M.105.

OBSERVATIONS

ON THE

APPLICABILITY

OF

GAS LIGHT

TO

MADRAS.

BY

JOHN MAYER,

SURGEON, MADRAS ESTABLISHMENT; PROFESSOR OF CHEMISTRY, MEDICAL COLLEGE; MADRAS CHEMICAL EXAMINER TO GOVERNMENT.

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PREFACE.

A FEW years ago, while conducting some chemical experiments at Wallajahbad, I had occasion to make gas from oil ; the facility of its preparation, the simplicity of the apparatus employed, the brilliancy of the light on burning the gas, were sufficiently evident, and it struck me at the time, that gas so prepared might be employed for lighting buildings in the Presidency of Madras, where good coal is unknown as a natural product, and displace the many inseparable inconveniences attendant on the use of oil light, such as the soiling of tables, books, papers, fingers, &c., the thought was strengthened when I reflected that large quantities of oil were manufactured in India and that a considerable portion of this article was shipped to Europe, to return again to the country in the shape of stearine candles and soap, which yield profitable returns to those who deal in these articles. Since my arrival at Madras, I resumed my experiments on oil gas, and calculated the cost ; I was surprised to find that it was even less than the expense of oil employed for the ordinary purposes of lighting. I drew a comparison between it and the cost of coal gas used in Europe, I was in no way discouraged thereby. I considered I might do good by communicating the result of my investigations to authority, to whom I submitted the remarks embodied in this pamphlet, and I gratefully acknowledge the kind assistance and encouragement received from the highest quarters, as well as the warm interest expressed by the community at large.

From the recent experience I have had on this subject,I feel satisfied that gas tubing, jets, fittings, &c. should all be procured from England, where the manufacture of these things forms a distinct branch of trade. There exist great difficulties in this country in procuring workmen of sufficient intelligence to make any thing in the shape of gas fittings, and even the best workmen in want of special experience and appropriate machinery are quite unable to turn out gas fittings equal to those at home.

ABSTRACT OF THE SUBJECTS CONSIDERED IN THE ENSUING PAGES.

General advantages, attending the employment of Gas as a means of illumination. Enquiry to determine what material is here best suited to the purpose in view and why the suitability of this or that material depends in a great measure on local circumstances. Why Oil and Resin Gases have been laid aside in England, though preferred at this day in many places on the Continent.

The value of the various materials shown to be different in different localities which is the reason why one material is chosen in one place and not in another.

The lighting powers of Oil and Coal Gases compared, their differences and the causes of these differences.

The cost in Madras of the chief materials capable of affording lighting Gas.

The cost of apparatus suited to Gas making from Coal, and Gas making from Oil. The bearing of these various enquiries.

Details of early experiments showing the nature of the illuminating Gases derived from the decomposition of Cocoanut Oil.

Details of experiments with improved apparatus and the commonest Oil, amount of Gas obtained from 1½ Annas worth of Oil and length of time that such an amount of Gas will burn.

Comparison of the light thus obtained, with that of the common street lamp—cost of each; result, proving that an equal light from Oil Gas can be obtained for half the sum given for that afforded by the street lamp.

Explanation of the cause of the saving shown.

Estimate of probable cost for works capable of lighting the chief buildings in the Fort.

Examination and verification by Colonel McCally, Commissary General, of the money values taken, as the data for all the calculations given.

Examination and revision of the Estimate of cost for the erection of Gas works already given, by Colonel Faber, Chief Engineer, his Estimate.

Extract from Minutes of Consultation, No. 960, ordering a further enquiry into the amount and nature of the Fuel required in Oil Gas making. Correspondence in reference to the above.

Extract from Minutes of Consultation, No. 1068, ordering returns of cost for a given number of Oil and Gas lights, with that for interest and maintenance of Gas works according to the estimate of the Chief Engineer.

Correspondence relative to lighting the Lecture room of the Madras Medical College. The Right Honorable the Governor in Council sanctions the grant of 500 Rupees, by letter from T. Pycroft, Esq., *Chief Secretary.*

Letters to the Chief Secretary forwarding the returns called for, in Extract from Minutes of Consultation, No. 1068.

Reply of the Chief Secretary, stating that the Right Honorable the Governor in Council will await the issue of the experiment to be made at the Medical College.

No. 18 of 1853.

OUR GOVERNOR IN COUNCIL

At Fort St. George.

WE transmit a number in the packet a copy of a letter which has been addressed to us by the Chairman of the Oriental Gas Company setting forth the object of the Company and the privileges they seek with a view to carry out their plan of lighting the cities of India with Gas. We have informed the Chairman of the Company that it rests with the Government in India to determine what amount of encouragement shall be afforded to the undertaking and we will now only recommend the subject to your best consideration with the remark that it will give us great satisfaction if by any arrangement which you are able to make the great advantage of Gas lighting so desirable on every account shall be introduced into India.

We are,

Your loving friends,

RUSSELL ELLICE.
J. OLIPHANT.
J. LUSHINGTON.
J. COTTON.
R. D. MANGLES.
J. A. MOORE.
H. T. PRINSEP,
D. C. MAJORIBANKS.
W. DENT.
W. B. BAYLEY.
H. W. A. C. PLOWDEN.

LONDON, *24th May*, 1853.

Oriental Gas Company, London, 4th May 1853.

To

THE CHAIRMAN, DEPUTY CHAIRMAN AND DIRECTORS OF THE HON BLE EAST INDIA COMPANY.

GENTLEMEN,—The Board desire me in the first place to becomingly acknowledge the attention that was paid to the deputation representing

this company who had the honor to wait upon the Chairman and Deputy Chairman of your Hon'ble Court on Friday last.

The deputation explained the object " The Oriental Gas Company" had in seeking the audience granted, namely,

1. To shew that the Company is completely registered, the capital subscribed for : and that the Board desire to proceed in the undertaking with vigor, provided it receives that encouragement in India which will hold out a fair return for the capital to be employed.

2. That although the Directors considered £50,000 sufficient capital for a demonstration in Calcutta they have the power to increase it to £300,000, and that they feel confident the gentlemen who have become shareholders in the project will quadruple their stakes in this Company as an investment if called upon by circumstances to do so.

3. On the direction are two gentlemen of great practical experience in supplying Gas both in England and abroad, and the Consulting Engineer to the Company stands at the head of his profession.

4. The Board trust it will therefore be seen that they are guided by knowledge as well as zeal.

5. With these preliminary remarks the Board express a hope that your Hon'ble Court will be pleased to recommend the " Oriental Gas Company" to the favorable consideration of the local Government in India as being both capable and ready to supply this great want at each Presidency.

6. It appears to the Board that the local Government might materially encourage the object of the Oriental Gas Company by granting the following immunities, and the Board feel that if your Hon'ble Court would be graciously pleased to recommend the same it would greatly strengthen the application when made.

7. They would first ask for a free grant of land whereon to build the works should the Government have a spot vacant adapted for the purpose.

8. It would also be a reasonable indulgence if at starting this undertaking all importations of materials to be used exclusively for carrying it out might be landed free from Import Duty.

9. It will indeed be indispensable that the Oriental Gas Company be protected by a local charter of incorporation, and have a contract

granted for a number of years which should entitle them to supply all the public lights.

10. It will, the Board trust, not be out of place if they remind your Hon'ble Court that much larger indulgences than are here asked have been granted by the Government of Holland, Denmark, Berlin, Rome, and many Municipalities of France to English Companies to encourage the introduction of Gas into their dominions.

11. In conclusion the Board have to observe that Mr Stevens, the Company's Manager for India, proceeds to Calcutta by this day's mail and having concluded the necessary negotiations there, he will then go to Madras and Bombay, so that all possible despatch in supplying Gas consistent with efficiency may be carried on at each Presidency.

I have the honor to remain,

Your obedient servant,

(Signed) JAMES BARBER,

Chairman.

PUBLIC DEPARTMENT.

No. 653.

Extract from the Minutes of Consultation, dated 6th July 1853.

1. The Right Honorable the Governor in Council proceeds to pass the following orders on a Despatch from the Honorable the Court of Directors dated 24th May, No. 18 of 1853.

Recommend for the favorable consideration of the Madras Government, a project for lighting the cities of India with Gas, and forward copy of a communication from the Gas Company on the subject.

2. Ordered to be communicated to the Justices in Session for their information, also to the Military Board who will be prepared to afford the Agent of the Gas Company, on his arrival at Madras, all information he may require regarding the present cost of lighting the Fort, and Public Buildings.

3. The Military Board and Justices in Session will understand that it is the wish of Government to give every possible facility for the introduction of the proposed improvement.

FROM

J. E. MAYER, ESQ.,

Chemical Examiner.

To

T. PYCROFT, ESQ.,

Chief Secretary to Government.

SIR,—I have the honor to place in your hands the accompanying papers, on the subject of Gas illumination, and to request that you will at your early convenience have the goodness to lay the same before Government.

I have the honor to be,

SIR,

Your most obedient servant,

J. E. MAYER,

Chemical Examiner.

MADRAS, *2d May*, 1856.

