Port officers are recruited from the officers of merchant service and have not necessarily been inside a lighthouse up to the time they are called upon to take charge of, and supervise, the lights in their district. With a supervising establishment not necessarily acquainted with the practical working of lights, Superintendents who have had no proper training, who take no watch and do no actual work, and a number of ill-paid light-keepers who practically form the working establishment, the lights in this Presidency cannot be expected to be efficient, and any attempt to materially improve the lighthouse service must be unsatisfactory unless the establishment is reorganized. There is, in the English lighthouse service, no one who corresponds to the Madras Superintendent and the appointment might well be abolished.

12. The following instances appear to support the above condemnation of the Madras lighthouse establishment:—

(*a*) At Muttum, an important landfall light, the establishment consists of one Superintendent on Rs. 100, one head-keeper on Rs. 15, one assistant keeper on Rs. 9, one assistant keeper on Rs. 8 and two assistants on Rs. 7,—a total establishment of six persons, costing Rs. 1,752 per annum, at a station where, in England, two men would suffice. Of this establishment only four men, at the time of my inspection, were in the habit of keeping a watch or doing any actual work. The Superintendent considered it to be "derogatory to his dignity" to either take a watch or to do any work, and the head light-keeper followed the lead of his superior. This important light was, therefore, practically in the hands of cooly keepers throughout each night.

(*b*) At Point Calimere the establishment consists of one head-keeper on Rs. 12, and two assistants on Rs. 8 and Rs. 7, respectively. This light is a 6th-order port light and does not require an expensive establishment, but, owing to the necessity of filling up certain forms and returns, a head-keeper who can read and write English is considered a necessity. A boat overseer's clerk, a young Brahmin who has had no previous training, and who is plainly ignorant of his work, has been appointed. The result is that the cabin and mast is very badly maintained and the apparatus is not kept clean.

(*c*) At Point Divi, an important light about which there are frequent complaints, the establishment consists of one Superintendent on Rs. 70, one head keeper on Rs. 12 and four assistants. The establishment, therefore, numbers six persons whose total annual pay amounts to Rs. 1,356, of which one man, who does no work, and who is apparently often absent from the station, takes Rs. 840. None of the men live regularly at the station, and judging from the log book the light is often in charge of three men only, the rest being absent in Masulipatam where their families live. Three men, properly trained, are no doubt sufficient for the service of this light, but, in that case, the advantage of maintaining an establishment of six light-keepers is not evident.

(*d*) At Mangalore the establishment consists of a head light-keeper on Rs. 12, and two assistants on Rs. 8 and 7 respectively. None of the keepers live in the quarters which have been provided for them, and, on one occasion, when I visited the light at night, the head light-keeper was absent without leave. He explained that his uncle had died suddenly and he had attended the funeral, and the acceptance of this explanation seemed necessary as no better man could be obtained for the small pay sanctioned. The proceedings of the acting Port officer at Mangalore, dated 21st January 1895, forming an appendix to this report, are instructive as showing the result of obtaining men, to fill the important post of light-keeper, on the pay of an ordinary cooly. It will be observed that light-keeper Fakeera was suspended no less than five times before he was finally dismissed, and this leniency was necessary because an ordinary cooly can, at Mangalore, obtain wages which compare favourably with a light-keeper's pay without any of the disadvantages of a light-keeper's life.

(*e*) At Madras a new oil store has recently been constructed and is suitable, being fire-proof and provided with an impermeable floor. The oil is, however, stored in cisterns resting on wooden benches. The cisterns sweat a good deal, and the accidental spilling of oil appears to be considerable, with the result that the wooden benches are saturated with oil which also spreads over the floor. To soak up this oil, saw-dust has been thrown down and the oil store in Madras is, therefore, a source of considerable danger. In this instance the object of providing a suitable oil store is, to a great extent, defeated owing to the ignorance of the establishment.

13. The abovementioned instances are some of those which were brought to my notice during my inspection and appear to show—

(*a*) that the present establishment is not efficient;

(*b*) that the working keepers are underpaid and, in some cases, of the wrong class;

(*c*) that the policy of increasing the number of keepers, to make up for want of individual efficiency, is not successful.

14. I recommend that the whole establishment be reorganised and that two separate services be formed for "sea" and for "port" lights. The former—a "Provincial" service—may consist of Eurasians on pay which will attract good men for the service of the important and somewhat complicated sea lights; the latter, of natives on comparatively lower pay. The men forming the "Provincial" service should be either carpenters or mechanics, and both services should be specially trained for their duties.

N° 1397 W dt 2-5-96

No. 245, MARINE, 8TH APRIL 1896.

