(1) பக்கங்களின் எண்ணிக்கை 24 Pages

(2) புதுக்கித் திருப்பிய நாள் 31.7.90

(3) ஆதாரங்குறிப்பவர் சுருக்கொப்பம்

தமிழ்நாடு ஆவணக் காப்பகம்.

(15)

தமிழ்நாடு அரசு

P.W.D துறை

அரசாணை எண். —
மு. கோப்புத் தாள் எண். 314

அச்சகம்
பலவகை

நாள் : 3-2-1891 1891

ம்படிக்கவோ கண்டபடி கையாளவோ கூடாது

12 Sheets

ஆவண. கா-1—18,006—15-6-87.

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P.W. Department
Proc: of the Madras Govt
Read the following

22ND JANUARY 1891, No. 25, MARINE.

GOVERNMENT OF MADRAS.

MARINE DEPARTMENT.

READ—the following papers:—

From J. E. O'CONOR, Esq., Assistant Secretary to the Government of India, Department of Finance and Commerce, to the Chief Secretary to the Government of Madras, dated Simla, 10th October 1890, No. 4873.

I am directed to forward, in continuation of the Resolution in this department, No. 2633, dated the 27th May 1889, copy of a report submitted by Mr. W. T. Douglass on his inspection of the lighthouses in Madras, and to request that it may be carefully considered in view to the action to be taken thereon.

2. I am to add that the Government of India will be glad to be furnished with the conclusions of the Government of Madras on the report.

ENCLOSURE.

MADRAS LIGHTHOUSES REPORT.

I have the honor to present my final report on my inspection of lighthouses of the Madras Presidency, in compliance with the Resolution of the Government of India, Department of Finance and Commerce, No. 2633, dated 27th May 1889.

2. The date of my arrival in Madras, and the order in which the inspection was made, have already been communicated to Government.

3. 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, considering that India, with her vast and ever increasing maritime commerce, should hold a foremost position with regard to the efficiency of her coast lights.

4. With the exception of Allipee, Madras, Armeghon and Vakalapudi, the lights have no distinctive character, hence great danger is incurred by mariners from the possibility of mistaking one light from 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 land fall 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 distinctive character as to effectually prevent the possibility of its being mistaken for any other light, either ashore or afloat.

5. I may here remark that the remaining coast signal fixed lights of the British Isles are being rapidly altered to occulting and flashing. In the course of a few years there will probably not be found a single fixed light on these coasts.

6. I would especially recommend the marking of dangers and important channels in the vicinity of lighthouses by means of coloured sectors of red or green light, the former where possible in consequence of its greater efficiency. The intensity of light lost by colouring can in most cases be restored by utilizing, by optical agents, the rear light of the burner so frequently wasted over a sector of sea or land not required to be illuminated.

7. The dioptric system is greatly superior to other forms of optical apparatus in fulfilling perfectly the conditions required—1st, by producing the maximum of light for the service of the mariner; 2ndly, by distributing the light as required over the sea surface to be illuminated, with or without colored sectors; and 3rdly, by condensing the light into flashes or groups of flashes, of any distinctive character that may be found to be most desirable.

8. A very important improvement in the construction of the dioptric apparatus, attended with considerable economy, was effected by the Trinity House in 1881, on the recommendation of their Engineer-in-Chief, by suppressing the upper and lower prisms and extending the vertical angle subtended by the lenses to the utmost limits. Apparatus on this system have been installed by the Trinity House at the Anvil Point, Eddystone, Bishop Rock, Round Island, and St. Catherine's lighthouses, by the Board of Trade at the Minicoy, Dondra Head, and Barberyn lighthouses (Ceylon), and one is now under construction for the Indian Government at Oyster Island (Burma). The cost of the optical portions of the new form of apparatus is rather less than half the cost of the old form. This is attended with a loss of 17 per cent. of the intensity of the light produced by the optical apparatus, but, by adopting apparatus of larger dimensions at the same first cost as the old form of apparatus, an increased efficiency is obtained with fixed or occulting lights, and 183 per cent. with revolving or flashing lights. The interest on the saving effected with these apparatus is more than sufficient, in the Trinity House Service, to meet the annual cost of the mineral oil consumed. Further advantages of the improved form of apparatus are, decreased weight for rotation with flashing lights, and perfect freedom for the focal adjustment of the luminary at the lighthouses, to meet differences in the height of the focal plane above the sea that may occur where an apparatus is required to be removed from one station to another, or to meet requirements of the local navigation by placing the greatest intensity of the light on the sea surface at any special distance from the lighthouse.

9. I am of opinion that this system of apparatus is especially adapted for India, and would recommend that it be adopted as new apparatus of the various orders may be required. A very large saving would thus be effected.

10. For the most efficient lighting of a coast, the revolving, flashing and group flashing classes of lights demand the first consideration, on account of their superior condensed intensity and penetrative power as compared with the fixed or occulting class. The fact of being able to obtain from three to seven times the intensity of light with the same expenditure of illuminating material is of itself a very important consideration, even when judged on its economic merits, but when considered in its aspect of relative efficiency for the benefit of the mariner, where high intensity is demanded, it is impossible to over-estimate its real value. On the other hand, where channels or hidden dangers in the locality of a lighthouse are required to be efficiently marked by colored sectors, the occulting class must be adopted.

11. Many important improvements have been effected during recent years in the manufacture and quality of the glass, and the greater perfection in the curvature and surfaces of the lenses and prisms, resulting in increased intensity, and the more efficient distribution of the light over the sea surface. The weaker forms of distinction have been suppressed and the better forms retained and multiplied. Very valuable improvements have also been effected in the mechanism for revolving, flashing, and occulting light apparatus. In the lanterns gun-metal and steel helical framing has been substituted for vertical framing and cylindrical for flat glazing, thus intercepting the least possible quantity of light. Increased ventilation, with great reduction in the internal temperature, has also been obtained by the introduction of ventilators of increased dimensions and improved form. The defect peculiar to catoptric fixed lights is due to the beam of light from each reflector being so much more intense at the centre than towards the edges. Thus the light cannot be uniformly distributed in azimuth without unduly enlarging the light room, and increasing the number of reflectors and their focal flames, which is attended with waste of the illuminant, and is frequently found to be impracticable. Further, the introduction of colored sectors, with catoptric fixed or occulting lights, is not possible except in a few special cases.

12. Lighthouse burners have in recent years undergone very considerable improvement. The new Trinity House concentric oil and gas burners of Sir James Douglass, F.R.S., for coast illumination, are of from one to ten rings of flame. These are adapted for burning any oil, whether animal, vegetable, or mineral, or illuminating gas, and have the greatest intensity of light per unit of focal area and economy in combustion of the illuminant of any oil or gas burner yet produced for lighthouse illumination. These important results are accomplished by a special arrangement of air currents through the flames, and between them and the glass cylinders, which currents are also specially arranged to reduce the temperature and consequently the breakage of the latter. It is on this system that the old 1st order four concentric wick burners have been increased, both for gas and oil, from four to ten rings of flame, with an advance in the intensity of the collective flames from 230 to 2,300 candles when consuming animal, vegetable, or mineral oil, and to 2,600 candles with cannel or oil gas; whilst the focal compactness of the flames per unit of focal area, or in other words efficiency for service at the focus of the optical apparatus, has been increased, as compared with the Fresnel burners largely used in the Indian lighthouses, by 109 per cent. A further superiority in these burners consists of an arrangement for burning at various intensities without alteration in the form or dimensions of the flames. A very considerable economy is effected by the Trinity House with these burners in the annual consumption of oil by providing for the mariner just sufficient intensity of the light during clear weather, and the maximum intensity of the light only when the atmosphere is impaired for its transmission. Where new burners are required I would strongly recommend the adoption of these burners on

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the ground of their superior efficiency and economy. I append a statement showing the candle power and consumption of oil with the Trinity House Douglass burners :—

Description of Burners. Heavy mineral oil.	Illuminating power in standard candles.	Consumption of oil per hour in fluid ounces. (160 fluid oz. = 1 gallon.)
Wick.		
1	20	2·0
2	60	6·0
3	180	18·9
4	350	36·8
6	835	91·8
8	1,500	172·5
10	2,300	266·0

13. In regard to lanterns for dioptric lights of the several orders, I would state that too much importance cannot be attached to the subject of their ventilation, and the form of the framing for supporting the glazing; the former, 1st, for admitting an abundant supply of pure air and oxygen to the flame; 2ndly, for diminishing the precipitation of moisture on the internal surface of the glazing; and, 3rdly, for the efficient expulsion of heated gases through the roof of the lantern: the latter, for preventing loss of light to the mariner by obstructing its passage through the glazing. The floors of the lanterns should in all cases be fitted with open gratings, and the pedestals with large hit-and-miss air valves. The improved circular roof ventilators now generally adopted by the Trinity House, which are arranged to admit of the free egress of heated air and smoke, without any down draught, will be found very efficient in India, where the temperature in the lanterns at midnight, during hot weather, frequently reaches 134° F. It is found that vertical sash bars obstruct a large portion of the light in certain directions. I noticed, when on the coast, that the beam of light issuing through the unobstructed portions of the glazing of the Pámban lighthouse lantern was visible at a distance of 10 miles in a seaward direction, while the light when viewed in the direction of one of the vertical portions of the framing of the glazing was very indistinct at a distance of three miles. To obviate this great loss of light, the framing should be constructed diagonally throughout, forming panes of lozenge shape for the cylindrical glazing. Cylindrical lantern glass of this description has been found by actual experiment to be 68 per cent. stronger, for external pressures, than flat pane glass of the same thickness. This is a very important consideration for the exposed positions occupied by coast light lanterns. A further advantage attending the use of cylindrical glazing is, that by the radiant light always falling nearly normally on the surface, the mischief and loss of light caused by surface reflections is avoided. In glazing lanterns in a hot climate care should be taken to allow a clearance of from $\frac{1}{8}$th to $\frac{3}{16}$th of an inch between the metal framing and the glass, to admit of free contraction and expansion. A large amount of damage has been caused to the glazing of the lanterns in this Presidency by the glass fitting too snugly.