The advantages attendant on the employment of gas, as a material for lighting purposes, and its superiority in point of beauty, utility, economy, and cleanliness, over every other hitherto suggested, are so generally recognized, that it is quite unnecessary to insist on them here the fact that gas has for some time past been used, in every town of any importance in Europe and the British Isles, as well as in the United States of America, and in Canada, that it is used at Cape Town, at some places in New South Wales, and that it is about to be used in Calcutta prove that the appreciation of these advantages keeps pace with the spread of civilization and intelligence.

There is not then a question, as to the advantages of gas, the question is, what are the circumstances, which make its use, under ordinary conditions, impracticable at Madras. The opinion lately given by a gentleman connected with the Calcutta Gas Company was, I am informed* (to this effect) and I apprehend that with certain reservations, in favor of some localities, and large buildings, this opinion must be endorsed by every person, who reflects on the distance of the greater number of the houses in Madras, one from the other and the great expense that must under these circumstances be incur-

* Viz. that the application of coal gas for illuminating purposes is impracticable at Madras.

red, for laying down, renewing and keeping in order the extent of iron pipe, that would be necessary.

The general use of gas for Madras, appears then impracticable, because, for the reasons given, it would not be remunerative, but if it can be shewn, that for certain buildings and localities, where the houses are contiguous, it could be made remunerative—then the impracticability vanishes, or at least in these cases, it no longer applies.

I have little doubt that a full and fair enquiry into the subject will shew, if the expense of the Apparatus, Buildings, &c., can be reduced, while the outlay for piping is restricted chiefly to that required for the inside of houses or buildings, and the consumption of the lighting material, within a given area amount to a certain number of cubic feet of gas, nightly, that it can for such localities be economically employed. Experiments of a very precise character are now being carried out, with the view of determining the exact cost of gas made from *oil* as this, for reasons about to be detailed, appears to offer the means of illuminating separate buildings and localities at less cost than that made from coal, this however is a point that also demands rigid comparative experiment. In the meantime it will be expedient to ascertain if possible what has been done elsewhere. First, whether gas made from oil or other substitutes, for coal is now employed in any particular localities, and what are the causes that determine its employment in these localities, (if any such can be found) ; secondly, whether oil or other gas, after having been tried, has in any place been laid aside, and if so, for what reason ; thirdly, which of all the sources for gas making can be most profitably made use of in Madras. To answer these enquiries it will be necessary to refer to works that treat of technical and manufacturing operations.

Dr. Knapp states in his Chemical Technology, pages 161 and 162, that " coal, fats, or oils, resin, tar, asphaltum, soap water, &c., are all practically employed *according to the locality* in the production of gas." The meaning of this evidently is, that in countries where coal is found, or in localities to which it can be sent, at small charge, *it* is the material for gas making, in oil or resin producing countries—either of these *two* is the proper material, and where neither of the above can be had, any fatty refuse. In England accord-

ing to the locality, different kinds of coal are used—it is admitted that canel-coal is superior to all other kinds for gas making, yet on the East coast, and in France for the greater part, caking coal is employed for this purpose. In many towns in Germany, to which coal cannot be brought without considerable expense, they make gas from any cheap seed oils that are the growth of the country. At page 179 of the work before quoted it is stated "Resin gas is not so highly illuminating as oil gas, and is of about the same quality as coal gas, it is used in many towns, as in Frankfort on the Maine, Antwerp, &c." further, on the same page, we find "Few cases are adapted to give so favorable an idea of the practical value of gas illumination, as the process carried out at the works of Houzean Muiron at Rheims, where very good gas is obtained from refuse which previously cost something to throw away, and which is now a source of the profit to the manufacturer. This refuse is the soap water, in which woollen stuffs have been freed from fat," page 180. Bituminous slate marl of Autun is used by M. Sellique, along with other matters to furnish gas, moreover this gas is said to be better than ordinary coal gas. Experiments in other parts of France have even been made with the view of obtaining lighting gas from animal matters, flesh of dead animals, &c. Gas from the last named source, has not however as far as I can learn been actually used in practice, but gas from all the other named sources is now in use, in certain localities. In Ireland gas for illumination has been made from turf, see Mr. Peckston's work on the Theory and Practice of gas lighting, pages 81 to 84, and he recommends it to be used in Ireland on account of local circumstances, i. e. because the turf is obtained so cheaply. If it be necessary to say more relative to the importance of local circumstances in determining the material that should any where be employed in gas making, I may extract a passage from Mr. Parnel's Applied Chemistry, see page 97. Under the head of oil gas he says, but it must be remembered he refers only to England. "In a few localities, where coal is difficult to procure, oil may be advantageously substituted as a source of gas, the oil employed for this purpose is the crudest and cheapest that can be procured ; even pilchard dregs and sediment of whale oil, quite unfit for burning in the ordinary manner, are sufficiently pure for making gas," and at page 46 of the same work he says "refuse oily matters are now common as sources of gas on the continent."

In the last edition of M. Dumas's splendid work Tracti de Chimie appliquie Aux Arts, published in 1848, see Tome premier, Partic Inorganique, &c. page 478 and page 509, he speaks of gas from oil, resin, soap water and other sources as being largely employed in France, the preference for any particular source being determined by local causes.

From this and all that has been previously adduced, it may be safely stated in answer to the first enquiries that gas made from oil and from other sources is now actually employed in many European towns, and that the material from which gas is to be made, appears mainly to depend on local circumstances.

In reference to the second question, it may be at once admitted that in *England* oil and other gases have been used at different times and places, and that these gases have in almost all instances been laid aside, why they have been so laid aside remains to be shewn. For which purpose it is necessary to make further reference to the works already quoted, Mr. Parnell states, see Applied Chemistry, page 98 " oil gas contains neither nitrogen, nor sulphuretted hydrogen. It contains more carbonic oxide than coal gas, but the presence of that gas (which has hardly any illuminating power) is more than counterbalanced, by the *large relative proportion of olefiant gas*, on which the illuminating power of both oil and coal gas essentially depends. From the presence of so much olefiant gas and vapours of hydrocarbons, which are liquid at common temperatures, the illuminating power of oil gas is reckoned, at three times that of ordinary coal gas, and twice that of the best coal gas." Again at page 101 he states " notwithstanding the great illuminating power of oil gas the abundance of the product compared with that from coal, and the simplicity of the process, yet the commonest oil, is far *too expensive* in this country (England) to rival coal as a source of gas." On the same page speaking of resin gas, he states " resin is another substance which may be advantageously substituted for coal in the manufacture of lighting gas where coal is not readily accessible. It affords an abundance of gas of excellent quality nearly equal to oil gas, but the *price of resin* compared with that of pit, coal, must ever prevent the former from coming into successful competition with the latter, in *Great Britain.* The attempt made, a few years ago, to introduce the manufacture on the large scale into this coun-

try (England) proved a decided failure, but in some parts of *France* resin gas is, I believe, manufactured with success.

Dr. Knapp, see Chemical Technology, page 174, vol. 1, says after giving a table, shewing the effects of temperature in the manufacture of oil gas. It appears then that oil gas is superior to that obtained from coal, as is also shewn by its density, and that the product dependent chiefly on temperature, is of the best quality when obtained at a low red heat—this temperature suffices to convert oil to gas, but is not sufficiently high to decarbonize the gas to any great extent." Again at page 215, Dr. Knapp states under the head of illuminating power of gases. "According to Brande, to produce the light of 10 wax candles 2·7 cubic feet of olefiant gas, 5·1 cubic feet of oil gas, and 13·75 cubic feet of coal gas are requisite, hence the illuminating power of oil gas is 2·6 times greater than that of coal gas but only half of that of olefiant gas." The following table given by Christison and Turner, and quoted by Knapp, shews the relative sp. gravities and illuminating powers of coal and oil gases, in a very striking manner.

Specific Gravity.		Illuminating Power.	
Coal Gas.	Oil Gas.	Coal Gas.	Oil Gas.
0·659	0·818	100	140
0·578	0·910	100	225
0·605	1·110	100	250
0·407	0·940	100	354
0·429	0·965	100	356
0·508	1·175	100	310
0·529	0·986	100	272

Thus the mean of six experiments, gives us the sp. gr. of coal gas 0,529, while that of oil gas is 0,986 and the illuminating power, for equal volumes burned under the same circumstances, gives the relation of 100 for coal gas, to 272 for oil gas, in short nearly 3 to 1.

The same author at page 216 after shewing the superiority of coal gas over other modes of lighting, both as relates to illuminating power and cost, has this remark.

"The two-fold greater illuminating power of oil gas presents greater advantages; far less expensive apparatus, gasometers, &c.,

are required : hence less capital is necessary for the production of an equal supply of light."

Peckstan, Ure, Dumas,—as well as every authority I have consulted agree with the statements above given, it is therefore unnecessary to take up further time or space by additional quotations. The unavoidable deductions, from a mode already given are that the abandonment in England of oil, resin, &c., as gas making materials arises solely from their high price, and not from any other cause, that on the contrary, in every other point of view these materials are for gas making purposes, superior to coal.

The third and most important question, viz., which of all the sources known can be most profitably employed in Madras for gas making, remains still for consideration. Nothing short of actual experiment can decide this positively, but by what has already been ascertained, and by certain other data that are at hand, the judgment will be materially aided in making a selection. First, it will be advisable to ascertain what is the precise meaning to be attached to the terms cheap and dear, as applied to coal, oil, and other materials to be used as gas sources.

No. 1.