GOVERNMENT OF MADRAS.

MARINE DEPARTMENT.

READ—the following papers:—

From F. W. ASHPITEL, Esq., Executive Engineer, Public Works Department, lately on Special Duty, Marine Department, to the Chief Secretary to Government, dated Madras, 22nd June 1895, No. 20 W.

With reference to G.O., No. 318, dated 10th August 1894, I have the honour to forward herewith a report on the lighthouses in the Madras Presidency.

ENCLOSURES.

REPORT ON LIGHTHOUSES IN THE MADRAS PRESIDENCY.

1. In 1890 Mr. W. T. Douglass, the present Consulting Engineer to Trinity House, inspected the lights of this Presidency and his opinion regarding their condition and state of efficiency may be gathered from the following extracts from his report:—

"As a subject of first importance, I would beg to suggest the desirability of "improving generally the coast lights, on which the safety of shipping so much "depends" . . . "With the exception of Aleppi, Madras, Armeghon, and Vakalapudi, "the lights have no distinctive character, hence great danger is incurred by mariners "from the possibility of mistaking one light for another, or a shore or a vessel's light for "a coast light. The object in establishing a coast signal light is either to indicate to "the mariner the landfall he has made—and with as much certainty by night as by "day—or to reliably mark some hidden danger. It therefore becomes a matter of the "utmost importance to impress upon each coast signal light such a trustworthy dis-"tinctive character as to effectually prevent the possibility of its being mistaken for "any other light, either ashore or afloat" . . . . . "The coast signal "lights of this Presidency are very inadequate in penetrating power for the service of "their respective stations; this is due, not only to the small quantity of oil sanctioned "for each establishment and insufficiency of ventilation, but to the restricted dimen-"sions of the optical apparatus" . . . "In very clear weather the better lights "are frequently visible at the limit of the range due to their height above the sea-"level, but when the atmosphere is slightly impaired by rain, haze or fog, and con-"sequently when they would prove of the utmost service to the navigator, they are "obscured at a distance of from two to three miles" . . . . . "With "a view to increasing the intensity of the lights, and giving to the existing stations "a power and character suited to the ever increasing demands of coast navigation, I "would suggest, in addition to improved burners, increased ventilation and the use "of heavy mineral oil, the adoption of illuminating apparatus of larger dimensions at "stations where the light is to be maintained throughout the year, and where it is of "direct service to steamers and other vessels passing up and down the coast during "the south-west monsoon. I am decidedly of opinion that a flashing or occulting dioptric "apparatus of the 2nd order or 700 m.m. focal distance, is the smallest that should "be adopted for such lights. For some of the more important landfalls an apparatus "of 1330 m.m. focal distance should be adopted. The 4th order apparatus of "250 m.m. focal distance is an efficient size for the illumination of ports and "entrances of small rivers where the light is not directly required for the navigation "of the coast."

2. This condemnation of the system of placing port lights on high columns and calling them sea-lights, in spite of the fact that, when the atmosphere is impaired, their rays have no chance of reaching the horizon, is nothing new, for, in P.M.G., No. 36, dated 14th November 1867, Marine Department, a letter from Messrs. Chance Brothers is printed from which the following is extracted :—

"We are of opinion that the range of visibility respectively appropriated to the "proposed lights by the Superintendent of Marine at page 15 of the printed docu- "ments, are in general considerably too great. The extreme distance at which fixed "dioptric apparatus of the 4th and 6th orders can be seen, in a mean state of the "atmosphere, is respectively eleven miles and eight miles. The greater and lesser "distances of visibility under exceptional atmospheric conditions of clearness or "mistiness ought not to be taken into account in determining the order of the "apparatus to be employed."

"We therefore request to know whether, on the one hand, the stipulations as to "the range can be reduced to suit the mean power of the apparatus proposed, or "whether, on the other hand, apparatus of larger dimensions can be selected to give "effect to the stipulations."

3. As regards the desirability of generally improving the lights of this Presidency it seems unnecessary to make further remarks. Thirty years ago Messrs. Chance Brothers brought to notice the inexpedience of installing 4th order fixed apparatus as sea-lights and Mr. Douglass reiterated Messrs. Chance's remarks in 1890. If the opinions of Messrs. Douglass and Chance, which have not been accepted, have needed any proof, it has been signally afforded by the disastrous wreck of the *Lanark*,—and I can but echo those opinions.