14. In designing lighthouse towers the interior should in all cases be open to the free ventilation of air between the entrance door, windows, and lantern. In towers of large internal diameter the steps can be self-supporting, with one end built into the wall, and the inner edge protected by a handrail. In towers of less diameter a wrought-iron spiral staircase with cast-iron treads will best suit the requirements of the station by admitting a greater amount of light and air to the tower. The windows require to be of adequate area, well arranged, fitted with opening sashes, and easily accessible from the stair landings and steps. The lantern floor gratings should be of iron, carried on iron or steel girders, and arranged to admit of free ventilation to the lantern. All the towers for the 1st and 2nd order lights should be provided with a service room under the lantern. This room should be fitted with four windows for aiding the ventilating of the lantern, and a door should be provided between this room and the tower for preventing disturbances in the ventilation of the lantern by sudden currents of air through the tower. All lighthouse towers and lanterns should be rendered, as far as possible, fireproof.

15. Turning now to the system of store accommodation, each establishment requires to be provided with adequate accommodation for the safe storage of at least six months' supply of oil, lighting stores, &c. The oil should be placed in iron or steel tanks tinned internally, and provided with proper draw-off cocks and tight-fitting covers, and mounted on stone or slate benches, the latter to facilitate drawing off the oil. Mineral oil can be readily and safely stored in lead-lined masonry tanks of special construction, the oil being removed from these when required by a pump. The oil should always be allowed to settle for at least one month before being used. However carefully the oil may be stored at the central depôt, a certain amount of sediment will be found to occur after carriage to the station, and thus the oil, if burnt before allowance for proper settlement, will prove destructive to the cotton wicks and detrimental to the efficiency of the light.

16. It is essential that the wicks should be woven of cotton, of excellent quality, that their tissue be uniform, as flexible as possible, and neither too closely nor too openly woven. It is of

great importance that the wicks be kept free from dust and dampness. After being burnt for a few hours there is formed on the wicks (where cocoanut oil is in use) a hard crust, which arrests the capillary action of the oil and lowers the flame. This crust is not formed to any appreciable extent where heavy mineral oil is used.

17. I cannot too highly recommend the use of heavy mineral oil of about 250° F. flashing point (close test). This oil is giving general satisfaction in the Trinity House lighthouse and lightvessel service, on account of its low cost, high illuminating power, perfect safety in storage, and general efficiency. The consumption of heavy mineral oil, light for light, does not exceed the consumption of cocoanut or kerosene, while the price in England is at present only about 6½*d.* per gallon. I may add that this oil is found to be most efficiently and economically stored at lighthouses in lead-lined masonry tanks of special construction.

18. Gas buoys and beacons as auxiliaries to lighthouses have engaged the attention of light-house authorities for several years. After careful experimental trial their use is now established on a fairly satisfactory basis. The numerous outlying shoals, bars, and banks surrounding the coast of this Presidency constitute a serious danger to mariners, and their position up to the present time has only been indicated by buoys and beacons by day. These positions can now be efficiently marked by night, and thus enable vessels to navigate with safety channels which hitherto could not have been attempted, except at considerable risk. The great advantage secured by gas buoys and beacons cannot fail to be of the utmost importance to the requirements of this Presidency, more especially within reasonable distance of a central depôt, where the cost of the establishment of works for making and compressing the mineral oil gas would be justified. The buoys are constructed of steel, of special form, surmounted by an iron superstructure, carrying a lantern. The illuminating apparatus of about 20 candles power is enclosed in the lantern, the light from which is fixed, flashing, or occulting, as may be demanded. In some cases a bell is added as a signal for foggy weather. A complete buoy, weighing about 4 tons, is charged to a pressure of 90 lb. per square inch, and contains the equivalent of about 1,910 cubic feet of gas at atmospheric pressure, which, when consumed at the rate of 0·75 cubic feet per hour, will burn continuously for 100 days and nights without recharging. The beacons are of iron or steel, with gas chambers at the base, and are provided with a lantern and illuminating apparatus as described above. These can be made, if desirable, of greater illuminating power. The cost of the gas, which is made from mineral oil on Pintsch's system, would not exceed three annas per day (per buoy) of 24 hours. The gas is conveyed to the buoys or beacons in large steel receivers of a capacity of about 250 cubic feet. These are charged to a pressure of 10 atmospheres. Connection is made between the receiver and the buoy or beacon by means of a flexible hose. The cost of a gas buoy complete is about 420*l.* The cost of gas plant, with engine and compressor, about 800*l.* The cost of a beacon 40 feet in height, about 650*l.* I may mention that the Suez Canal Company has over 100 lights, of various kinds, on Pintsch's system.

19. It would appear that sufficient care has not been bestowed on the method of fixing the lightning conductors at the several stations. These are usually composed of copper wire attached to wood plugs, let into the external surface of the tower, the wire between the plugs (a distance of 12 feet) having no support. The terminals are carried above the lantern roof, but are not attached to the lanterns. I would point out that, in the majority of cases, the conductors are loose, and the joints are seriously disturbed by the action of the wind during stormy weather. I would recommend that all conductors be arranged on the system adopted by the Trinity House on the advice of Faraday, viz., to be made of $1\frac{8}{4}$ inch half-round copper, with scarfed joints, screwed and sweated together; the conductor to be carefully secured at every three feet to the internal wall of the tower, and well connected at the upper end to the iron pedestal of the lantern, and at the lower end to a large copper plate buried in moist earth at 10 to 12 feet below the surface of the ground, and at a distance of 15 feet from the tower, with a copper vane and terminal, which conduct electrical currents to the iron pedestals; where these do not exist it will be necessary to fit them. The metal pedestal of the optical apparatus, and all internal and external ironwork of the tower, should be connected to the main conductor by branches. Were these means employed, the conductors would practically escape expansion and contraction by changes of temperature, which prove so detrimental to the joints, and the conductors would at all times be accessible from the stairs for periodical inspection and test, also for effecting any necessary repairs. These would also be protected from the effects of winds during stormy weather, which have proved so injurious in many cases.

20. The coast signal lights of this Presidency are very inadequate in penetrating powers 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 dimensions of the optical apparatus. The imperfect focussing of the flames to the apparatus is another serious obstacle to securing the greatest efficiency from the existing 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 consequently when they would prove of the utmost service to the navigator, they are obscured at a distance of from two to three miles. The modes of utilizing the rearward light where possible, of covering dangers with red sectors, of collecting and condensing the light in the most efficient manner, of giving the

light the normal direction due to its height, and the same power in all directions seaward, are not generally adopted. The lighthouse towers are generally of sound construction. The most noticeable features are the inefficient arrangement of internal ladders, 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 oil flames. There exists a want of accommodation through the manholes of the lantern floors.

21. Referring to the system of burners, undue simplicity and economy appear to be the ruling influences. That which is the simplest and most economical to maintain is used, without regard to the form of flame and power of light required to fill perfectly the optical apparatus with which it is associated, or the consumption of oil necessary to maintain the light at maximum intensity to meet the requirements of the mariner.