		Rs.	A.	P.
1850	per Ton ..	18	5	7
Nov. 1851 to April 1852,	do. ...	16	2	3
May to October 1852,	do. ..	16	12	5
Nov. 1852 to April 1853,	do. ..	17	8	10
May to October 1853,	do. ..	20	15	3
Nov. 1853 to April 1854,	do. ..	22	11	1
May to October 1854,	do. ..	24	1	0
Nov. 1854 to April,	do. ...	27	7	0
May to October 1855,	do. ..	27	7	0
Purchased in Dec. 1855,	do. ...	27	7	0

Marginal statement No. 1 kindly furnished by Col. McCally informs us first what the average price of coal per ton may be taken at here ; from this it will be evident that the price of coals here and of coals in England are two very different things, and that coal considered cheap here would be thought enormously dear there, the same probably to an equal extent is true of oil.

No. 2.

	Cocoanut Oil.			Lamp Oil.			
	Rs.	A.	P.	Rs.	A.	P.	Per Gallon.
Contract rate...	1	4	0	0	11	$1\frac{1}{2}$	
Market rate....	1	9	0	0	10	$9\frac{3}{13}$	

Marginal statement No. 2 kindly forwarded by Capt. Nicholas will afford us the means of comparing the price of oil here, with that of oil at home.

From statement No. 1 which includes a period of 5 years, it appears that coal has been purchased at different rates at intervals of about 6 months each in this way, 10 separate purchases of coal have

been made, the 10 prices per ton added together and divided by 10, show that coal during the past 5 years has cost on an average in Madras Rs. 21-14-1 per ton, i. e. a fraction less than 22 Rs. per ton. We may therefore say, converting Rupees into Shillings, that it has cost more than 43 shillings per ton.

43 Shillings per ton Madras price of coal.

Mr. Parnell, see page 121, states the average price of coals per ton to be 17 shillings. Mr. Peckston reckons 790 tons of coal at £1,027, i. e. about 26 shillings per ton, see page 75. Mr. Hedley in his paper submitted to a committee of the House of Commons in 1837, gives the prices of a great many varieties of coal, ranging from 19*s.* 6*d.* per ton for canal-coal, though almost every intermediate price to 8*s.* and even 7*s.* per ton. See Ure's Dictionary, page 566, edition of 1846, which is much later than Mr. Peckston's work, which was published in 1823, Mr. Parnell's in 1843. These considerations show that we may safely take the price of good canal-coal fit for gas making at 20 shillings per ton, the coal we obtain here for 34 shillings per ton being used chiefly for steam boilers, is very likely not of the best description, being more probably of an intermediate quality that would not in England fetch more than 13 or 14 shillings per ton, and if this be correct, Madras would pay for coal, supposing it used for gas making in the ratio of 3 to 1, compared with the price of the same article at home.

(According to Mr. Parnell) 17 shillings per ton Home price of coal.

Average Home price of coal per ton 20 shillings.

Let us now see how the case stands with regard to oil.

Mr. Peckston gives £22 for 1 ton of whale oil, i. e. 2 shillings and a small fraction per gallon. The price of lamp oil here is 1*s.* 4½*d.* per gallon, in other words there is here a saving on this item of one-third, but it may be observed that Mr. Peckston was able to buy whale oil at the time he wrote, at a more reasonable rate than it could be bought by Mr. Parnell in 1843—for the latter gentleman reckons it at 3 shillings and 6 pence per gallon, see page 123 of his Applied Chemistry.

Dr. Ure, see page 562 of Dictionary, reckons for the gallon of oil 5 shillings, the average of the three sums given is 3·6, we may therefore assume that Mr. Parnell's figures are very near the truth—that is, that they represent the ordinary price of common lamp oil in England, if so, the difference between the price of our lamp oil and that at home is very considerable, being nearly in the ratio of 3 to 1 in

favor of Madras, nor is this difference greater than we might reasonably expect—England is not, and India is, an oil producing country.

The prices of coal and oil in India compared with the prices of the same things in England (admitting that the endeavour to ascertain these points has been successful) certainly show strongly in favor of oil, but still it is to be borne in mind that the original cost of gas making materials, though perhaps the most important item in the account is not all that is to be considered, true economy demands that the relative value of the products also be considered, and under this head quantity, chemical constitution, and lighting power are included —finally, the process to be employed, its outlay for fuel and attendants, the wear and tear of apparatus, and its original cost with the buildings required, and the enclosure to guard them from mischievous or ignorant persons—all require to be estimated. The value of the products obtained from coal and oil, supposing them to afford gases identical in quantity and quality to those obtained at home for the same weights and measures of material, will stand as follows.

In Madras 43 shillings buy 1 ton of coal, from which according to Mr. Hedley on average from 7,000 to 8,000 cubic feet of gas are produced, this makes the cost of 1,000 cubic feet about 5*s*. 6*d*. The cost of 1 gallon of lamp oil in Madras is 1*s*. 4*d*. and 1 gallon of oil according to Mr. Parnell produces about 90 cubic feet of gas, assuming these data for calculation we ought to obtain for 5*s*. 6*d*., if that sum be expended for oil nearly 400 cubic feet of gas, in other words the quantities of gas obtained for the same money may stand in the relation of $2\frac{1}{2}$ to 1.

This is certainly an enormous disproportion in amount of product, and if the illuminating powers of the two gases were equal, would at once decide the question in favor of coal, it has however been shown that the illuminating powers stand in the relation of $2\frac{1}{2}$ or 3 for oil gas to 1 of coal gas, this remarkable difference in quality again restores the balance and places the two materials in the same degree of eligibility—at all events leaving but small superiority to oil.

The cause of the difference in illuminating is, that both coal and oil gases are mixtures of several gaseous compounds, each of which possesses distinct powers as illumination, this will be seen at once from the subjoined analysis, by Drs. T. Thomson, T. Richardson, and Henry.

First Series Coal Gas.

	1	2	3	4	5
Olefiant Gas	14·50	17·50	20·00	10 19	9·25
Carburetted Hydrogen	66·49	59·14	47·77	31·35	36·05
Carbonic Oxide	7·07	12·00	11·76	16·28	11·42
Hydrogen	12·29	11·46	17·32	28·80	30·17
Atmospheric Air	.....	.....	.....	trace	trace
Naptha Vapour.	.....	.....	.....	0·48	0·50
Ammonia.	.....	.....	.....	traces	traces
	100·35	100·90	96·85	100·35	101·40

Second Series by Dr. Henry, Oil Gas.

	1	2	3	4
Olefiant Gas and Hydrocarbonus.	·6	19·2	22·5	38·
Carburetted Hydrogen.	28·	32·4	50·3	46·5
Carbonic Oxide.	14·1	12·2	15·5	9·5
Hydrogen.	45·1	32·4	77·	·3
Nitrogen.	66·	·4	·4	·3
	99·8	100·2	100·0	100·0

This table in a practical point of view is doubly valuable, as it not only shows the constitution of oil gas, but the importance of attending to the temperature. Nos. 1 and 2 made at a bright red heat, show but small quantities of the important material olefiant gas. No. 3 made at too low a temperature shows still an indifferent result. No. 4 which was manufactured at a low red heat, affords the best product. This precaution is now well known and oil gas always made at this temperature—therefore the results in No. 4 only are those we have to do with.

If the mean of the olefiant gas found in the five samples of coal gas be taken, the result is 14·3, in oil gas we find nearly three times this quantity 38 (and this compared with several other analysis is about the average)—now the only other gas possessed of any illuminating power is carburetted hydrogen*—which depends on the carbon it contains, and of this element it possesses but half the

The mean amount of carburetted hydrogen in the samples of coal gas given is 48, the amount of this gas found in No 4 of the oil gas series is 46, so that coal and oil gases differ little in this respect.

amount found in olefiant gas—finally, compared one with another it is to the surplus amount of carbon that illuminating gases owe their power—it is therefore easy to understand why, from their relative constitution, the one gas possesses illuminating qualities, so much above those of the other.

The nature of the two processes, and their bearing on the question of expense, calls for a few words. That for coal demands the greater number of attendants, and is from the higher temperature required to decompose coal the more destructive to retorts—which is a consideration especially in this country of some moment—the greater amount of fuel required, is not an item as it is more than covered by the coke formed in the process.

The last yet one of the most important considerations is the expense of apparatus, &c., required for making gas from coal—this in rough, approaches nearly to double that for making oil gas—as I shall show by extracting from Mr. Peckston's work, his estimates for the buildings, apparatus, &c., required for carrying out both processes.

Coal Gas.

"*Estimate of the expense of erecting an apparatus for generating coal gas, for lighting* 160 *public, and* 500 *private lights.*

	£	*s.*	*d.*
Expense of erecting the necessary buildings, forming tanks, and building a boundary wall to the station;—this item also includes the money required for purchasing ground to erect the works upon	4,630	0	0
Expense of apparatus, viz., retorts, condenser, purifiers, gas holders, connexions, and valves, &c	2,800	0	0

Oil Gas.