4. It may be worth while, however, to give a few typical instances in which lights of insufficient power have been installed :—

(*a*) The present light at Hope Island was installed as recently as 1893, when a new 4th order fixed apparatus was obtained from England. The Sacramento Shoal, one of the dangers this light is supposed to mark, is distant some 14 miles from the light which, unless the weather is very clear, has a range of only 12 miles. As happened in the case of the *Lanark*, therefore, a ship may be ashore on the Shoal before sighting the light. This apparatus was installed in direct opposition to Mr. Douglass' recommendation with the idea that two dangers could be guarded by one light of insufficient power exhibited from a tower whose location is unsuitable for either.

(*b*) Another instance is at Manapaud Point, where a small port light apparatus with a range of about 7 miles is supposed to guard dangers which extend from 10 to 12 miles from the point. In this case the light does not even show over the whole sea-horizon and a ship might be ashore near the point without the light being seen.

(*c*) Mangalore light is an instance of a port light with a range of about 12 miles installed at an elevation of 240 feet, corresponding to a range of 22 miles. This light is one of those against the installation of which Messrs. Chance protested thirty years ago, as it is only under exceptional atmospheric conditions that the light reaches the horizon. The brightest part of the beam, in an ordinary state of the atmosphere, is of no service to the mariner, being wasted in the air (See also Appendix A, paragraph 2).

5. Assuming that the necessity of improving the sea-lights in this Presidency does not admit of further argument, the question of what new lights are required for the efficient lighting of the coast has to be determined. Fortunately, on the coasts of Madras the atmosphere is very much clearer than in Europe and there is no necessity for the installation of lights of great power. Some two years ago a 3rd order double flashing apparatus (lenses only) was obtained from England for the new Madras lighthouse ; before this apparatus was placed in position, its intensity was determined and, after its exhibition, the light-keepers at Pulicat were instructed to note in their log book whether the new light was always visible from that station. The result of these observations was that the new light, with its intensity of 18,000 candles, was, during the months October to March 1894, visible at Pulicat every night except at intervals of a few hours, and, in many cases, of only a few minutes at a

time. Pulicat is distant $20\frac{1}{2}$ miles from Madras and the observations were made during the most unfavourable months in the year over land where there is occasional haze, which does not necessarily extend seawards ; and, therefore, for all practical purposes, it seems perfectly safe to assume that the new Madras light has a range of 19 miles in all weathers and at all seasons of the year. Enquiries made at other stations during the recent tour of inspection appear to confirm this assumption, and, in the absence of any evidence to the contrary, it seems probable that, if this standard of efficiency is worked up to, the lights in this Presidency will be seen, throughout the year, at the extreme limits of their ranges. The fact must not be lost sight of that, in India, it is not necessary to go to the expense of lights of great power, as the atmospheric conditions are totally different from those obtaining in England, where frequent fogs render the installation of lights which will be always visible at their extreme ranges an impossibility, and all that can be done is to provide the maximum power within reason available, and, when the weather is foggy, to start a sound signal.

6. In any scheme for the efficient lighting of the coasts of the Madras Presidency it appears to be advisable to distinguish between sea and port lights. The former are exhibited for the benefit of the general navigation to indicate to the mariner his position, and to warn him of his approach to the coast line or to some hidden danger, while the latter are merely required to provide him with the means of proceeding safely to his destination after his position has been indicated by the sea-light. For the sea-light service complicated apparatus of considerable power is necessary and a more-highly trained establishment of keepers is required than for the service of simple port lights, which only benefit a particular port and are, comparatively speaking, not of so much importance. It is suggested, therefore, that the lights of this Presidency should be divided into two services : the one a "Provincial" service (sea lights) for the benefit of general navigation and maintained by dues collected from the shipping ; the other a "Local" service (port lights) maintained from the funds of the port at which the light is exhibited. This division of lights will relieve some of the ports, especially in the Eastern group, of the expense of maintaining sea lights which do not exclusively benefit them, and will render possible the construction of the additional lights required for general navigation which have, so far, been held in abeyance for want of funds.

7. The lights, existing and proposed, which appear to be absolutely necessary for the efficient lighting of the coast, are shown in Table I and are marked on chart No. I which accompanies this report. At the present time, the only lights which have a distinctive character are Aleppi, Madras, Armeghon, Vakulapudi and Kalingapatam : the rest, with the exception of Muttum and Santapilli, are merely small port lights exhibited from towers which are, as a rule, of very inconvenient design, badly ventilated, and quite unsuitable for anything but port lights. These lights are, moreover, of but little use to general navigation, being, in many cases, exhibited at ports where no special dangers to navigation exist (see chart No. II).