22. It is most disadvantageous, and wasteful of the illuminant, to form the local source of light in lenticular apparatus by the assemblage of a large number of burners of any type (and more particularly the two-wick flat type) at a great distance from each other. All the flames are more or less exfocal, and loss of light is very considerable. At Muttum lighthouse five out of the six burners placed in the lenticular apparatus in the form of a circle, having a diameter of 1 ft. 3 ins., are exfocal. These do not add 20 per cent. to the intensity of the light obtained from the single burner of 20-candle power at the focus. The fact does not appear to be recognized that the power of the light depends as much on the compactness and intensity of the luminary as on the dimensions of the optical apparatus. Again, the apparatus is designed for flames of certain dimensions to meet the requirements of the special character of the light. The intensity of the flame being the most essential quality, it is highly important, in order to make the most advantageous use of the optical apparatus, to produce a focal light of maximum brilliancy and minimum dimensions. The four-wick burner formerly in use at Muttum, when consuming cocoanut oil, had an intensity of 350 candle units, and was of its size the most economical and powerful burner in the world. This has been substituted by flames having a combined useful intensity of only 25 candle units.

23. Santipilly luminary furnishes another illustration of the fallacy of using a number of burners. I may mention that the four-wick cocoanut oil burners were discarded at Muttum and Santipilly after an unsuccessful attempt to burn heavy mineral oil. These can be arranged to consume the latter oil, when the apparatus would give the illuminating power for which it was designed.

24. The portions of the luminous beam of the greatest intensity emanating from a dioptric apparatus should be inclined to the horizon, while the divergent portions of the beam, which are of low intensity, are sent below the horizon. On careful examination of the position of the flames of the burners in the Presidency lanterns, I found 90 per cent. out of focus, both vertically and horizontally. The burners were placed on a table in the apparatus without due regard to the determined focus. In certain instances burners varying considerably in height were in use, without any allowance being made in the height of the tables.

25. The difference in the height between the true foci of the apparatus and the foci of the burners ranged between three-eighths and five-eighths of an inch, thus reducing the power of the beam of light sent to the mariner from 30 to 60 per cent.

26. The burners with two flat wicks (ordinary duplex domestic mineral oil burners), universally used in the lighthouse lanterns, are entirely inadequate, both in the form of their flames and their illuminating power, to the requirements of the optical apparatus on the coast. In all cases the apparatus were designed for burners of a certain form and size of flame, each lens or prism taking its light from different parts of the flame. With the flat-wick burners above mentioned, the light is far more intense in the front position of the flame than at the side. In revolving lights I have observed two distinct flashes produced by flames of the flat-wick burners; such flashes are misleading to the mariner.

27. The present wicks are supplied by capillary action alone, therefore the heights of the flames decrease as the level of the oil falls in the lamp reservoir, thus materially reducing the intensity of the luminary between the time of lighting and trimming. The very low power of the burners is again considerably reduced by the allowance of oil being made for each lamp per night, viz., about one pint, and a necessity on the part of the light keepers to burn the flame at one-half to three-quarters of its maximum height. To illustrate the very low consumption of oil in the Presidency lights, and corresponding low power of the beams of light sent to the mariner, I may mention that more oil is annually expended in a 1st order Trinity House light than in the whole of the lights in this Presidency.

28. I have ascertained that the beam of light emanating from any one 4th order fixed light on the coast line has a power not exceeding 110 candle units, while the order of apparatus is designed to give an intensity of at least 650 candle units.

29. The concentric two-wick burners designed for the dioptric apparatus of the 4th order have an intensity of flame of 82 candle units, with a consumption of 8·2 fluid ounces of oil per hour, equal to a consumption of half a gallon per night. These burners are supplied from constant level reservoirs or pressure lamps, thus maintaining the oil in the burner at a constant level, with a

nearly uniform intensity of light. Burners of this description will run for 16 hours without trimming of the wicks when consuming mineral oil (heavy). The intensity is practically the same throughout, it being only necessary to regulate occasionally the current of air through the flame.

30. Until the original burners are substituted, or new and improved lamps adjusted to consume heavy mineral oil, it is impossible to give to the apparatus the power they are intended to develope, or in any material degree to improve the lights.

31. I would recommend, for consideration by the Government of India, the introduction of new improved burners and reservoirs, or pressure lamps, which can be applied with facility to all the optical apparatus in the Presidency.

32. No adequate accommodation for storing the spare burners, tips, and illuminating stores exists at the several establishments. At present these are not unfrequently placed in old packing cases, in contact with tools, &c., causing serious damage to these delicate appurtenances. A glazed cupboard, fitted with shelves, properly arranged for holding the burners in a vertical position, is very desirable for preserving them in good and efficient condition. The cupboards should, where practicable, be placed in the service room or otherwise in the store.

33. The optical apparatus in many of the lighthouses are seriously damaged from want of care in transport, packing erection, and cleaning; also from unequal expansion and contraction between the metal framing and the glass, caused by the direct rays of the sun. 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. The surface of the polished glass prisms requires to be polished daily with a soft, clean chamois leather or cloth, and every week they should be carefully cleaned with spirits of wine.

34. The lanterns of the several orders, enclosing dioptric and catoptric apparatus, are all defective in their ventilation. The lantern floors are close boarded, and thus not ventilating or fire-proof. The exit of heated gases through the lantern roof is much restricted. The object of good ventilation is threefold—1st, to furnish an ample supply of pure oxygen to the flames of the burner; 2ndly, to diminish the precipitation of moisture on the interior of the lantern glass, which reduces more or less the intensity of the light; 3rdly, for the efficient exit of the heated gas through the roof of the lantern.

35. The temperature of the lanterns at midnight frequently exceeds 125° F.—a heat which does not admit of the perfect manipulation and combustion of the flames. With more powerful burners the heat must necessarily be increased.

36. Ventilating tubes carried up to the roof ventilator, and fitted with ball and socket joints and damper gear, are imperative for the maintenance of perfect flames with concentric wick burners. It is highly important that the inspectors, when visiting the establishments at night, should satisfy themselves that the ventilating arrangements are properly adjusted for the efficient burning of the flames.

37. I observed that few stores were fitted with provision for storing oil in tanks, to admit of proper settlement of the oil and assure its being in an efficient condition for burning well. Each store requires at least two tinned iron tanks, fitted with draw-off taps, and capable of holding collectively a half-yearly supply.

38. The efficient burning of the lamps must always be largely dependent on the ability, skill, watchful care, and attention of the light keepers, on whom the safety of life and property at sea in a great measure depends.

39. I would recommend to the immediate consideration of Government the desirability of acquiring the services of a thoroughly efficient European lighthouse mechanic for training the existing keepers in the manipulation of concentric wick burners, lamps, clockwork, &c. This officer would be available for inspection duty, and competent to execute small running repairs to the burners and lamps, clockwork, &c. Special attention should be given to the selection and training of the men. All candidates should be required to pass a simple examination in reading, writing, and arithmetic, with a view to their keeping the requisite store books and journals of a lighthouse in an efficient state. They should each be required to obtain a certificate of proficiency in the management of the several orders of lights before appointment to a station. During the night a keeper on duty should never, under any circumstance, be absent from the lantern. In visiting one station at night I found the tower door locked, all means of ventilation to the lantern and flame closed, the flame turned down to half power, and the keeper absent. I would remark that the strictest supervision and most careful management are required to be exercised to render the lights of this Presidency efficient.

40. In examining the wicks of the several stations I found them of very indifferent manufacture.

41. 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 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.

42. 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 1,330 m.m. focal distance should be adopted. The 4th order of apparatus, of 250 m.m. focal distance, is an efficient size for the illumination of ports or entrances of small rivers where the light is not directly required for the navigation of the coast. For marking inshore spits and sandbanks, apparatus of the 5th and 6th orders will generally meet the requirements of the station.

43. After very careful consideration of the present requirements ofcoast illumination, I would desire to suggest the following new lights, and alterations to existing ones, in addition to the improvements already recommended:—

Pigeon Island.
Cape Comorin. (To mark the Crocodile Rocks.)
False Point, Divi. (A very powerful flashing light.)
Masulipatam. (To seaward of existing station.)
Sacramento Shoal. (On the shore to the southward of the shoal, with a red sector from Hope Island.)
Vizagapatam, Bimlipatam. Small lights would be of service at these stations.

Cundapur Light.

(*a*) and (*b*) The flagstaff is well secured and in good order.
(*c*) Inspection is efficient.
(*d*) The location is satisfactory.
(*e*) The burner is suited to the lantern and of sufficient power. The lantern glass (ruby) is of too dark a tint, absorbing too much of the power of the burner. The metal reflector is out of focus. A colored glass cylinder, with white lantern glazing, would give the light more power. I would suggest a 5th order dioptric apparatus, with service cabin, being provided at this port, exhibiting a white beam with a red sector between the following bearings, viz., S.W. by S. $\frac{1}{2}$ S. and W. by S. $\frac{1}{2}$ S., to guide vessels clear of the breakers in making the anchorage.
(*f*) Stores are well supplied.

Malpé Light.

(*a*) and (*b*) The flagstaff is well secured and in good order.
(*c*) Inspection is sufficient.
(*d*) The location is unsatisfactory. The light should be exhibited from a tower placed on Deria Bahadur Ghur Island, covering the dangers to the northward and southward, including Molky rocks, with red sectors. The present light has a range of $2\frac{1}{4}$ miles only, and is obscured in certain directions by the islands to seaward.
(*e*) The lamp and burner are not efficient, and of too low a power. It is almost impossible to distinguish the light from ordinary shore lights in the vicinity.
(*f*) Stores are well maintained.