Estimate of the expense of erecting an apparatus for generating oil gas, for lighting 160 *public, and* 500 *private lights.*

	£	*s.*	*d.*
Expense of erecting the necessary buildings, forming a tank, and building a boundary wall to the station;—this item also includes the money required for purchasing ground to erect the works upon	3,550	0	0
Expense of apparatus, viz, retorts, condenser, washing vessels, gas holder, connexions, and valves, &c	1,460	0	0

The outlay even if considerable for works on the large scale,

where thousands of subscribers or rate-payers can be looked for, would not be, eventually of any consequence, but in cases, where the contemplated works are to be small, and the number of rate payers very limited, the primary outlay becomes an item of greatly increased importance. For these reasons chiefly, it appears to me that the process by means of oil offers advantages of such magnitude, as to outweigh all those attaching to coal.

No estimates for buildings or apparatus have yet been attempted —they will be commenced as soon as the first series of experiments relative to the exact amount of gas obtainable for equal money values from coal and oil have been completed—next to the facility of the operation which has already been demonstrated, the precise amount of products and their relative value as lighting materials requires determination—as on this, taken in conjunction with the original cost of materials, all further calculations depend.

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1. Before the preceding observations and details were written a series of experiments on the production of illuminating gas from cocoanut oil had been carried out, they were planned with the view of demonstrating the facility with which gas from oil could be obtained and the nature of the light afforded by burning it. I believe I may say that they were perfectly successful in so far as the two points named, were concerned, at least the Right Honorable the Governor and several gentlemen interested in the subject, who on one occasion, did me the honor to be present, expressed this opinion.

2. The facility of the operation required, the simplicity of the apparatus employed, and the brilliancy and beauty of the light obtained, having been thus publicly ascertained, the question of cost became the leading consideration, this demanded such a variety of information that added to the general considerations connected with the subject, this paper has swelled to the length of 20 pages of foolscap, to have dealt more cursorily with such a subject would not have given it fair play.

3. The oil employed in the primary set of experiments was as stated that made from the cocoanut, this however was well known to be very expensive source for gas, while the cheapest oils would afford as good a product, it (cocoanut oil) was employed simply on account of its flowing readily through the apertures of the stopcocks forming

a necessary part of the gas making apparatus. To use a viscid oil such as common lamp oil, it was imperative to work with larger tubes and stopcocks, after a delay of nearly two months these have been made, the gasometer has also been guaged, and its cubic capacity found, and marked to tenths of a cubic foot. These arrangements will enable me not only to use the cheapest oil but to ascertain with the greatest accuracy, the exact amount of gas obtainable from any given quantity of it, and the length of time that one cubic foot of gas will last when burners of known size are employed.

4. The first experiment with common lamp oil was conducted on the 22nd January 1856, the 2nd on the 24th of the same month. The results of these experiments were as follows : 20 oz. of lamp oil, i. e. one pint imperial measure yield from 14 to 15 cubic feet of gas. The money value of the oil is $1\frac{1}{2}$ annas. The charcoal employed $1\frac{1}{2}$ annas.

With an argaund burner bored for 12 jets, one cubic foot burns one hour. The comparative determination of the amount of light afforded by one cubic foot of gas for one hour, has not experimentally been determined, but if the data at hand may be relied on, we can arrive at it indirectly, as follows.

5. Tabular statement taken from supplement to the 3rd edition of Ure's Dictionary, see page 102, deduced from experiments, showing the cost of candles to produce as much light as 9,000 cubic feet of gas would afford, being the product of one ton of coal (the candles are moulds, 6 to the pound, 9 inches long and each candle is calculated to burn $9\frac{1}{3}$ hours, cost of candles $7\frac{1}{2}d.$ per pound or $7s.\ 6d.$ per dozen pounds.)

Candles would cost, to be equivalent to	Where a single jet burner is used.			Where a 20 hole argaund burner is used.			Where a 30 hole argaund burner is used.			Where a bude burner is used according to statement of Company.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Common Coal Gas.....	10	18	6	15	15	8	21	18	0	59	2	7
Good do. do.....	25	18	4	39	9	6	54	16	7	148	0	9

6. The selling price of 1,000 cubic feet of gas being on average 10*s.*, the cost of 9,000 cubic feet would be £4-10-0, candles to afford an equal light, cost as above shown. This calculation shows the relation between coal gas and mould candles very clearly, which is borne out by the estimate of Mr. Peckston as to the relation of a 15 hole gas burner properly supplied with gas to mould candles, we find that he regards the light it affords equal to that of 12 mould candles, i. e. the jet of gas that passes through $1\frac{1}{4}$ hole (when burned) gives a light equal to that of one mould candle ; in a subsequent calculation it will be found that I have taken two jets of a burner pierced for 12 holes, as equal (when burned) to the light given by one street lamp, this is in all probability an error, but it is an error on the right side, for, certainly the light afforded by 2 jets of gas issuing from a twelve hole burner (when burned) will not be *less* than that given by a street lamp, however much more it may be.

7. If the above relations as to lighting power be regarded, as sufficiently near approximations to the truth, as to allow of their being received as practical working data, and there is no reason for doubting that they are so, we shall, by making use in addition to these, of the data already absolutely determined be in a condition to complete the required calculation and thereby to answer those questions which Government is desirous of having definitely and clearly answered, viz., what will the cost of the street gas light be ? will it be as cheap as the light afforded by the common lamp oil, and if it be asserted to be so how can this be ascertained ?

20 oz. of oil (equal to 5-12th of a measure, value 2 annas and not $1\frac{1}{4}$ annas as herein stated.

1st. It has now been determined by repeated experiments that 20 oz. of common lamp oil yield 14 cubic feet of gas, and we know that the money value of the oil is $1\frac{1}{2}$ annas. When only one retort is used the price of the charcoal also equals $1\frac{1}{2}$ annas, but when 5 or 7 retorts are, as they must be, employed on the large scale, heated at the same time in one furnace, the outlay for fuel will be at least reduced to half, which for each retort will not exceed 9 pie. We have therefore 27 pie as the price of 14 cubic feet of oil gas, now if we take eleven hours as the time each public night lamp is required to burn we shall have to ascertain the money value of 11 cubic feet of gas, for it has been determined that 1 cubic foot of oil gas lasts one hour, burned by a 12 hole burner, 14 cubic feet have been shown to cost

27 pie ; 21 pie or one anna and 9 pie therefore will be the cost of 11 cubic feet of gas, and lastly, as a burner bored for 12 holes has been employed, and as 2 holes afford a better light than that of an ordinary street lamp, it is evident that the 12 hole burner gives a light at the least equal to six street lamps ; in other words 6 street gas lamps can be kept alight during one night for 21 pie, then the cost of one street oil lamp per night being found to be 7 pie, we have $6 \times 7 = 42$ pie or exactly double that of oil gas light.

From this para it would appear that one street lamp lighted by gas would cost $3\frac{1}{2}$ pie, whereas the present expense for the same is 10·88 pie.

8. This leaves a handsome balance to pay for the interest on outlay, &c. The calculations are however subject to variations in the price of oil and fuel, but such variations are little to be dreaded in an oil producing and charcoal making country. Even allowing that some error or omission has taken place which with the most cautious persons, will sometimes occur, it is most unlikely that either error or omission to a great extent has been allowed to creep into these calculations which any one may verify for himself. Under all circumstances, there certainly appear to be solid and sufficient grounds for carrying out the first experiment on the large scale, viz., that of lighting the barracks and other buildings situate in Fort St. George, which after many comparative inspections of other localities, offer the greatest facility for such an undertaking—since unoccupied ground outside the fausse bray on the Rancet bastion can be obtained for building the necessary furnaces, tanks, &c. Both the Chief Engineer and the Superintendent Engineer, Colonels Faber and Atkinson, have in the most handsome way afforded me every assistance, and have both agreed that there is no objection to making use of the ground in question as proposed.

It has been suggested to me, that, as it appears opposed to preconceived notions, to assert that the light from oil gas is cheaper than the light obtained by burning the oil itself, I should explain how this can be possible. I therefore beg to offer the following remarks, I have little doubt that it will appear to many, a statement amounting to an impossibility to say that notwithstanding the expense of converting the oil into gas, the light produced by such gas shall

be less expensive than that afforded by the oil itself, yet a few plain and simple facts will show that such a statement is neither absurd nor impossible. The chief reasons on which the economy of gas burning compared with oil burning depend, are in the one case (that of the gas,) that the combustion is nearly perfect, very little of the gas passing through the flame unburnt, it being on the contrary almost entirely converted into watery vapour and carbonic acid gas, while in the burning of oil by means of a wick, it is self evident that combustion can only take place at the circumference of the body of combustible vapours which are seen to resemble a cone, the shell only of which being in contact with the air is burnt, or is capable of affording light, the whole of the *interior* of the cone, though composed of the same combustible vapour as the circumference passes off *unburnt*, as it cannot come into contact with the air until beyond the flame, the temperature of which is necessary to determine the combination between the oxygen of the air on the one hand and the carbon and hydrogen of the combustible vapour on the other. There is on these accounts, a very great loss of combustible matter which is diffused into the surrounding atmosphere and is the cause of the unpleasant smell and oppression always produced, when oils, particularly common and viscid ones like the ordinary lamp oil are employed, nor can these unpleasant effects be obviated by any means that does not ensure perfect combustion which is to a very great extent, attained in the case of gas by means of burners and jets, the fine pencil of flame permitting but minute portions of gas to escape combustion, hence the superior economy of gas, as well as the absence of the unpleasant and deleterious effects described, which when much ordinary oil is being burned in the common way is almost insupportable as may be observed at all Native feasts and other places where much oil is burned in the manner described. Snuffing and trimming though entailing much loss of time and trouble, do but mitigate the evil, for a season. Nothing can altogether remedy it, but a better method of effecting the combustion; gas requires neither snuffing nor trimming, can be increased or decreased at pleasure so as to serve a sick chamber or a hospital, where much light is objectionable. Gas is more cleanly, much more beautiful, more healthful, and finally more *economical* than any other known method of obtaining artificial light.