8. The chief dangers to navigation along the coasts of this Presidency, commencing on the west, are —

(*a*) Mulki Rocks and St. Mary's Isles with several rocky patches between and adjacent to them. An 18-mile triple flashing light, on the mainland opposite Mulki Rocks, or, better still, on the rocks, if sufficiently smooth water can be found alongside, would guard these dangers and would form an efficient landfall light for direct steamers from Europe, and for steamers from Bombay which make Mangalore a first port of call. The Mulki Rocks stand some 50 feet out of the water and are of sufficient size for a tower and the necessary quarters for establishment. It would be a pity if, owing to the difficulty in landing stores, the light has to be placed on the mainland where it will not be nearly so efficient.

(*b*) South of Mulki the next danger to navigation is the Sacrifice Rock 40 feet high and with deep water all round. This rock is $4\frac{1}{2}$ miles from Cotta Point and is in the direct track of steamers from Bombay. An 18-mile double flashing light, on

the rock, would guard this danger and be useful as a landfall light for the ports of Tellicherri and Calicut, the existing lights at these stations being relegated to their proper duty as port lights.

(*c*) South of Sacrifice Rock the existing light at Aleppi, maintained by the Travancore Government, is of sufficient power. It guards no danger but is useful as a guide to the natural harbour or refuge south of the lighthouse.

(*d*) The next danger to navigation, south of Sacrifice Rock, is the Tangacheri Reef distant $\frac{3}{4}$ mile south-east from the point of the same name. This reef and the detached rocks near it, stretch from the south of the point 3 miles to seaward and 7 miles north, and is a distinct danger to navigation. An 18-mile triple flashing light, which would also serve as a landfall light for the important port of Quilon, is required. A light here is much needed as, in its absence, ships are likely to pass the port owing to the necessity of giving the rocks a wide berth. There has been correspondence with the Travancore Government about a light at this point and, when I visited the Aleppi lighthouse, the Commercial Agent informed me that the British India Agents had recently complained that, for want of a light, steamers making for Quilon at night have great difficulty in finding the place and often miss it altogether, going 10 to 20 miles beyond and having to return at a loss of time and money. The question of a light at Quilon (Tangacheri) has previously been raised (*vide* G.O., dated 13th November 1894, No. 443, Marine), but was dropped as the Travancore Government wished the British Government to construct and maintain the lighthouse as being more likely to benefit Imperial navigation than the shipping of any port in the State. From the information given by the Commercial Agent, however, it seems evident that a light on Tangacheri Point would benefit the shipping at Quilon, but, as a sea-light is required in the interests of general navigation and the cost of construction and maintenance can be met from the proposed light dues, any difficulty regarding funds is removed. This question of funds, apparently, was the real cause why the proposal was dropped, and, as this objection will be met if the proposed light dues are collected, there seems to be no reason why the exhibition of the light should be postponed.

(*e*) South of Tangacheri there is no special danger to navigation up to the Crocodile Rocks off Point Muttum and the existing light there is sufficient. It would be better, however, to increase the range to 18 miles so as to show beyond Cape Comorin, and this can be done by using a 6-wick burner in misty weather.

(*f*) Between Cape Comorin and Pambam the chief danger to navigation is the shoal off Manapaud Point. As mentioned in paragraph 4 (*b*) the existing red light on Manapaud Point is very unsatisfactory; it does not show over the whole sea horizon, and has not sufficient power to reach the dangers it is supposed to guard, except in very clear weather. An 18-mile double flashing light is suggested to guard the dangers and to serve as a landfall light for the port of Tuticorin.

(*g*) The existing light at Pambam can be retained as a port light; vessels are said not to attempt to pass Pambam during the night.

(*h*) Between Pambam and Negapatam the shoals off Point Calimere and Negapatam are dangers to navigation which are not properly guarded by the existing lights at Point Calimere and Negapatam. The former is a 6th-order (red) port light exhibited from a mast, and a glance at the chart will show how insufficient its range of 6 miles is. An 18-mile revolving light at Point Calimere will, with the existing light at Negapatam, efficiently light this part of the coast. The new light will be of great service to steamers from Ceylon and to the small craft which navigate Palk Straits. From a steamer's bridge the range of the proposed light will be 19 miles.

(*i*) Between Negapatam and Madras no sea-lights appear to be necessary except to guard the Tripalur Reef off Seven Pagodas. The present light at Seven Pagodas is a 4th-order fixed red light of small power, exhibited at an elevation of 119 feet corresponding to a range of 17 miles. The light is very inefficient and the building unsuitable. An 18-mile triple flashing light is suggested and would be most useful to coasting and other steamers, especially the direct line from Negapatam to Burma.