Mangalore Lighthouse.

(*a*) The tower is well built and founded. The wood gallery under the lantern exposes too great an area to the wind during stormy weather, causing the lantern to vibrate and water to be driven through the glazing. The ladder arrangement for ascending the tower is unsatisfactory.
(*b*) The tower is maintained in good repair.
(*c*) The inspection is satisfactory.
(*d*) The location is adapted to the requirements of the port.
(*e*) The dioptric apparatus is efficient as a fixed light and in excellent condition. The burner is deficient in power and unsuitable in pattern. The light is maintained at low power to consume only one pint of oil per night. The ventilation of the tower is very imperfect.
(*f*) Stores should be kept at the station and suitable tanks provided for the oil; also a cupboard for spare burners and stores.

Cannanore Light.

(*a*) The tower is fairly well built and founded. This form of structure is not well adapted to dioptric port lights, owing to a difficulty in igniting the wicks in rough weather. A service cabin and mast would be more efficient and of cheaper construction.
(*b*) The building is maintained in good order. No lightning-conductor is provided.
(*c*) The inspection should be more frequent.

(*d*) The location is adapted to the port.
(*e*) The illuminating apparatus is efficient for the port. The burner requires focussing, the wicks more careful trimming, and the light should be maintained at its maximum power.
(*f*) The station should be supplied with oil tanks, and all stores kept in the tower.

Tellicherry Lighthouse.

(*a*) The tower is of rough construction, and unsuitable to the form of apparatus. The apparatus requires to be lowered into the tower daily for cleaning, also for igniting the wicks.
(*b*) The building is out of repair generally.
(*c*) Inspection is satisfactory.
(*d*) The location is adapted to the port.
(*e*) The apparatus is efficient for the present requirements of the port and for a fixed light. The front uprights of the shelter require to be moved to allow the light to be seen in all directions seaward. The burner is out of focus horizontally.
(*f*) Stores are well supplied. Oil tanks and a cupboard are required.

Calicut Lighthouse.

(*a*) The tower is well built and founded. The internal arrangement of ladders is unsatisfactory.
(*b*) The repairs are well carried out.
(*c*) Inspection is satisfactory.
(*d*) The location is well suited to the port.
(*e*) The optical apparatus is efficient as a port light and well kept. The burner is deficient in power and unsuitable in pattern.
(*f*) The store at the station should be utilised and fitted with oil tanks and a cupboard. Stores are well maintained.

Cochin Lighthouse.

(*a*) The tower is well built and founded. The ladders, as fitted, are very inconvenient for reaching the lantern.
(*b*) The buildings are in good repair
(*c*) The light requires more frequent inspection at night.
(*d*) The location is suitable.
(*e*) The illuminating apparatus requires a silvered reflector in the dark arc, of suitable form, the existing parabolic reflector being adjusted to a focus of three inches only. The burner is deficient in power, unsuitable in pattern, and out of focus. The lantern is deficient in ventilation.
(*f*) Stores are well supplied. The oil store at the station should be fitted with oil tanks and store cupboard, and all stores kept at the station.

Allipee Lighthouse.

(*a*) The tower is well built and founded.
(*b*) The buildings are kept in good repair.
(*c*) Inspection is efficient.
(*d*) The location is a desirable one.
(*e*) The illuminating apparatus is efficient, and the light viewed from seaward sufficiently powerful.
(*f*) Stores are well supplied.

Muttum Lighthouse.

(*a*) The tower is well built and founded.
(*b*) The buildings are in good repair.
(*c*) The establishment requires to be visited more frequently.
(*d*) The site is well selected.
(*e*) The 1st order optical apparatus is efficient for a fixed light. Serious damage has occurred to the lenses, prisms, and dioptric mirror. The form of luminary is entirely unadapted to the lenticular apparatus. The outer five duplex burners are entirely out of focus, and of little service to the mariner. A six-wick burner and pressure lamp, burning heavy mineral oil, are required, adapted to burning two wicks only during clear weather, with the reserve of power when the atmosphere is impaired by fog or mist. The lantern floor requires ventilating, and it will be advisable to fix a large improved ventilator on the roof to carry off the heated products of combustion. The apparatus is maintained in a clean state, and the paint work well preserved.
(*f*) Stores are well maintained. Oil tanks and a store cupboard are required.

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Manapaud Lighthouse.

(*a*) The lighthouse is well built and founded. The design is not suited to the form of apparatus. A service cabin, with iron mast and lowering gear, is better arranged for port dioptric lights.
(*b*) The buildings are in good repair.
(*c*) Inspection is not sufficient.
(*d*) The location is satisfactory.
(*e*) The illuminating apparatus is very deficient in power, ill adapted for lighting the burner, and the latter out of focus, both horizontally and vertically. The apparatus is in good condition.
(*f*) Stores are well supplied. Oil tanks are required.

Tuticorin Lighthouse.

(*a*) The upper portion of the structure appears needlessly heavy in design. The interior space is much confined by the addition of a central pillar. The stones forming the gallery course are too light, and are being seriously shaken during stormy weather, admitting water into the tower through their beds.
(*b*) The building below the gallery course is in good repair.
(*c*) Local inspection should be carried out more frequently.
(*d*) The position is a very desirable one.
(*e*) The optical apparatus is efficient as a fixed port light, and maintained in good order (one prism broken). The duplex burner is deficient in power, out of focus, and unsuited to the form of apparatus. The ventilation of the tower and apparatus is imperfect.
(*f*) Stores are badly maintained, only one gallon of oil being kept in stock at the station. Oil and water tanks are required, also a store cupboard.

Pámban Lighthouse.

(*a*) The upper portion of the tower has a larger diameter than the foundation. The design should receive consideration before a new lantern is fixed.
(*b*) The buildings are in fair repair; the concrete area is out of repair.
(*c*) Local inspection is satisfactory.
(*d*) The location meets the requirements of the Pass.
(*e*) The optical apparatus is efficient as a fixed light. The duplex burner is very inefficient and out of focus. The lantern is obsolete in form, without pedestal, and wanting in ventilation. The sash bars on certain bearings obscure the light. The light requires to be altered to occulting, with a red sector between N.E. by E. and S.E. ½ S., to mark the sandbanks to the northward and southward of the Pass.
(*f*) Stores are well maintained; oil tanks and a store cupboard are required.

Negapatam Lighthouse.

(*a*) The tower is well built, and exhibits no sign of weakness.
(*b*) The building is in fair repair. The roof ladders and lantern require scraping and painting.
(*c*) Local inspection is not satisfactory.
(*d*) The position of the light is well suited to the requirements of the port.
(*e*) The optical apparatus is efficient as a fixed light, and maintained in fair order. The lantern glass was covered with thick white paint to a distance of one inch on either side of the sash bars, thus unnecessarily obscuring a large amount of light. The duplex burner is out of focus horizontally, and not adapted to the optical apparatus; the flame is very deficient in power.
(*f*) Stores are well maintained, although kept in a dirty condition in a general store at the Custom House. The store accommodation at base of tower requires to be fitted with oil tanks and store cupboard, for receiving the stores of the establishment.

Cuddalore Light.

(*a*) and (*b*) The light is exhibited from the cross-trees of the flagstaff.
(*c*) Local inspection is satisfactory.
(*d*) The position is suited to port requirements.
(*e*) The lantern, 4-inch pressed glass lens, and reflector are ill adapted to port lighting, and the light very deficient in power. A 5th order dioptric port light would suit the requirements of the station.
(*f*) Stores are well maintained.

Seven Pagodas Lighthouse.

(*a*) The tower is well founded, and forms part of an ancient temple. The additional masonry is of rough construction.

(*b*) The building is in fair repair. A leakage is noticeable around the holding-down bolts of the lantern.
(*c*) More frequent inspection is advisable.
(*d*) The location is satisfactory.
(*e*) The dioptric apparatus is not efficient as a fixed red light. A number of prisms are shaken in the setting, and require attention. The form of burner is unsatisfactory, and the power far too low for a red light. The lantern is very imperfectly ventilated.
(*f*) Stores are well maintained. Oil tanks and a store cupboard are necessary, the former in the oil store and the latter in the tower.

Madras Lighthouse.

(*a*) The tower is well built and founded.
(*b*) The buildings are in good repair.
(*c*) Inspection is satisfactory.
(*d*) The location is admirably adapted to the port.
(*e*) The catoptric illuminating apparatus is of obsolete design, and extravagant in its consumption of oil. The space for the manipulation of the burners is confined, and the lantern ventilation inadequate for the proper combustion of the flames. The burners are seriously corroded at their tips, and the adjustment unsatisfactory. A 3rd order dioptric flashing light, placed in a new helically-framed, well-ventilated lantern, fitted with an improved burner, consuming less oil than the existing burners, would increase the power of the beam 25 times, and add considerably to the efficiency of this important station.
(*f*) Supplies are well maintained.