Should the foregoing statements and calculations be found satis-

factory, it remains only to give an approximate estimate of the outlay to be incurred for setting up the apparatus required.

As nearly as can be ascertained by personal enquiries of those officers who may probably be entrusted with the work, the expense will be as follows :—

Two tanks and bells	2,400	0	0
Furnaces	250	0	0
Shed	500	0	0
Stopcocks and guages with the metres for adjusting in the first instance the required pressure as well as the amount of gas to be supplied from the gas holder and shed, probably	1,500	0	0
Piping of various calibres at first calculated only for the barracks	1,000	0	0
Five retorts	500	0	0
Rupees	6,150	0	0
Workmen's wages for laying down, fitting and joining tubing with coolies' hire for digging and piercing walls, probably	1,000	0	0

For a working apparatus I think it will on all hands be allowed that £700 is a very small sum, it is in fact lower than anything of the kind that I have seen, and it is to be borne in mind that 2 tanks and 2 gas holders are included, and that the main pipes are to be of such size that hereafter as Government may see fit to order, or as the personal convenience of the inhabitants of the fort may require—gas can be conducted to the Church or to any part of the fort. The advantage of having 2 gas holders and tanks is so great in many ways that although it involves an additional outlay of about 1,200 rupees, it appears better to incur it at once, than to run the risk of an interruption, after the gas has been in use, which would inevitably happen should any leakage or accidental damage happen to the gas holder (supposing one only to be in use) and any repairs to be required.

J. E. MAYER.

21st April, 1856.

PUBLIC DEPARTMENT,

No. 585.

Extract from the Minutes of Consultation, dated 20th May 1856.

Read the following letter from Dr. Mayer, 2nd May 1856.

The Right Honorable the Governor in Council is disposed to regard favourably Dr. Mayer's scheme for lighting the Fort with oil gas. Before however passing any order upon it, he would wish to have the opinion of the Chief Engineer on the estimated cost, Rs. 7,150, of the works to be provided for the purpose. He would also desire to learn from the Commissary General whether the rates assumed by Dr. Mayer in his calculations as the prices of oil and fuel are correct or nearly correct, as also to have from him a return showing the actual present expense of lighting that part of the Fort included in Dr Mayer's proposition.

T. PYCROFT,

Chief Secretary.

Commissary General's Office, Madras, 9th June, 1856.

No. 65.

FROM

THE COMMISSARY GENERAL,

To

THE CHIEF SECRETARY TO GOVERNMENT,

Fort St. George.

20th May, 1856.

SIR,—Adverting to extract from the Minutes of Consultation, No. 585, I have the honor to forward a statement showing the number of lamps lighted in the Fort by the Commissariat as well as the amount of expenses incurred on that account.

2. From the above statement it will be seen that 113 street lamps with lamp oil cost

	Monthly cost of			Average cost per each per day.			Average cost per each per hour.		
	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.
Exclusive of lamp lighters..	192	1	9	0	0	10·88	0	0	0·91
Inclusive of do. ..	219	3	9	0	1	0·42	0	0	1·03

and for 23 guard lamps with lamp oil, the expense incurred is

	Monthly cost of			Average cost per each per day.			Average cost per each per hour.		
	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.
Exclusive of lamp lighters..	26	1	7	0	0	7·26	0	0	·6
Inclusive of do. ..	30	7	7	0	0	8·48	0	0	·71

and for 65 globe lamps with cocoanut oil, the charge is

	Monthly cost of			Average cost per each per day.			Average cost per each per hour.		
	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.
Exclusive of lamp lighters..	140	0	9	0	1	1·78	0	0	1·15
Inclusive of do. ..	157	8	9	0	1	3·51	0	0	1·29

3. With reference to the prices quoted in Dr. Mayer's report, I beg to observe that the quantity of charcoal to be used is not specified, I am therefore unable to state the cost; lamp oil is provided for this department by contract at $11\frac{1}{16}$* measures per pagoda, at this rate, the value of 20 oz. of lamp oil (alluded to in Dr. Mayer's report) which is equal to $\frac{5}{12}$ of a measure, is annas 2, and not 1-6, which however appears to have been actually disbursed by Doctor Mayer. The cause of difference in price may be that whilst the oil furnished by the Commissariat is of the best quality, that required for the purpose of producing gas may be of the commonest description —during the present year oil has been generally selling very dear. The prices of the last four years are shown in the margin. It is hoped that prices will fall next year.

* For 1856.

	Lamp oil per gallon. R. A. P.	Cocoanut oil per gallon. R. A. P.
1853..	0 10 0	0 11 9
1854 ..	0 13 8	1 1 6
1855..	0 11 1½	1 4 0
1856...	0 11 11¾	1 6 10¼

4. The calculations are all in favor of Dr. Mayer's plan, as will be observed by the annexed abstract showing the cost of gas lights, and that of oil lights.

I have the honor to be,

Sir,

Your most obedient servant,

A. McCALLY,

Commissary General.

ABSTRACT.

According to Dr. Mayer's calculations.

For 14 cubic feet of gas.	R.	A.	P.	R.	A.	P.	For 11 cubic feet of gas for 6 street lamps.	R.	A.	P.	R.	A.	P.	For 6 street oil lamps at 7 pice each.
20 oz. of oil.	0	1	6				at 27 pice							
Fuel 0-1-6				0	2	3	for 14 cu-	0	1	9	0	3	6	
reduced to.	0	0	9				bic feet.							

According to the calculations made at the Commissary General's Office.

For 14 cubic feet of gas.	R.	A.	P.	R.	A.	P.	For 11 cubic feet of gas for 6 street lamps, supposing they are lighted 11 hours.	R.	A.	P.	For 12 cubic feet of gas for 6 street lamps, supposing they are lighted 12 hours.	For 6 oil street lamps at 10·88 pice each.		
20 oz. of oil.	0	2	0				at 33 pice							
Fuel.....	0	0	9	0	2	9	for 14 cu-	0	2	2	0 2 $4\frac{1}{4}$	0	$55\frac{88}{100}$	
							bic feet.							

A. McCALLY,

Commissary General.

Statement showing the number of lamps lighted in the Fort and the quantity of oil, &c. supplied for them for a month of 30 days, as also the amount of expenses incurred on their account.

No. of lamps.		Oil, cocoanut, measures.	Oil, lamp, measures.	Cotton wick, oz	Cost of oil.			Cost of thread.			Proportion of cost for lamp lighters.			Total cost exclusive of lamp lighters.			Total cost inclusive of lamp lighters.			Average for each for a day.			Average per each per hour.	
																				Exclusive of lamp lighters.			Exclusive of lamp lighters.	Inclusive of lamp lighters.
					R.	A.	P.	R.	A.	P	R.	A.	P.	R.	A.	P.	R.	A.	P.	R	A.	P.	R.	A.	P.	Pice	Pice
113	Street lamps at 1½ ollock each per day	0	635⅝	113	190	5	6	1	12	3	27	2	0	192	1	9	219	3	9	0	0	10·88	0	1	0·42	·91	1·03
23	Guard lamps at 1 ollock each per day	0	86¼	17¼	25	13	3	0	4	4	4	6	0	26	1	7	30	7	7	0	0	7·26	0	0	8·48	·6	·71
2	Main Guard lamps at 1½ ollock each per day	11¼	0	·2	6	6	10	0	0	6	0	0	0	6	7	4	6	7	4	0	1	8·67	0	1	8·67	1·72	1 72
65	Globe lamps in the European Barracks at 1 ollock each per day	243¾	0	48¾	139	4	7	0	12	2	17	8	0	140	0	9	157	8	9	0	1	1·78	0	1	3·51	1 15	1·29
2	Barrack Guard lamps at 1½ ollock each per day	0	11¼	2	3	6	4	0	0	6	0	0	0	3	6	10	3	6	10	0	0	10 97	0	0	10·97	·91	·91
6	Privy lamps at 1 ollock each per day	0	22½	4½	6	12	8	0	1	1	0	0	0	6	13	9	6	13	9	0	0	7·32	0	0	7·32	·61	·61
211*	10 Lamp lighters 43 12 0 1 Maistry do. 5 4 0 49 0 0		To	tal...	372	1	2	2	14	10	49	0	0	375	0	0	424	0	0	0	0	11·37	0	1	·86	·95	1·71
118†	Lamps in the Church, lighted twice a week, for 4 weeks, at ½ ollock each per day	59	0	12	33	11	5	0	3	0	0	0	0	33	14	5	0	0	0	0	0	6·89	0	0	0	2 3	0

These lamps are kept burning (12 hours) the whole night. † These for 3 hours.

COMMISSARY GENERAL'S OFFICE:
Madras, 9th June, 1856.

A. McCALLY,
Commissary General.

CENTRAL OFFICE OF PUBLIC WORKS,
Fort Saint George, 29th July 1856.
No. 5348.