(*j*) The existing light at Madras requires no alteration.

(*k*) North of Madras the first danger to navigation is the Pulicat Shoal, which the existing light, with the new Madras light, guards sufficiently well. It would be better, however, to increase the range to 13 miles by substituting a 3-wick burner when the atmosphere is impaired. The present light has a range of only 12 miles.

(*l*) North of Pulicat is the Armeghon Shoal, which is guarded by the existing 4th-order revolving light with a range of 14 miles. The present apparatus is sufficient, but the range may be increased to 15 miles by installing a 3-wick burner when the weather is misty.

(*m*) North of Armeghon no lights are necessary up to the mouth of the Kistna river. The existing light at Point Divi is very inefficient, being wrongly located and at too great a distance from the sea, thereby rendering the light liable to be obscured by the haze which often hangs over the land. The range of 12 miles does not cover the False Point, and vessels coming from the south are liable to be set in by the strong and variable current and might be ashore before the light is seen. This, apparently, often happens in the case of native craft. A new light should be exhibited from the False Point near the sea. The height of the tower need only be sufficient for a range of 16 miles, when viewed from a height of 15 feet above the water, as this will be sufficient for native craft, but the power should be sufficient for a range of 18 miles when viewed from a steamer's bridge. With the proposed new light on False Point, the existing light at Point Divi can be discontinued, as the approaches to Masulipatam will, with the proposed port light at that place, be efficiently lighted.

(*n*) North of Masulipatam the next dangers to navigation are the Sacramento Shoal and the dangers off Gódávari Point. To mark these dangers and to light the approaches to Cocanada, the lights at Hope Island and Vakalapudi were installed. As pointed out in paragraph 4 (*a*), the existing light at Hope Island is very inefficient as its range of about 12 miles is insufficient to cover the Sacramento Shoal. The existing revolving light at Vakalapudi is sufficient, but its range may be increased to about 15 miles by installing a 3-wick burner during misty weather. If a new 18-mile light (from a vessel's bridge) is installed on the mainland opposite Sacramento Shoal the ranges of the two lights will cut in 30 fathoms off Coringa and the approaches to Cocanada will be efficiently lighted. The new light can be exhibited from a pile lighthouse if sufficiently good foundations cannot be obtained for a masonry tower. The height may be sufficient for a range of 16 miles when viewed from a vessel's deck, but the power should be sufficient for a range of 18 miles when viewed from a steamer's bridge. The Presidency Port Officer originally suggested a site for the new tower at Thirtlamundi, distant some six miles from Sacramento Shoal. This site is, however, very inaccessible and there is no good water available. The Executive Engineer, Gódávari Western Division, on a further reference, reports that the proposed site, opposite the shoal, is infinitely superior and more accessible, but, before anything is settled, further information on this point is necessary.

(*o*) North of Vakalapudi the next danger to general navigation, along the coast of the Madras Presidency, is the Santapilli Rock lying some 6 to 7 miles from the existing light. This rock is described as one of the most dangerous shoals which the mariner has to avoid in the Bay of Bengal; there is deep water close alongside and, during fine weather, the sea is said not to break on the shoal. The existing 2nd-order apparatus is barely sufficient and, as it is exhibited from a great elevation, it would be better, in misty weather, to install a more powerful burner so as to ensure that the light shall reach the horizon as often as possible. If a 6-wick burner is installed the range will be increased to 17 miles, except perhaps in extraordinary weather when a mariner should be extremely cautious in approaching the coast. The ventilation of the existing lantern requires to be considerably improved, as at present the light-keepers find great difficulty in maintaining the light at more than $\frac{1}{2}$ power of the existing burner.

(*p*) The only other light proposed to be classed as a sea-light is at Kalingapatam, where a new 4th-order occulting light has been recently installed. This light is said to be useful for steamers from Madras or Ceylon to Calcutta, and marks a reef of rocks which extends about $\frac{1}{2}$ a mile to seaward.