Pulicat Lighthouse.

(*a*) The tower is of solid construction and well founded.
(*b*) The buildings are undergoing thorough repair.
(*c*) More frequent inspection is advisable.
(*d*) The position is a suitable one.
(*e*) The optical apparatus is in good order, and of sufficient power for a fixed light. The illuminated arc is not extended as far to the northward as would appear desirable. The burner is inadequate in power and out of focus of the lens. Better ventilation is necessary, with a more powerful burner.
(*f*) Supplies are well maintained. Oil tanks and a storage cupboard are required.

Armeghon Lighthouse.

(*a*) The tower is well built and founded.
(*b*) The buildings require a general repair.
(*c*) More frequent inspection is desirable.
(*d*) The location is satisfactory.
(*e*) The optical apparatus is very efficient, and in good condition. The duplex burner is totally unsuited to the form of apparatus, causing a double flash in certain azimuths, which is misleading to shipping. The power of the burner is inadequate, and the light out of focus of the apparatus. The lantern requires scraping and painting.
(*f*) Stores are well maintained. Oil tanks and a cupboard are required.

Point Divi Lighthouse.

(*a*) The tower is well built and founded. The alteration in the course of the river must be guarded against. The lantern gallery constructed of wood is not adapted to the masonry tower. This form of construction admits of vibration in the lantern glazing. I noticed only one pane remained intact.
(*b*) Heavy repairs and alterations are in hand.
(*c*) Inspection is satisfactory.
(*d*) The tower is situated at too great a distance from the danger it is intended to mark. At an elevation of 15 feet from the sea level the light is lost at a distance of 12 miles, while the dangers extend to a distance of at least 10 miles (5 fathoms).
(*e*) The dioptric apparatus is very deficient in power. The optical apparatus is in good condition.
(*f*) Supplies should be kept at the station, and not at Masulipatam.

Masulipatam Lighthouse.

(*a*) and (*b*) The flagstaff is well secured and in fair order.
(*c*) Local inspection is satisfactory.
(*d*) The light is situated at too great a distance from the shore and anchorage.

(*e*) The optical apparatus is very deficient in power. Ventilation defective, burner out of focus, and lenses damaged.
(*f*) Stores are well maintained.

Hope Island Lighthouse.

(*a*) The tower is sound, and well founded on a swamp. The stair arrangement is unsatisfactory, and the tower badly ventilated.
(*b*) The buildings require general repair.
(*c*) Inspection is satisfactory.
(*d*) The location is very unsatisfactory, being at a distance of nine miles from the dangers off Godávari Point.
(*e*) The optical apparatus of the 6th order (5·9 m.m. focal distance, with a nautical range of eight miles in clear weather) is very inefficient. This apparatus is described in the "List of Lights" as of 4th order, visible 14 miles. The whole is in good condition. The burner now in use is out of focus vertically, and deficient in power.
(*f*) Stores are well provided. No oil tanks or store cupboards are fitted.

Vakalapudi Lighthouse.

(*a*) The structure is well built and on a secure foundation. The arrangement of internal ladders is convenient.
(*b*) The tower requires whitewashing. The lightning-conductor is out of repair.
(*c*) Inspection is satisfactory.
(*d*) The location is well adapted to the requirements of the shipping entering the port.
(*e*) The optical apparatus is efficient, but seriously damaged. The burner is out of focus, both horizontally and vertically, ill adapted to the requirements of the apparatus, and deficient in power.
(*f*) Stores are well supplied. No store cupboard or oil tanks are provided.

Santipilly Lighthouse.

(*a*) The lantern-pedestal and lantern are well founded on a masonry base. The latter is out of repair.
(*b*) The buildings are out of repair.
(*c*) Inspection is satisfactory.
(*d*) A position nearer the danger would prove more efficient.
(*e*) The optical apparatus is very efficient for a fixed light, six lenses are damaged, otherwise the whole is in excellent condition. The existing burners are utterly inadequate to the requirements of the apparatus, the four outer ones being entirely out of focus, and of no service to the mariner. The four-wick improved burner, now discarded in consequence of its failing to burn 160° and 300° F. mineral oils, has with cocoanut or colza oil (for which it was designed) a power of 350 candles, while the available existing light does not exceed 15 candles. The consumption of oil in the four-wick burner can be reduced by suppressing during clear weather the two inner wicks, and the burner readily arranged for burning mineral oils. I would suggest a red sector being shown over the Santipilly rock.
(*f*) Stores are generally well provided. Oil tanks, cupboards, spirits of wine, sponges, and lens brushes are not supplied.

Calingapatam Lighthouse.

(*a*) The building is of very rude construction, and badly arranged.
(*b*) The building at the summit is out of repair.
(*c*) Inspection is satisfactory.
(*d*) Location is desirable.
(*e*) The whole apparatus is very inefficient, and the beam of light issuing from the reflector and burners (which are completely out of focus) misleading to the mariner. The light is obscured seaward in certain directions by the shelter standards. I would suggest the existing antiquated apparatus being replaced by a 5th order white occulting light, the Santara Reef marked by a red sector, and a green sector shown inside, bearing N.E. ½ E., to mark the limit of anchorage.
(*f*) Stores should be kept at the station and oil tanks provided.

Gopálpur Light.

(*a*) The flagstaff is in fair repair.
(*c*) The inspector should see that the burner or burners are placed in and maintained at the focus of the reflectors.
(*d*) The location is well adapted to the requirements of the port.

(*e*) The illuminating apparatus is obsolete in form and very unsuitable. The two brass reflectors are fixed in the lantern with a lamp burnt between the two, and entirely out of focus of both. The light is not well arranged on all bearings. I would suggest the present lantern being replaced by a 5th order occulting dioptric port light, with suitable hoisting gear. The power of the light would in this way be increased tenfold with no additional consumption of oil.

(*f*) Stores are well supplied. No tanks are provided.

19th June 1890. (Signed) W. T. DOUGLASS.

From Captain H. A. STREET, Her Majesty's Indian Marine, Presidency Port Officer, to the Chief Secretary to Government, dated Madras, 20th November 1890, No. 690—556-G.

In accordance with the instructions contained in Marine Department reference on current No. 922, dated 7th November 1890 (herewith returned), I have the honor to submit, for the consideration of the Government, the following remarks on the several points noted on by Mr. Douglass in his report on the Madras Lighthouses, viz.—

I.—RESPECTING EXISTING LIGHTS GENERALLY.

(*a*) It is true that with the exception of the lights at Alipee, Madras, Armeghon and Vakalapudi, the apparatus at each of the lighthouses is of the same nature—fixed—but, as one-third of these lights is of a different color from the remaining two-thirds, this difference combined with the position of each of the colored lights in respect to the white and the distance of the different lights from each other, as well as their respective illuminating powers which are superior both to the lights on shore in the vicinity and to the anchor lights of native craft, gives to each light that very distinctive character to which Mr. Douglass attaches so much importance, and shows that, in establishing the several coast lights, this very important point has not been overlooked.

(*b*) The penetrating powers of the coast lights are described as being very inadequate for the service of their respective stations. This defect is attributed, among other minor causes, to the restricted dimensions of the optical apparatus. Be this as it may, I would point out that the greater number of the coast signal lights were procured to meet the wants more of *coasting* than of the *foreign-going* vessels, and consequently, lights with great penetrating powers have never been considered an actual necessity, especially as, during the bad weather seasons, many of the ports are unapproachable, and at those ports which are open during such seasons the light in each case has hitherto been found sufficiently powerful. That the existing lights, with a few exceptions to which reference will be made hereafter, have fulfilled the purpose for which they severally have been exhibited is, I think, proved by the fact that if the greater number had been found unsuitable and of insufficient penetrating power by the coasting mariners, the attention of the Government would have been drawn to the same long before this by the commanders, owners and agents of vessels connected with the coasting trade. The fact that certain of the coast lights are of insufficient penetrating power has not escaped notice, and measures have been taken to replace such of these lights as required earliest attention by an apparatus in each case of an improved pattern.

(*c*) Mr. Douglass' suggestions in respect to store accommodation, the best class of burners, wick, &c., as coming from an expert in such matters, are valuable and will receive due attention. His remarks relative to ventilation, lightning-conductors and the internal arrangements of lighthouses generally, are matters for the consideration of the Public Works Department.

II.—RESPECTING INDIVIDUAL LIGHTS.

Coondapoor.

A 6th order red dioptric port light (fixed) with a radius of 180° will, I consider, fully meet the requirements of the vessels calling at this port, which is seldom visited except by small coasting steamers of light draft and native craft. A requisition for a light of this description has already been submitted.