FROM

THE CHIEF ENGINEER.

To

THE CHIEF SECRETARY TO GOVERNMENT.

General Estimate for lighting the European barracks with gas.

SIR,—I have the honor to acknowledge the receipt of extract from Minutes of Consultation, No. 585, dated 20th May 1856, calling for my opinion on the estimated cost of works to be provided for lighting the European barracks in Fort Saint George with gas.

1 Plan.
1 Estimate.

2. I regret to say that owing to the novelty of the proposition, I have been unable to obtain strictly correct and complete data for the estimate; the following is however as near an approximation as I am able to submit.

	RS.	A.	P.	RS.	A.	P.
1. Buildings, including a shed and two wells for the gasometers, a furnace and a store godown.....	3,320	0	0	3,320	0	0
2. Two gasometers.....	1,680	0	0	1,680	0	0
3. Piping.						
1—230 feet of main from the gasometer to the vicinity of the barracks 2½ inches in diameter at 1 Rupee per foot.....	230	0	0			
2—25 feet of submain 1 inch diameter at 4 annas 8 pie per foot..	7	4	0			
3—2,880 feet of submain for the ground floor and 1st story of the barracks ¾ inch diameter at 3 annas 4 pie per foot.....	600	0	0			
4—3,600 feet of short branches for 120 lights of ½ per foot at 3 annas.....	675	0	0			
900 feet of sheet lead pieces..	75	0	0			
Total cost of piping in England.	1,587	4	0			
Add for freight to India.....	100	0	0			
	1,687	4	0	1,687	4	0

4. For stop cocks and gauges with the metres for adjusting in the first instance the required pressure as well as the amount of gas to be supplied from the gas holder and shed, probably	1,500	0	0
5. Five Retorts	500	0	0
6. For laying down the piping and fixing it in the barracks	1,000	0	0
	9,687	4	0
Sundries	312	12	0
Rupees	10,000	0	0

3. For the first item detailed Plans and Estimates have been prepared and are herewith forwarded.

4. For the second item the Estimate obtained by Dr. Mayer from Major Maitland has been adhered to.

5. The third item has been ascertained as follows, the measurements have been taken from a plan of the barracks in communication with Dr. Mayer, and the prices have been taken from a list obtained by Dr. Mayer through an agent from Messrs. Bryan, Donkin and Co. of Bermondsey, London.

6. The fourth and fifth items I have no means of checking, but I feel pretty sure that they are adequate and even liberal.

7. The sixth will I believe be found quite sufficient.

8. As experience shows however that Estimates framed, where so much is altogether novel and uncertain, are generally erroneous on the side of defect rather than of excess, I would recommend that (12,000) twelve thousand Rupees be looked upon as the probable amount, although it seems very possible Rs. 10,000 may suffice, and I accordingly recommend that authority be given for an expenditure of Rupees (12,000) twelve thousand.

I have the honor to be,
Sir,
Your most obedient servant,
C. E. FABER, *Colonel,*
Chief Engineer.

CENTRAL OFFICE OF PUBLIC WORKS,
FORT SAINT GEORGE, *29th July* 1856.

To

The Chief Secretary to Government.

Estimate of the probable expense of constructing Store Room, Gas Shed and Furnace in the Berm of the Royal Bastion of the Fortifications of Fort St. George.

Measurement.							Price.											
Length.	Depth.	Thickness.	Supl. Ft.	Cubic Ft.		Rupees.	Annas.	Pice.	Rate.	Rupees.	Annas.	Pice.	Rupees.	Annas.	Pice.
					Store Room.										
78 0	4 0	2 9	.....	858	Foundation of Walls.										
8 0	4 0	2 9	.....	88	Do. of 4 Counterforts.										
78 0	1 0	2 0	.....	156	} Basement of do.										
8 0	1 0	2 0	.....	16											
78 0	12 6	1 6	.....	1462½	Walls above.										
42 0	3 3	1 6	.....	204¾	2 Gable ends.										
6 0	11 0	1 6	.....	99	4 Counterforts.										
				6	Steps.										
				2890¼											
				156¼	Deduct.										
			Total..	2734	Brick work in Chunam.....	0	1	9½	per c. ft.	306	2	5			
45 0	1 3	1 6	.....	84⅜	Flat Arch work in do. ..	0	2	9½	do.	14	11	7			
94 0	0 6	0 6	.....	23½	Cornice work in do. ..	0	3	0	do.	4	6	6			
22 0	26 0	0 0	572	.....	Roofing with Palmirah couples of 2 collar beams reepers, nails, flat and pan tiles and chunam borders	18	2	0	per sqre.	103	10	9			
			2589	.....	Plastering 2 coats chunam.	1	13	9	do.	48	2	3			
			332½	.....	Flooring with 8 ins. square bricks in chunam and a levelling course of wall bricks underneath	6	9	6	do.	21	14	9			
40 0	0 5	0 3	---	4 2	Teakwood wall plates.....	2	4	0	per c. ft	9	6	0			
6 0	3 0	0 0	.....	.....	1 Pair batten doors with frames, &c. complete ...	..	..	..	.....	15	7	6			
3 0	1 3	0 0	.....	.....	8 Attick windows with frames and close iron bars, &c. complete.	4	0	0	E	32	0	0			
3 0	2 0	0 0	.....	.....	8 Weather boards complete over the Attick windows..	5	4	0	do.	42	0	0			
					Red paint 3 coats to the doors and windows, &c..	..	..	..	.....	4	0	0			
					1 Double bolt iron padlock with key...	..	..	..	.....	1	4	0			
					Excavating the foundation and filling the basement	..	..	..	.....	3	8	0			
					Sundry charges and scaffolding.., &c.....	..	..	..	.....	23	6	3			
													630	0	0
					Gas Shed.										
148 0	4 0	2 9	.....	1628	} Foundation.										
20 6	4 0	1 0	.....	82											
148 0	1 0	2 0	.....	296	} Basement..										
16 0	1 0	1 0	.....	16											
36 0	14 0	1 6	.....	756	} Pillars.										
13 0	14 0	1 0	.....	182											
			Total..	2960	Brick work in chunam . .	0	1	9½	per c. ft.	331	7	4			

Estimate, &c.—continued.

Measurement.							Price.										
Length.	Depth.	Thickness.	Supl. Ft.	Cubic Ft.			Rupees.	Annas.	Pice.	Rate.	Rupees.	Annas	Pice.	Rupees.	Annas.	Pice.
			2075	.....		Plastering with 2 coats of chunam.....	1	13	9	per sqre.	38	9	4			
53 0	35 0	0 0	1855	.....		Roofing with Palmirah rafters, reepers, nails, flat and pan tiles and chunam borders.....	14	15	0	do.	277	1	5			
						Excavating the foundation and filling the basement...	..	..	..	.....	8	12	0			
26 0	0	11½ 0	5	.....	51	10 11	5 Tie beams each.									
8 0	0	5 0	4	.....	5	6 8	5 King posts each.									
15 0	0	5 0	4¼	.....	22	1 7½	10 Principal rafters each.									
7 0	0	4¼ 0	2½	.....	5	2 0	10 Braces do.									
208 0	0	8¾ 0	5	.....	63	2 4	Puriin.									
154 0	0	9 0	6	.....	57	9 0	Breast summer.									
24 0	0	8 0	6	.....	8	0 0	Ridge beam.									
23 0	0	6 0	4¼	.....	16	3 6	4 Hip rafters each.									
0 9	0	8¾ 0	5	.....	5	5 7½	24 Cleats each									
13 0	2	0 0	4	.....	8	8 0	Pillarplates.									
			Total..		244	1 8	Teakwood wrought & put up	2	4	0	per c. ft.	549	5	0			
							Iron work for 5 truss.....	..	..	..	....	35	0	0			
							Sundry charges and scaffolding, &c	..	..	..	..... .	59	12	11			
															1300	0	0
							2 Cisterns.										
44 6	4	0 2	6	.....		445	Foundation.										
44 6	10	0 1	1½	.....		500⅝	Walls above.										
			Total..			945⅝	Well brick in chunam.....	0	3	0	per c. ft.	177	14	10			
						214	Inverted Arch work in chunam.....	0	2	6¾	do.	34	4	5			
				142	.....		Jelly and chunam 9 inches thick in average under the inverted Arch work.	..	..	..	.....	10	0	0			
				800	.....		Plastering with 2 coats of chunam.....	1	13	9	per c. ft.	14	14	0			
							Excavating and removing the earth.....	...	..	..	.....	17	8	0			
							Sundry charges..	..	..	..	.....	10	6	9			
							For 1 Cistern.....	...	..	..	.....	265	0	0			
							Do. 2 do. .....,	..	..	..	.....	..	..	..			
															530	0	0
							Furnace.										
32 6	4	0 3	9	.....		487½	Foundation.										
21 6	4	0 2	9	.....		236½											
8 0	4	0 3	9	.....		120											
12 9	4	0 3	3	.....		165¾											
31 0	1	0 3	0	.....		93	Basement,										
21 0	1	0 2	0	.....		42											
2 0	0	6 2	0	.....		2											
8 0	1	0 3	0	.....		24											
13 6	1	0 2	6	.....		33¾											
30 0	12	0 2	6	.....		900	Walls above.										
24 0	12	0 1	6	.....		432											

Estimate, &c.—continued.