9. It will be observed that the new lights proposed to be installed are all of the flashing type as recommended by Mr. Douglass. To install any other class of light would mean a needless waste of light and money, as these lights are about eight times more powerful than fixed or occulting lights of a corresponding order, with the same cost of maintenance. The flashing system has now been universally adopted as being the most efficient, easily maintained and easily identified, and, as Mr. Douglass remarked in a paper read at a meeting of the International Maritime Congress, "the language of numbers is a universal one and 4 to 14, indicated by flashes, "conveys an identical meaning to the master of a Chinese junk, the captain of a "French chasse marée, or the skipper of a North country whaler." If he had thought of India, he would no doubt have included the British India skipper and the masters of the native craft which navigate these waters, as there is no reason to suppose that they are one whit inferior in intelligence to those he did mention. It is proposed that the new lights shall have three characteristic distinctions, viz., one, two, or three flashes, separated by intervals of darkness, a group being followed by a comparatively long eclipse; they are all of the same description as the new Madras light and are at such distances apart as to fulfil the condition fixed by the French Administration that no two lights of the same character should recur at intervals of less than 80 miles. To identify one of these lights, the mariner will only have to count the number of flashes forming a group, and need not attempt to time the duration of light and darkness,—a matter of considerable difficulty in bad weather.

10. A difficulty in the efficient management of the lights of this Presidency is the absence of a properly trained establishment, capable of taking charge of any light and having a practical knowledge of matters relating to a light-keeper's duty. At present, light-keepers appear to be selected at random; clerks, fishermen, or even the ordinary cooly, are considered to be quite good enough to take charge of a light with its valuable appurtenances, and, with the exception of the Superintendents, the scale of pay is, apparently, fixed on this assumption. There is no central place where expectant light-keepers can be trained as is the case in Europe, and the result is, badly managed lights and a staff of keepers who have no idea of discipline and who fail to appreciate the importance of keeping their light at the maximum service intensity. The whole establishment is, in my opinion, wrongly organized, without proper training and in many cases far too numerous. The employment of a large number of cooly keepers does not compensate for the want of individual efficiency.

11. The system now in force in the Madras Presidency is to make the Port officers ex-officio inspecting officers of the lights near their ports; if the light is within the port limits the Port officer is the ex-officio Superintendent; but if the light is at a distance, a Superintendent is appointed, who is expected to live at the station, and is under the orders of the local Port officer, who visits the light at stated intervals. The whole working establishment consists of cooly-keepers on small pay, whose numbers, apparently, depend on no recognized rule. This system of managing lights might have some chance of being efficient had either the Port officers or the Superintendents received any special training; but, as a matter of fact, Port officers are recruited from the officers of merchant service and have not necessarily been inside a lighthouse up to the time they are called upon to take charge of, and supervise, the lights in their district. With a supervising establishment not necessarily acquainted with the practical working of lights, Superintendents who have had no proper training, who take no watch and do no actual work, and a number of ill-paid light-keepers who practically form the working establishment, the lights in this Presidency cannot be expected to be efficient, and any attempt to materially improve the lighthouse service must be unsatisfactory unless the establishment is reorganized. There is, in the English lighthouse service, no one who corresponds to the Madras Superintendent and the appointment might well be abolished.

12. The following instances appear to support the above condemnation of the Madras lighthouse establishment:—

(*a*) At Muttum, an important landfall light, the establishment consists of one Superintendent on Rs. 100, one head-keeper on Rs. 15, one assistant keeper on Rs. 9, one assistant keeper on Rs. 8 and two assistants on Rs. 7,—a total establishment of six persons, costing Rs. 1,752 per annum, at a station where, in England, two men would suffice. Of this establishment only four men, at the time of my inspection, were in the habit of keeping a watch or doing any actual work. The Superintendent considered it to be "derogatory to his dignity" to either take a watch or to do any work, and the head light-keeper followed the lead of his superior. This important light was, therefore, practically in the hands of cooly keepers throughout each night.

(*b*) At Point Calimere the establishment consists of one head-keeper on Rs. 12, and two assistants on Rs. 8 and Rs. 7, respectively. This light is a 6th-order port light and does not require an expensive establishment, but, owing to the necessity of filling up certain forms and returns, a head-keeper who can read and write English is considered a necessity. A boat overseer's clerk, a young Brahmin who has had no previous training, and who is plainly ignorant of his work, has been appointed. The result is that the cabin and mast is very badly maintained and the apparatus is not kept clean.

(*c*) At Point Divi, an important light about which there are frequent complaints, the establishment consists of one Superintendent on Rs. 70, one head keeper on Rs. 12 and four assistants. The establishment, therefore, numbers six persons whose total annual pay amounts to Rs. 1,356, of which one man, who does no work, and who is apparently often absent from the station, takes Rs. 840. None of the men live regularly at the station, and judging from the log book the light is often in charge of three men only, the rest being absent in Masulipatam where their families live. Three men, properly trained, are no doubt sufficient for the service of this light, but, in that case, the advantage of maintaining an establishment of six light-keepers is not evident.