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Malpé.

A 6th order white dioptric port light is, I consider, sufficient for this port, which, like Coondapoor, is only visited by small coasting steamers of light draft and native craft. A requisition for a light of this description has already been placed before Government.

I do not concur in Mr. Douglass' view that the location of the present light is unsatisfactory, and that the new light should be placed on Deria Bahadur Ghur Island. The position of the present light was fixed after a personal inspection of the locality by Mr. Wicks, when Port officer at Mangalore, and fully met with my approval on my inspection of the port shortly afterwards, as the light is only required to mark the entrance to the river and to guide the small class of vessels which visit the port to the best anchorage.

A light on Deria Bahadur Ghur would not mark the entrance to the river, and if placed there, a second light in the position of the present one would be necessary. Neither Deria Bahadur Ghur nor the Molky Rocks are in the track of the larger class of coasting steamers, and I submit that it is not necessary to put up a light on places which would not be of use to mariners generally. The lights at Malpé and Coondapoor were only placed to meet the requirements of the small coasting steamers, which during the fine season call about once a week at each of these ports. The question was fully considered by me at the time of my inspection, and I see no reason for departing from the views I then formed on the subject.

Mangalore.

The ladder arrangement referred to answers the purpose for which it is applied. Personally I have never found it unsatisfactory, though it certainly is not an easy way of mounting to the top of the lighthouse.

The remark respecting the burner will receive attention, as well as the suggestions respecting stores, oil tanks and a cupboard for spare burners and stores.

Cannanore.

The difficulty in igniting the wicks in rough weather has long been known, but I do not consider it of such importance as to render it now necessary to go to the expense of obtaining a service cabin and mast. When a more powerful light is required at this port, the question might be then considered.

The light is under the supervision of the Port Conservator, who has instructions to visit it frequently during each week. It is also occasionally inspected by the Port officer at Calicut and by the Presidency Port Officer during his yearly inspection of the coast ports.

Tellicherry.

Mr. Douglass is mistaken in stating that the apparatus requires to be lowered down into the tower daily for cleaning and also for igniting the wicks. It is true that, as at Cannanore, the wicks are ignited with difficulty, but the matter, in my opinion, is not of sufficient importance to justify the expense attending the fitting of a cabin and mast. Repairs to the building have been effected from time to time, and the Executive Engineer of the district, in whose charge the building is, reported in March last that it was in good order.

Attention will be paid to the improvements suggested, which will be carried out in due course.

Calicut.

The internal arrangement of ladders makes mounting to the top of the lighthouse somewhat tedious, but I do not consider that the arrangement is of so unsatisfactory a nature as to call for any re-arrangement.

The improvements considered necessary will receive due attention.

Cochin.

The light is under the supervision of the local Port officer, who has instructions to visit it frequently. I notice that Mr. Douglass in page 28 of his report under reference states that at one station—which I have ascertained was Cochin—he found "the tower door locked, all means of ventilation to the lantern and flame closed, the flame turned down to half power and the keeper absent." Due inquiry was made by me into this matter, and measures taken to prevent a recurrence of such an offence. The defects pointed out will receive attention.

Mutlum.

Mr. Douglass' views in respect to the present arrangement of burners will receive attention.

The attention of the Public Works Department might be called to the extra ventilation considered necessary.

Manapaud.

A more powerful illuminating apparatus had been indented for prior to Mr. Douglass' inspection, and was put up after he had visited the place. It is reported to afford an excellent light.

The lighthouse is inspected every three months by the Port officer at Tuticorin.

Tuticorin.

Measures to remedy the defects pointed out will be taken.

The inspection is carried out by the local Port officer.

Pámban.

Measures to remedy the defects pointed out will be taken.

I do not consider that an occulting light is required at this port, nor that colored sectors are necessary. The fixed light is in such a position as not likely to be mistaken for any other light either on shore or afloat. Vessels seldom approach the port at night, and, when they do, their course takes them well clear of the shoals. The absence of any serious strandings or other accidents to vessels trading to Pámban proves, I submit, that neither colored sectors nor an occulting light is at all necessary.

Negapatam.

The defects pointed out will meet with attention.

The local inspection is carried out by the Port officer, but in what manner it is unsatisfactory Mr. Douglass does not point out.

Cuddalore.

A new light of an improved pattern is under demand.

Seven Pagodas.

The defects pointed out will meet with attention.

Madras.

The range and power of the present apparatus, in spite of the defects pointed out by Mr. Douglass, continues to give satisfaction to mariners approaching the port, and I submit that it is a matter for serious consideration whether, as long as it continues to do so, a new apparatus of an improved pattern should be substituted. New burners are certainly required, as the present ones have been in constant use ever since the apparatus was put up; they are not so corroded at the tips as to be actually useless, and they will probably last for a couple of years more. Should it be eventually decided, however, to place the light on the top of the new High Court, it might be advisable to adopt Mr. Douglass' suggestion in respect to obtaining a new light.

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Pulicat.

The defects pointed out will meet with attention.

The inspection is carried out by the Personal Assistant to the Presidency Port Officer from time to time under the latter officer's instructions.

Armeghon.

The defects pointed out will meet with attention.

Point Divi.

The light at this place is one of the few on the coast about which coasting mariners mostly complain, as during thick weather its penetrating power is insufficient, and the light then can rarely be seen beyond 9 miles. It is very necessary that a light with a range of about 20 miles should be substituted, but to obtain such a range a higher column is necessary, as well as a higher order of apparatus than the one now in use. The question is entirely one of expense, and proposals for erecting a new column and for obtaining a new apparatus will be put before Government in due course.

There is no objection to the supplies being kept at the lighthouse instead of Masulipatam, and instructions to that effect will be issued.

Masulipatam.

The defects in regard to burners, &c., pointed out will be remedied.

To place the light nearer to the anchorage would necessitate the erecting of either a column or another flagstaff for the apparatus and buildings for the light keepers. This would involve a great deal of expense, but I am inclined to the opinion that the change would be advantageous to shipping.

Hope Island.

If this light was only intended to guide vessels clear of the dangers off Godávari Point I should concur in Mr. Douglass' remark respecting its location, but as vessels are now guided instead by the light at Vakalapudi in rounding Godávari Point, Hope Island light is of little use for that purpose, and really is only used by coasting vessels in fixing their position in proceeding either up or down the coast. For this purpose the present apparatus, which, apparently through some oversight, has, in the list of lights referred to by Mr. Douglass, been incorrectly described as a 4th order light, is sufficient.

The defects mentioned will be remedied in due course.

Vakalapudi.

The defects mentioned will be remedied.

Santopilly.

The defects mentioned will be remedied.

There is no better position for the lighthouse in the vicinity, and in my opinion the site selected was the best that could be found.

Calingapatam.

A new apparatus, a 4th order dioptric port light (red), has lately been substituted for the apparatus to which Mr. Douglass refers.

Repairs to the building have been effected.

Gopálpur.

A new apparatus of the 4th order has been demanded to take the place of the one now in use.

III.—RESPECTING DEFECTS IN APPARATUS AND BURNERS, &c.

At the ports at which the illuminating apparatus was found by Mr. Douglass to be obsolete in form and unsuitable, I would point out that the apparatus (generally of country make) appears to have been placed only at small ports where an inexpensive light was solely required to mark the anchorage, and as the light afforded by such apparatus was found sufficiently effective, the question of replacing these country-made lanterns by an apparatus of a more modern description was never apparently seriously considered before 1888. Since that year the attention of the Government has been drawn from time to time to the matter, and several important changes have been made of late.

Burners.

The burners originally supplied with the different apparatus obtained from Home, I am told, were only suitable for cocoanut oil, and, from what I have been able to ascertain from the records in my office, the class of burner to which Mr. Douglass refers was introduced when kerosene oil was brought generally into use.

The alteration at the lighthouse at Muttum appears to have been made about seven years ago in consequence of a difficulty in working the pressure lamp sent out with the apparatus, and, as it had the effect of reducing the consumption of oil and of affording a better light, seems to have been considered a success. A similar alteration with equally good results in regard to the expenditure of oil was made at Santopilly last year.

The bad focussing referred to is due to ignorance on the part of the superintendents and lightkeepers. The matter will receive my serious attention, and measures will be adopted which, it is hoped, will prevent any possibility of the burners being improperly placed in future.

Wicks.

The description of wick used is in some cases of native manufacture, as it was considered desirable to obtain it locally if at all suitable for the burners.

Store Accommodation.

As pointed out by Mr. Douglass, the accommodation for stores at the different lighthouses is inadequate. Measures have been taken to effect the necessary improvements.

Location.