Measurement.						Price.									
Length.	Depth.	Thickness.	Supl. Ft.	Cubic Ft.		Rupees.	Annas.	Pice.	Rate.	Rupees.	Annas.	Pice.	Rupees.	Annas.	Pice.
24 0	3 6	1 6	.....	126	Gable ends.										
6 0	10 0	2 6	.....	150	4 Counterforts										
14 0	16 0	2 0	.....	448	Walls for fire places.										
				3260½											
				188½	Deduct.										
		Total..		3072	Brick work in chunam.....	0	1	9½	per c. ft.	344	0	0			
110 0	0 9	0 9	.....	61⅞	Cornice work in do.	0	3	0	do.	11	9	8			
20 0	1 3	1 6	....												
4 0	1 3	2 0	....	78¾	Flat Arch work in do.	0	2	9½	do.	13	11	10			
10 0	1 3	2 6	....												
15 0	1 3	23 0	.....	431¼	Arched roof with brick in chunam.....	0	3	1½	do.	84	3	7			
					Cartering to do. ..	..	..	..	.....	30	0	0			
15 0	24 0	0 0	360	.....	Laying with jelly 3 courses of flat tiles and plastering with 3 coats chunam over the Arched roof.....	10	13	0	per sqre.	38	14	10			
			250	.....	Plastering 2 coats chunam to the outside of the arched roof....	2	6	0	do.	5	15	0			
			2200	.....	Plastering with 2 coats chunam...	1	13	9	do.	40	14	6			
			125	... .	Flooring with 8 inches square bricks in chunam and a levelling course of wall bricks underneath...	6	9	6	do.	8	3	10			
					Erecting Masonry chimney complete..... ...	..	..	..	.....	65	0	0			
					Excavating the foundation and filling the basement..	..	..	..	....	6	0	0			
4 6	2 0	0 0	.....	.....	1 Iron dividing shutter complete	..	..	..	.....	63	0	0			
4 0	2 0	0 0	.....	.....	1 Iron door complete.....	..	..	..	.....	56	0	0			
4 0	2 0	0 0	.....	.....	1 Iron grating for fire place.	..	..	..	.....	40	0	0			
4 0	1 3	0 0	.....	.....	1 Grated window with frame and close iron bars, &c. complete..	..	..	..	.....	5	0	0			
3 0	1 3	0 0	.....	.....	2 Do. do. do. ..	4	0	0	E.	8	0	0			
					Painting to do. ...	..	..	..	.....	1	0	0			
					Sundry charges and scaffolding, &c.	..	..	..	.....	38	6	9			
													860	0	0
					Total Company's Rupees three thousand, three hundred and twenty..								3320	0	0

C. E. FABER, Colonel,

Chief Engineer.

CENTRAL OFFICE OF P. W.
FORT SAINT GEORGE,
29th July, 1856.

PUBLIC DEPARTMENT,

No. 960.

Extract from Minutes of Consultation, dated 14th August 1856.

Read letters

From Commissary General, 9th June 1856.

From Chief Engineer, 29th July 1856.

It is observed that the Commissary General has not reported on the price of the charcoal assumed by Dr. Mayer and taken by him at 9 pice for the production of 14 cubic feet of gas, because the quantity was not specified in Dr. Mayer's memorandum.

The price of fuel is obviously a very important element in the calculation. The Right Honorable the Governor in Council therefore requests that the Commissary General will ascertain at once from Dr. Mayer what according to his estimate will be the quantity of charcoal required and report to Government how far the price set upon that quantity by Dr. Mayer is correct.

This information should be furnished as soon as possible.

T. PYCROFT,

Chief Secretary.

COMMISSARY GENERAL'S OFFICE:

Madras, 25th August, 1856.

No. 100.

FROM

THE COMMISSARY GENERAL,

To

THE CHIEF SECRETARY TO GOVERNMENT,

Fort St. George.

Dated 14th August 1856.
Dated 22d August 1856.

SIR,—With reference to extract from the Minutes of Consultation, No. 960, I have the honor to annex copy of a letter from Dr. Mayer relative to the quantity of charcoal to be used for the production of gas.

2. Ten pounds of charcoal are shown as required on anaverage for 14 cubic feet of gas, the price for the same, quoted by Dr. Mayer, is 1 anna and 6 pice, but the cost at the Commissariat contractrate (as per margin) for this year is only 1 anna and 3·36 pie.

	Per parah weighing 34½ pounds.	Per Cdy.
Charcoal ordinary.	0 4 5	4 0 0, 12/07
Firewood.....	.....	2 4 3

3. From Dr. Mayer's letter (annexed) it would also appear that firewood might on the large scale be employed with the charcoal in about equal parts. If therefore 5 pounds of charcoal and 5 pounds of firewood are used, the cost of the former is pice 7·68, and of the latter pice 4·35, or 1 anna 0·3 pice for 14 cubic feet of gas.

4. This however as Dr. Mayer observes is the most unfavorable view of the expense as on a large scale the consumption of fuel will be proportionately reduced and to a very considerable extent.

I have the honor to be,

Sir,

Your most obedient servant,

A. McCALLY,

Commissary General.

To

THE DEPUTY ASSISTANT COMMISSARY GENERAL,

Madras.

SIR,—In reply to your letter, No. 1673, I have the honor to state I have ascertained by weighing that the quantity of ordinary charcoal employed for making 14 cubic feet of gas varies from 8 to 10 lbs., if the latter weight be taken for the purpose of calculation, then at the Commissariat valuation of 34½ lbs. to a parah, the value of the 10 lbs. will be 1 anna 3 5/69 pice, it appears that as I paid 1 anna 6 pice, I bought at a dearer rate than I ought to have done. Firewood might on the large scale be employed with the charcoal in about equal parts. The reduction of the money value of the charcoal, has been already explained at page 5 of my second paper on gas illumination, but as this appears not to have been made sufficiently clear, I beg to state, that it is beyond dispute that if 7 sepa-

rate retorts are heated in 7 separate furnaces, they will consume, more than double perhaps treble, the amount of fuel that 7 retorts heated in one furnace will consume, it was therefore well within the mark when I reduced the expense of fuel by half.

I have the honor to be, &c.

(Signed) J. MAYER,

Chemical Examiner.

MADRAS, *22d August*, 1856.

(True copy.)

A. McCALLY,

Commissary General.

PUBLIC DEPARTMENT,

No. 1068.

Extract from the Minutes of Consultation, dated 5th September 1856.

Read the following letter from the Commissary General.

(Here enter 25th August 1856, No. 100.)

It was computed by Dr. Mayer that the expense of the works, piping, &c. to be provided for carrying out his scheme of lighting the fort with oil gas, would be rupees 7,150.

2. The Chief Engineer to whom Dr. Mayer's calculation were submitted, estimates the cost of those works at rupees 10,000, but considering the novelty of the undertaking he thinks it would be well to reckon the expense at rupees 12,000, or 4,850 in excess of that assumed by Dr. Mayer.

3. As to the cost of the gas after the works have been provided it was calculated by Dr. Mayer that taking the oil 20 oz. at 1 anna 6 pice and the fuel at 9 pice, 14 cubic feet of gas would cost 2 annas and 3 pice. At this rate 11 cubic feet which would light 6 street lamps would cost 1 anna and 9 pice. The expense of the same lamps lighted by oil was reckoned by Dr. Mayer at 3 annas and 6 pice. The advantage in favor of the gas being then 1 anna and 9 pice, or cent per cent on the cost of the latter.

As.	P.
3	6
1	9
1	9

4. Reference was made to the Commissary General to ascertain the number of lamps lighted in the fort, and the expense of them, as also for the verification of Dr. Mayer's prices of oil and fuel.

5. Colonel McCally gives the price of oil at a higher rate than Dr. Mayer, though he admits that oil of inferior quality to that furnished by the Commissariat might perhaps answer for the production of gas. Adopting his own higher prices however, the Commissary General in the abstract appended to his letter of 9th June has brought out a result more in favor of gas than that arrived at by Dr. Mayer. Colonel McCally estimated the gas for 6 street lamps at 2 annas and $4\frac{1}{4}$ pice, and the cost of the same lamps lighted with oil at 5-$5\frac{28}{100}$ difference or excess of cost of oil above gas annas 3-$1\frac{1}{100}$.

6. The Commissary General did not however verify Dr. Mayer's prices of fuel but took them at the rates assumed by that gentleman. He was called on to supply the deficiency which he has done in his letter above recorded.

7. From this it seems that Dr. Mayer's price for charcoal is considerably in excess of the Commissariat contract rate, and that supposing firewood to be used with the charcoal the cost would be still further reduced.

8. Dr. Mayer's calculations are so much per 6 street lamps. It appears from the statement No. 1 enclosed in the letter from the Commissary General of 9th June last, that there are 113 street lamps in the fort, besides 98 other lamps and 118 lamps in the Church.

9. The Right Honorable the Governor in Council now desires that Dr. Mayer will furnish a return showing the expense of lighting these lamps with oil and with gas respectively, taking the prices of oil and fuel as obtained from the Commissariat, and calculating interest and maintenance of the works and apparatus, according to the estimate of the Chief Engineer rupees 12,000.