(*d*) At Mangalore the establishment consists of a head light-keeper on Rs. 12, and two assistants on Rs. 8 and 7 respectively. None of the keepers live in the quarters which have been provided for them, and, on one occasion, when I visited the light at night, the head light-keeper was absent without leave. He explained that his uncle had died suddenly and he had attended the funeral, and the acceptance of this explanation seemed necessary as no better man could be obtained for the small pay sanctioned. The proceedings of the acting Port officer at Mangalore, dated 21st January 1895, forming an appendix to this report, are instructive as showing the result of obtaining men, to fill the important post of light-keeper, on the pay of an ordinary cooly. It will be observed that light-keeper Fakeera was suspended no less than five times before he was finally dismissed, and this leniency was necessary because an ordinary cooly can, at Mangalore, obtain wages which compare favourably with a light-keeper's pay without any of the disadvantages of a light-keeper's life.

(*e*) At Madras a new oil store has recently been constructed and is suitable, being fire-proof and provided with an impermeable floor. The oil is, however, stored in cisterns resting on wooden benches. The cisterns sweat a good deal, and the accidental spilling of oil appears to be considerable, with the result that the wooden benches are saturated with oil which also spreads over the floor. To soak up this oil, saw-dust has been thrown down and the oil store in Madras is, therefore, a source of considerable danger. In this instance the object of providing a suitable oil store is, to a great extent, defeated owing to the ignorance of the establishment.

13. The abovementioned instances are some of those which were brought to my notice during my inspection and appear to show—

(*a*) that the present establishment is not efficient;

(*b*) that the working keepers are underpaid and, in some cases, of the wrong class;

(*c*) that the policy of increasing the number of keepers, to make up for want of individual efficiency, is not successful.

14. I recommend that the whole establishment be reorganised and that two separate services be formed for "sea" and for "port" lights. The former—a "Provincial" service—may consist of Eurasians on pay which will attract good men for the service of the important and somewhat complicated sea lights; the latter, of natives on comparatively lower pay. The men forming the "Provincial" service should be either carpenters or mechanics, and both services should be specially trained for their duties.

15. The system of managing lights adopted by the Trinity House Corporation may be taken as a model for the reorganisation of the lighthouse service in this country. For lights, such as the majority of the proposed sea lights, the number of keepers in England, Scotland or France would be two, but, owing to the difference of climate and other causes, it is extremely unlikely that lights, in this Presidency, would be efficiently maintained by less than three men with a reserve to fill temporary vacancies, and for reliefs at a rock station.

16. To supervise this establishment two inspecting officers will be required, one for the East and the other for the West coast, whose duties, in the words of the Trinity House instructions, will be to "frequently visit the stations in his district, examine "carefully the state of each establishment, and see that it is maintained in a substantial "condition, clean, and in good order; also note particulars of any defects and repairs "that may be necessary; but unless it is a case of urgent need, he shall not order "any work to be carried out until after approval, as provided in section 9, General "duties. He shall particularly inspect the lighting apparatus and accessories, and "see that the orders of the Board with respect to them are carried out. He will also "examine the journal, oil book, store accounts, and other records, kept at the "station."

"The Superintendent shall also make occasional visits to the establishment at "night, but not at any stated times or regular intervals. He should immediately on "arrival proceed to the lantern; satisfy himself then of the efficiency of the light; "measure the height of the flame; note the condition of the wicks, their height "above the burner, and amount of char; note the thermometer, and state of ventila- "tion of the lantern, specially in reference to condensation on the glazing; and enter "these particulars, with the name of the keeper on watch, in the order book of the "station with any other remarks necessary." These men should in my opinion be properly qualified mechanics, who have received a special training to fit them for their duties, and have actually had charge of a light. They should be able to test lightning conductors, and should have a sufficient knowledge of drawing and estimating to prepare estimates for the annual repair of the stations in their charge; they should receive ordinary travelling allowances, and be provided with a furnished house, free of rent, at the head-quarters of their district. The cost of these men will be partly met by the saving of the pay and travelling allowances of the present lighthouse mechanic, and the travelling allowances of Port officers who will no longer be required to visit stations at a distance from their ports.

17. The working establishment of each station should consist of three men only with the necessary reliefs, the headman being styled the "Principal light-keeper" and held responsible "for the oil, stores, goods, furniture, and materials belonging to "the establishment; he is to see that no waste or embezzlement takes place and that "economy and good management, consistently with the maintenance of a perfectly good "light, are at all times observed. He is daily to serve out the quantities of oil and "other stores required, to keep an exact account of the quantities thereof received "from time to time, and of the issues for the necessary purposes of the establishment; "also an accurate account of the nightly consumption of oil and other stores, on the "forms provided for that purpose, which are to be made up monthly and delivered, "together with all other accounts for which forms are furnished, to the District "Superintendent at the regulated periods for transmission to this House."