The opinion expressed by Mr. Douglass on this point in connection with the unsuitability of the position of certain lights is, I submit, open to question, as the necessarily rapid inspection made by him of the several lights afforded no time, in my opinion, for making that close examination of their several localities which would be required by even a person qualified to express an opinion on the matter. I do not concur in the view taken by Mr. Douglass in respect to the unsuitability of the location of the lights to which he refers in his report, and my opinion, I would add, is based on an intimate acquaintance of several years' standing with the seaboard of this Presidency.

Inspection.

The inspection of the different lights is carried out under instructions issued by me, and I am unable to concur in Mr. Douglass' opinion that in some instances the inspection has been insufficient.

IV.—RESPECTING DIFFERENT PROPOSALS.

Acquiring the services of a thoroughly efficient European Light-house Mechanic for training the existing keepers in the manipulation of concentric wick burners, lamps, clock-work, &c.—see page 28 *of Mr. Douglass' report.*

A mechanic for the purpose specified would no doubt tend towards keeping light arrangements in an efficient state, and should the Government decide to adopt Mr. Douglass' proposal to substitute new improved burners and reservoirs or pressure

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lamps for the existing burners, it would be necessary to have some person with sufficient knowledge of the working of such lamps to impart instruction to the different superintendents and lightkeepers. I do not consider that a *European* mechanic would answer. In the first place, he would require high pay, probably Rs. 300 per mensem, and his passage paid both out and back; in the second place, men of that class generally become very troublesome after they have been in India for a little time, as they soon begin to be a little above their work, and if all their demands are not satisfied get discontented; they can seldom get on with natives, and as a rule have neither the tact and temper to enable them to impart instruction satisfactorily; and as a man of this class in addition would know nothing of the native dialects, I consider it would be preferable to select one of the lighthouse superintendents for the purpose, and to even send him to England to be trained if it is found that sufficient instruction cannot be imparted to him at the lighthouse recently erected on the coast of Ceylon. As these lights are directly under the Board of Trade, they probably will have been supplied with the latest kind of burners. Should the Government approve of this suggestion, I will submit definite proposals.

Best kind of Burner.

For the dioptric apparatus of the 4th order the concentric two-wick burner is recommended. Mr. Douglass states—see page 27 of his report—"that until the original burners are substituted, or new and improved lamps adjusted to consume heavy mineral oil, it is impossible to give to the apparatus the power they are intended to develope, or in any material degree to improve the lights."

Ten concentric two-wick burners and pressure lamps suitable for a dioptric apparatus of the 4th order will thus be necessary. One six-wick burner and pressure lamp adapted to burning two wicks only during clear weather is recommended for Muttum light, and a four-wick burner and pressure lamp for Santopilly. The four-wick apparatus at this latter place to which Mr. Douglass refers will be brought again into use if it can be adapted to burn mineral oil.

Wick.

With each new lamp, wick of the kind recommended by Mr. Douglass should be supplied.

Oil.

A new description of heavy mineral oil has lately been obtained through the India Office, and excellent results have been obtained from its use. It is intended to use this description of oil in future.

Care of Apparatus.

It has long been the practice to keep the optical apparatus in all lanterns covered between sunrise and sunset.

The several superintendents and other persons in separate charge of light apparatus have full and clear instructions as to the cleaning and polishing of the surface of the polished glass prisms.

Ventilation.

As with more powerful burners the heat will necessarily be increased, the attention of the Public Works Department might be drawn to Mr. Douglass' remarks regarding ventilation, and his proposals with reference thereto.

Description of Illuminating Apparatus recommended.

A flashing or occulting dioptric apparatus of the 2nd order is considered by Mr. Douglass to be the smallest that should be exhibited at stations where the light is 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.

"For some of the more important landfalls" an apparatus of 1,330 m.m. focal distance is recommended, and "for the illumination of ports or entrances of small rivers where the light is not directly required for the navigation of the coast" the 4th order of apparatus of 250 m.m. focal distance is stated to be an efficient size.

With the exception of the lights at Muttum, Manapaud, Point Calimere, Seven Pagodas, Pulicat, Armeghon, Point Divi, Hope Island, Santopilly and Calingapatam, the different lights on the seaboard of this Presidency are not required for the navigation of the coast, but solely for the illumination of the port at which they are respectively located, and of these lights 3 are of the 4th order dioptric, 3 of the 4th order catadioptric, 1 of the 4th order catoptric, 1 (Madras) of the 1st order catoptric, 3 of the 6th order dioptric port light description, and 4 with an apparatus of country make. It will thus be seen that of the illuminating apparatus at each port, 6 are of the character recommended and 1 of a superior order (Madras). The 6th order dioptric port light now in use has hitherto been found sufficient for all practical purposes at each of the small ports at which it has been exhibited, and I do not consider that it is at all necessary at present to replace any of these lights, especially as they are not directly required for the navigation of the coast, by an apparatus of a superior order or of a different nature. Of the lights which are required for the navigation of the coast, that at Muttum and the one at Santopilly mark the dangers most directly in the way of coasting vessels; the former is an apparatus of the 1st order dioptric and the latter is of the 2nd order dioptric. Both are fixed lights, but beyond supplying each apparatus with the description of burner recommended by Mr. Douglass, no other change is needed. The lights next in importance as marking dangers to navigation are Armeghon, Pulicat and Seven Pagodas. The apparatus in each case is of the 4th order dioptric, the first named being a white revolving light, that at Pulicat fixed white, and the one at Seven Pagodas a fixed red light. As Mr. Douglass anticipates that with the introduction of concentric two-wick burners the penetrating power of the 4th order lights will be greatly improved, and also as the penetrating powers of the lights at the three places above mentioned, even with the burner now in use, have in each case been found sufficient for the purposes of coast navigation and also for the requirements of non-coasting vessels approaching Madras, I am of opinion that a more powerful apparatus is not needed at either place. The red fixed light at Manapaud is now of the 4th order dioptric port light description. When Mr. Douglass visited the place the apparatus was of the 6th order, and the fact of it being deficient in power had been previously brought to the notice of Government. The present light answers the purpose for which it has been exhibited, viz., to guide coasting vessels clear of the shoals in the vicinity, and an apparatus of greater penetrating power is not required. At Point Calimere the light red and fixed is of the 6th order. A more powerful apparatus is certainly unnecessary, as the range of the present light is amply sufficient to meet the wants of vessels passing between Point Calimere and the shoals to the eastward, for which purpose only it has been exhibited. I would further point out that, for marking inshore spits and sandbanks, the 6th order apparatus is considered sufficient by Mr. Douglass. Even if it were necessary to adopt, in place of the existing illuminating apparatus, one of larger dimensions at any port where the light is maintained throughout the year, I do not consider that the reasons given by Mr. Douglass in favor of the flashing or occulting description of apparatus are sufficient as to render it absolutely requisite that every new light which may be required should be of that nature. Mr. Douglass' reasons for advocating the adoption of occulting or flashing lights are—(*a*) that, with the exception of Allipy, Madras, Armeghon and Vakalapudi, the coast signal lights of the seaboard of this Presidency have no distinctive character; (*b*) that the fixed coast signal light is liable to be mistaken for some other light either on shore or afloat; (*c*) that it is therefore desirable to impress upon each coast signal light such a trustworthy distinctive character as to effectually prevent the possibility of its being mistaken for any other light either on shore or afloat; (*d*) that the remaining coast signal fixed lights of the British Isles are being rapidly altered to occulting and flashing. With regard to these reasons, I beg to point out that the location of each of the fixed coast signal lights; the distance between each light, which on an average is upwards of 60 miles; the proportion of red lights to white—fully one-third— and the manner in which the red lights have been distributed; combined with the fact that the illuminating power of the greater proportion of the lights is in each case superior to that of any light on shore in the vicinity or of the anchor lights of the shipping which frequent the coast ports, gives to each light, if the apparatus is not of country make, a sufficiently distinctive character as to render it unnecessary in my opinion to adopt generally a class of light the cost of which is so much greater than that of the description now in use. Flashing or occulting lights are no doubt requisite at ports lying close together and also at places where the outlying dangers necessitate the exhibition of a number of lights as on the coasts of the British Isles, but on the seaboard of this Presidency the outlying dangers which require marking by lights are widely separated and few in number, and, as mentioned before, the different ports at which lights are exhibited are far apart from each other. It is, therefore, apparent that the conditions which have rendered necessary the adoption on the coasts of the British Isles of lights of a flashing or occulting nature do not exist on the coast of this Presidency.

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New Lights proposed.

Mr. Douglass' rapid tour round the coast I do not consider gave him sufficient time to inquire thoroughly into the question of extra lights, and I further submit that, to advise on that head, not only is a personal knowledge of the locality necessary, but also an intimate acquaintance with the track usually taken by vessels plying in the vicinity of the spot on which it is proposed to place a light, and the difficulties attending the safe navigation of vessels when approaching the spot.

Pigeon Island.