10. It is desirable also that Dr. Mayer should consider in what other place his experiment might be tried in the event of barracks in the fort being rebuilt, but this will not interfere with his making the calculations referred to in the preceding para.

T. PYCROFT,

Chief Secretary.

No. 133.

MADRAS MEDICAL COLLEGE,

1st *September*, 1856.

FROM

A. J. SCOTT, ESQ. M. D.

Secretary Medical College Council.

To

THE CHIEF SECRETARY TO GOVERNMENT.

SIR,—I have the honor by desire of the College Council to request you will be good enough to submit for the sanction and approval of the Right Honorable the Governor in Council the wish of the College Council, that the evening lectures of Dr. vanSomeren on Natural Philosophy may have the advantage of gas light which Mr. Mayer is prepared to make available for the purpose. The cost will not exceed that which has already been sanctioned for ordinary light.

I have the honor to be,

Sir,

Your most obedient servant,

ANDREW J. SCOTT,

Secretary Medical College Council.

To

T. PYCROFT, ESQ.

Chief Secretary to Government.

MY DEAR SIR,—In forwarding the accompanying letter from the Secretary to the Medical College, I beg to say, that he has been informed by Messrs. Oakes and Co. that the lamps needed for lighting in the usual way, will cost about 200 rupees, the cost for gas fittings, I am of opinion, will not exceed this sum, the putting up these fittings will not occupy more time than five or six weeks.

I remain, my dear Sir,

Faithfully yours,

JOHN MAYER.

September 1*st*, 1856.

No. 137.

MADRAS MEDICAL COLLEGE,
6th September, 1856.

FROM

A. J. SCOTT, ESQ. M. D.
Secretary Medical College Council.

To

THE CHIEF SECRETARY TO GOVERNMENT,
Fort St. George.

SIR,—I have the honor to request you will have the goodness to submit for the sanction of Government the following suggestions respectfully offered by the Medical College Council with reference to the lighting up of the principal lecture room by gas.

2. The sum originally sanctioned will in the opinion of the Council not suffice to effect the intended object in a way calculated to attract the notice of the public, or to forward the introduction of gas generally, they therefore think, that it will be more advantageous and with reference to the future more truly economical to expend a sum that will permit of the execution of the work required, in a satisfactory and tasteful style. For this purpose they venture to solicit a grant of rupees (500) five hundred.

I have the honor to be, &c.,
(Signed) A. J. SCOTT,
Secretary Medical College Council.

(True copy.)
ANDREW J. SCOTT,
Secretary Medical College Council.

No. 1099.

Under the circumstances represented by the Medical College Council the Right Honorable the Governor in Council authorizes an expenditure, not exceeding 500 rupees, for lighting the principal ecture room with gas, during the lectures on Natural Philosophy to lbe given by Dr. vanSomeren.

T. PYCROFT,
Chief Secretary.

FORT ST. GEORGE, 11*th September* 1856.

To

THE CHIEF SECRETARY TO GOVERNMENT,

Public Department.

SIR,—I have the honor to acknowledge extract from Minutes of Consultation, dated 5th September 1856, and in obedience to the instructions of the Right Honorable the Governor in Council therein conveyed, beg to forward the following statement and returns.

From an abstract furnished by the Commissary General dated* 15th December 1855, it appears that there are including 50 lamps in the General Hospital, 442 lamps in and about the Fort, most are lighted at the expense of Government, and that the monthly expense for the above is 553 rupees 8 annas and 5 pice.

The expense of lighting with gas for the above, not including outlay for piping, will be as follows. Assuming that all the burners are simple jets, according to the instructions conveyed in your letter, I have taken as factors to work with the data given by the Commissary General instead of those of actual outlay.

The Commissary General calculates that if the lamps and jets burn 12 hours which is the longest period that can be required, six gas jets will cost 2 annas and $4\frac{1}{2}$ pice; while six oil lamps cost for the same period 5 annas and $5\frac{28}{100}$ pice.

These figures worked out, give for the month of 30 days, an expenditure for gas, rupees 328-2 for 442 lamps, and for oil of rupees 751-6-6.

*751	6	6	Annual calculated outlay.
553	8	5	Annual outlay as shown by the Commissary General.
197	14	1	

The latter sum is in excess of the real payments, by rupees* 197-14-1, but the reason is given by the Commissary General; 118 lamps are only burned twice a week for 3 hours instead of 12; nevertheless as the gas has been calculated for 12 hours throughout, it was necessary to do the same with the oil, thus a perfect comparison of relative expenses is shown, supposing that hop oil and gas were burnt in all cases 12 hours, and for the same number of lights, the relative expense stands out clear, viz., as 328 rupees 2 annas and 1 pie for gas, is to 751 rupees 6 annas and 6 pie for oil, or less than half.* And in addition it is to be borne in mind that a cheaper oil than that intended by the Commissary General

* 44 per cent.

* Not sent up, for Commissary General's return see enclosure to his letter of 9th June last.

will be used and that firewood can be employed in equal parts with charcoal, so that in point of fact the use of oil gas will be more economical than would appear from the foregoing figures.

Rs. 3,940 8 for gas.
„ 9,016 14 for oil.

The annual difference in expense admitting the calculations given will be as per margin, or if for the reasons given, these figures be not regarded as the actual sums expended. The actual sums will certainly stand to one another in this ratio. Therefore let the figures be what they may there will be a real saving of more than half by using gas.

Without knowing how long the different sets of lamps are kept lighted, it is not possible to make an exact calculation, but if the only exception to the 12 hours every night be the Church lamps, and the lamps be not lighted more than eight times a month, and that then they be burnt only 3 hours instead of 12, it is easy to reduce the above figures and the results will be so much nearer to the expression of exact outlay; for then instead of 442 lamps burnt 12 hours for 30 days we shall only have 324; and if 442 lamps cost 9,016 rupees and 14 annas annually, then 324 will cost 6,609 rupees and 10 annas; and gas by the same calculation will only cost 2,888 rupees and 8 annas, which merely verifies the former ratio, but will not be the true expression, as the expenditure for the Church lamps is not included—this is found by the Commissary General's statement to be per month, i. e. 8 times in the month and being kept burning 3 hours on each occasion to amount to rupees 33, annas 11 and pice 5, this gives a total cost per year of 404 rupees, 9 annas and pice 5. Gas burners kept alight for the same number of hours, eight times during every month will give according to the ratio already ascertained a value less than half, therefore if 200 rupees be taken as the approximate amount there will result for the annual expense of gas 2,888 rupees 8 annas × 200 rupees = 3,088 rupees and 8 annas, and for oil 6,609 rupees and 10 annas × 404 rupees 9 annas and 5 pice = 7,014 rupees 3 annas and 5 pice, now the latter result can easily be checked by reference to the total monthly expense paid by the State for lighting the lamps specified, viz., 553 rupees 8 annas and 5 pice, this multiplied by 12 should approximate to the figures above, but as I do not know precisely how long all the different sets of lamps are to burn and have therefore taken all but the Church lamps at 12 hours, when this may not be true for all, there may be some discrepancy: this is found to be the case since the yearly expenditure calculated by multiplying the monthly expendi-

ture only gives 6,642 rupees and 5 annas, but even then allowing that there is an error in some part of my calculation amounting to 374 rupees in the year, the ratio between the expenditure for gas and for lamp lighting is preserved, for 3,088 rupees and 8 annas subtracted from 6,640 rupees and 3 annas leaves a balance saving to the State of 3,551 rupees and 11 annas which is more than cent. per cent. saving; if 3,088 be admitted as the annual expenditure for gas.

With these data at hand, it will be easy to ascertain if the interest on the Engineer's estimate for outlay can be covered. I have not been instructed as to the rate of interest that I am to calculate by, but if it be assumed as 5 per cent. then the simple interest on 12,000 rupees per annum will be 600 rupees leaving a balance of 3,000 rupees nearly, so to meet repairs, servants' wages, &c. if these be calculated at 12 per cent. on the outlay, which is much the same as the average cost at home. There will be a further expenditure annually of 1,440 rupees or about half the surplus, still leaving 1,500 rupees per annum as a saving to Government.

In these calculations no probabilities have been taken into account, but it is obvious that so great an improvement, comfort, and convenience, will attract rate-payers in all localities to which the gas can be carried. Therefore much greater advantages to Government than have here been noticed will eventually accrue. With reference to other localities beyond the Fort, besides Government House, the General Hospital, and some parts of Black Town; it scarcely seems probable that the present work could be so extended as to afford adequate means of supply, but by separate works several localities might be advantageously supplied, such as the Club, the Cathedral, and the other Churches, and their neighbourhoods.

I will not now stay the present communication to enlarge on this part of the subject, but whenever His Lordship will honor me with commands to do so, I shall be prepared to go more into details.

I have the honor to be,

Sir,

Your most obedient servant,

JOHN MAYER,

Professor of Chemistry.

FORT ST. GEORGE,
MEDICAL STOREKEEPER'S OFFICE,
11*th September*, 1856.

No. 1149.

In the above letter Dr. Mayer seems very clearly to have made out his position of the superiority of gas above oil. Before however taking measures for the employment of gas on a large scale, the Right Honorable the Governor in Council will await the issue of the experiment about to be made for at the Medical College.

T. PYCROFT,
Chief Secretary.

FORT ST. GEORGE,
25th September, 1856.