"The keepers are to maintain a regular and constant watch in the light room "throughout the night, the *Principal taking equal duty with the assistant*; the dura- "tion of the watch never to exceed five hours at any period of the year, and when "the length of the days admit, it is not to exceed four. The watches are to be "changed each night, so that the same keeper shall not have the same watch two "nights consecutively."

The above extracts from the Trinity House Service Instructions indicate the proposed system. It will be observed that the advantage of the scheme is that each light will always be in charge of a competent man, who will be responsible for all that happens during his watch; that there will be no non-working men about the station, such as the present Superintendents, and no coolies. Each light-keeper should be provided with comfortable free furnished quarters, uniform, a supply of oil for

domestic purposes, and, in the case of isolated stations, should be allowed compensation for dearness of provisions. Care should be taken to keep a sufficient number of relief keepers in reserve, to ensure that each man shall get the leave which is his due and everything should be done in reason, such as the supply of books and periodicals, to make life at a lighthouse station comfortable. Table V gives details of the existing and proposed establishment.

18. The proposed "Local service" is not so important, and the establishment may be on lower pay and, owing to the simple apparatus in their charge, need not be so highly trained as the "Provincial service." All these lights are established where a Port officer, or a Port Conservator, is stationed and these officers may, as now, be *ex-officio* Superintendents, to exercise a general supervision over the lights, see that the apparatus and station are kept clean, and that the light is properly maintained, and generally exercise the same control as they now do. They should not, however, carry out any alterations or improvements in the service of the light, as the proposed Inspectors can be made available for this purpose. The keepers may be styled "Principals" and "Assistants" as in the Provincial service, and may be recruited, in the first instance, from the existing staff, the number being limited to three for a light exhibited from a tower and to two for a mast light, a few men being kept in reserve to fill temporary vacancies. The lights being ordinarily located in towns, no quarters need, as a rule, be provided, and the pay should include all allowances other than travelling in the event of a transfer. The provision of quarters for the native keepers, who may exclusively fill the appointments in this service, is, I am convinced, unnecessary where there is a town in the vicinity. The men much prefer to live in a town with their families, and resist any attempt to make them live in quarters where they are separated from those of their own caste. The only training necessary for these men is to be sent to a sea light to learn their duties. Table VI shows the establishment proposed for each "Local" light.

19. As regards educational qualifications of light-keepers, it seems unnecessary, in either of the proposed services, to insist on more than a knowledge of reading, writing, and arithmetic, sufficient to enable them to keep the requisite store books and journals. The great thing is to obtain good working men, and to insist on a higher standard of education would probably defeat this object altogether.

20. Tables II and III give the rates of pay proposed to be given in the two lighthouse services, and Table IV shows the rates of pay given in the Trinity House and Scotch services. It will be observed that the rates suggested for the Provincial service approximate to those in the Trinity House service for Principals, when the rupee is converted $\frac{1}{2}$ at par and $\frac{1}{2}$ at 1*s.* 6*d.*, while that proposed for the assistants is less. This deviation from the Trinity House scale of pay in the case of the assistants is suggested as it is thought that, in this country, a greater difference in the pay of the two classes is advisable in the interests of discipline. The proposed cost of the establishment does not appear to be extravagant, and, taking the value of the rupee at 1*s.* 1$\frac{1}{2}$*d.* is about the same as that of the ordinary Trinity House scale for two men. The average annual cost per light will be Rs. 2,220, including inspectors and reliefs, or Rs. 155 per month for the actual establishment employed at a station—a sum which compares favourably with present rates, when the difference in the description of the existing and proposed lights is taken into account. The cost per mensem at each of the proposed land stations is, in fact, practically the same as the cost of the establishment now employed at the new Madras light to which the proposed lights are similar. If a comparison is made with the establishment maintained at sea lights in Bombay, Burma and Bengal (*vide* tables VII and VII-A) the result is considerably in favour of the proposed scale, the averages per sea light being Rs. 3,680 in Burma, Rs. 4,545 in Bombay and Rs. 2,793 in Bengal, against Rs. 1,896 proposed in Madras, when cost of inspection and other local allowances are not taken into account. The above rates also do not take into account compensation for dearness of provisions at rock and other isolated stations, but all charges are approximately estimated in Table VIII.

It is suggested that the Provincial service should be entirely recruited by Eurasians as being more likely to give satisfaction and to live contentedly at the out-of-the-way places at which the lights are proposed. The President of the Eurasian