This island is in latitude 14° 1′ N. and longitude 74° 19′ E. and therefore outside the limits of this Presidency. It is 300 feet high and lies ten miles off the coast. It can be approached within a mile with safety, and as its height makes it clearly visible, I do not consider that a light on it is at all necessary. I have passed it frequently when in command of a vessel in all kinds of weather and experienced no difficulty in approaching it through the absence of a light.

Cape Comorin.

The light on Muttum Point marks the Crocodile Rock. A light on Cape Comorin for such a purpose, or indeed for any other purpose, is not necessary.

False Point Divi.

A light on False Point Divi is not requisite at present. Should the small ports in the Nellore district be opened out and vessels make a point of calling at them, a light on False Point Divi might become necessary, but if of a powerful flashing nature, it would be liable to be mistaken for the light at Armeghon. It is probable that Mr. Douglass in recommending a light on False Point Divi had in his mind the necessity of placing a more powerful light on Point Divi.

Masulipatam.

Should the location of the present light be changed, an additional light will not be necessary.

Sacramento Shoal.

A light in the vicinity of this shoal would be of considerable use to the commanders of the coasting steamers, but it is not an absolute necessity. The question has been under my consideration for some time, but I have deferred making any proposal to erect a light, as I considered it necessary that I should first visit the spot recommended for the light by the local Port officer at Cocanada; this I hope to do shortly, and I will then report further on the question.

Vizagapatam and Bimlipatam.

As a light is not required at either of these ports in the interests of mariners generally, I do not concur in Mr. Douglass' recommendation. Possibly a small light

on the flagstaff might be of use occasionally to coasting steamers, but it is so seldom that these steamers arrive off either port before daylight, that I do not consider any need exists for exhibiting a light.

CONCLUDING REMARKS.

In conclusion, I submit that the defects brought to notice are such as only an expert in light apparatus management would notice, and that many of them are due entirely to the carelessness of the native lightkeepers and the ignorance of the superintendents. Mr. Douglass' recommendations in respect to ventilation, burners, and improved illuminating apparatus, &c., as coming from an expert in such matters, are of infinite value, but I submit that he has not shown sufficient cause either for the exhibition of any new light or for any general alteration in the description of illuminating apparatus now in use, nor proved that lights of an occulting or flashing description are the best for general service on the coast of this Presidency.

From Captain H. A. STREET, Her Majesty's Indian Marine, Presidency Port Officer, to the Chief Secretary to Government, dated Madras, 26th November 1890, No. 690—572-G.

With reference to Mr. Douglass' remarks in respect to the Cochin light in paragraph marked (*e*) under *Cochin* in his report on the recent inspection of Madras lighthouses, I have the honor to acquaint you, for the information of the Government, that it is not quite clear what is meant by the expression "suitable form" as regards the reflector, and that further information on this point is necessary, such as can be afforded by an expert on such matters. Under the circumstance, I beg to inquire whether I may place myself in direct communication with Mr. Douglass on the subject.

ORDER—dated 22nd January 1891, No. 25, Marine.

With its letter, No. 4873, dated 10th October 1890, the Government of India forwards a copy of Mr. W. T. Douglass' report of his recent inspection of the lighthouses on the coasts of this Presidency, and in his letter, No. 690—556, dated 20th November 1890, the Presidency Port Officer submits his remarks on the several points noted on by Mr. Douglass.

2. Before proceeding to pass orders in detail, the Government observes that it entirely agrees with the Presidency Port Officer that, in the case of the ports of this Presidency, simplicity in lighthouse arrangements is of great importance, and that it is therefore advisable to adhere to the existing system of exhibiting fixed lights at them. This opinion His Excellency the Governor in Council has already expressed in the case of the new lights ordered for the ports of Gopálpur, Cuddalore, Malpé and Cundapur, although Mr. Douglass was strongly in favor of dioptric occulting lights and informed the Right Honorable the Secretary of State that in his opinion the exhibition of fixed lights was a fatal mistake. The Government, however, does not consider that there is any practical danger of these lights being confounded with any ordinary shorelights, but is of opinion that the apparatus used should be good and not of country make and that the burners and wicks should be of the best quality obtainable. Oil should be provided in ample quantities, and the establishment should consist of men of some education and thoroughly qualified for their work. In order to attain these objects, the Government will have no objection to the expenditure of such sums as may be necessary from time to time, and the Presidency Port Officer will propose any improvements in these directions that he is in a position to recommend.

G.O., No. 368 A, dated 20th Oct. 1890.
" " 400 A, " 18th Nov. "
" " 470 " 27th Dec. "

3. The Presidency Port Officer will report how far the suggestions contained in paragraph 13 of the report can be adopted and at what cost. With reference to

Captain Street's remarks in I (*e*) of his letter of the 20th November, it is observed that each case must be considered separately and proposals submitted by the Public Works Department for such improvements as are necessary.

4. The Government is not aware that there is any part of the coasts of this Presidency at which necessity exists for the adoption of the expensive arrangements recommended in paragraph 18 of the report. Paragraph 19 will be communicated to the Public Works Department for attention.

5. Referring to the remarks in paragraph 22 regarding the Muttum light, the Presidency Port Officer will explain how it is that the light is in such an unsatisfactory state. As to the question of the location of the light at Malpé, the Government agrees in the view taken by Captain Street, and is not prepared to direct any change from the present site, which was selected after careful consideration.

6. With respect to the light exhibited at the Presidency port, His Excellency in Council is of opinion that, if it is finally decided to remove it to the tower of the High Court, a new apparatus should be obtained without delay. The Presidency Port Officer's proposals for the provision of a more efficient light at Point Divi are awaited; and that officer should take steps at once to carry out the improvements which he considers to be called for in regard to the light at Masulipatam.

7. Captain Street has not noticed Mr. Douglass' recommendation that a red sector should be shown over the Santapilly rock. It is advisable that the reef should be distinctly marked, and probably a large red buoy carrying a bell would answer the purpose. The Presidency Port Officer will report on this suggestion. With reference to the remarks in section III of his earlier letter, Captain Street's attention will be drawn to paragraph 2 of this order. The existing system of lighthouse inspections is, no doubt, the best procurable at present and no improvement in the matter can be hoped for until the Government is in possession of the services of a properly trained engineer and a steam vessel of its own by means of which all the lighthouses could be inspected at frequent and regular intervals.

8. The Government agrees with the Presidency Port Officer that it is not advisable to procure the services of an European mechanic to train lighthouse-keepers in their duties, but at the same time considers it very necessary that there should be some one easily available who understands the mechanism and management of the expensive apparatus in use and who can carry out small repairs. The Presidency Port Officer will report whether he can obtain the services of some good mechanic with local experience and who speaks the native dialects in view to his being sent to England to be specially trained. The Government also considers that it would be desirable to offer a young engineer officer of a mechanical turn some inducement to make a study of lighthouse buildings and apparatus in use in England and France during his absence from duty on furlough. The Chief Engineer, Public Works Department, will be requested to report on the point.

9. The Presidency Port Officer will report the probable cost of the new burners which he states are necessary, and in order to avoid delay, he will at the same time submit an indent on the India Office Store Department for their supply. Captain Street's promised report regarding the necessity for a light in the vicinity of the Sacramento shoal should be expedited, and he will be informed that the Government agrees with him that no lights need be exhibited at Vizagapatam and Bimlipatam.

10. With reference to the Presidency Port Officer's letter of the 26th November, the Government has no objection to that officer placing himself in direct communication with Mr. Douglass, and considers that such a course will be not only simple but advantageous.

11. In conclusion, it is observed that there is much in Mr. Douglass' report which cannot fail to be of great value and assistance to the local authorities, who, it is hoped, will spare no endeavours to make a practical use of the suggestions and recommendations offered. The necessary alterations to lighthouses must be carried out gradually, but the Presidency Port Officer will lose no time in communicating with the Public Works Department on the subject.

12. These Proceedings will be communicated to the Right Honorable the Secretary of State for India and the Government of India.

(True Extract.)

J. F. PRICE,
Chief Secretary.

To the Presidency Port Officer.
" Public Works Department.

Exd. A. Raitt.

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Govt. of {1891} Madras.

MARINE.

Issued

Recd. Encl.

G.O., 22nd January 1891, No. 25.

JANUARY.

Lighthouses.

Passing orders on Mr. W. T. Douglass' report of his inspection of the — in Madras Presidency and on the Presidency Port Officer's remarks thereon, and directing that the Proceedings be communicated to the Secretary of State and the Government of India.

(12)

Order thereon No 314 W dy
3rd July 1891.

Communicated to Supt
Engineer concerned for
information and guidance
Special attention is drawn
to para 19 of the report by
Mr Douglas, and to the
remarks in para 3 of the
Govt: order

2. The Chief Engineer P.W.
Department will report on the
point referred to in para 8 of
the G.O.

(True Extract)

Major R.E.
Under Secy to Govt
P.W.D.

The Chief Engineer P.W.D.