

HOUSE No. 24.

Commonwealth of Massachusetts.

OFFICE OF GAS INSPECTION, 32 HAWLEY ST.,
BOSTON, Jan. 19, 1881.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts.

THE undersigned respectfully submits the following

REPORT.

The whole number of meters inspected during the past year was six thousand five hundred and sixty-one (6,561).

Six thousand four hundred and thirty-nine (6,439) were either new or had just been repaired. If any of these were found to be incorrect, they were returned for repairs, and then tested again.

The number of meters brought to the office and complained of as incorrect was one hundred and twenty-two (122). Of this number, forty-eight (48) registered against the consumer; the average error being four and fifty-four hundredths (4.54) per cent. Fifty-two were within the limits allowed by law, — namely, two per cent either way, and twenty-two (22) registered against the company; the average error being six and fifty-nine hundredths (6.59) per cent.

The average error of all meters complained of was fifty-two hundredths (0.52) of one per cent against the consumer.

These were all "dry" meters. The following table gives the results for the last nine years: —

YEAR.	Fast Meters.		Correct Meters.	Slow Meters.		Total.	
		Per cent.			Per cent.		Fast.
1872	87	4.30	81	32	9.55	202	0.32
1873	100	5.43	95	40	6.61	238	1.18
1874	101	4.76	131	51	6.22	285	0.57
1875	123	5.99	142	39	8.17	314	1.33
1876	148	5.19	179	53	9.17	381	0.74
1877	93	4.79	125	34	11.00	257	0.28
1878	111	5.34	180	44	9.51	343	0.63
1879	83	5.00	91	18	16.20	193	0.64
1880	48	4.54	52	22	6.59	122	0.52

As will be seen, the number of complaints has decreased rapidly during the last two years, and there has been rather less cause for complaint the last year than formerly. The meters thus brought to the office for inspection are in most cases brought at the request of the consumer, and are not to be taken as a fair average of those in use.

Last spring the Legislature passed a law relating to the inspection of gas and gas-meters, which embodied the recommendations made in my last annual report, except that the proposed requirements were lowered, owing to representations made by the gas companies to the committee having the bill in charge. The new law provides an assistant inspector, and calls for two inspections a year of the gas of every company having more than fifty consumers, and one additional inspection for every four million feet of gas manufactured by the company. The gas is required to have an illuminating power of at least fifteen candles, and to contain not more than ten grains of ammonia or twenty of sulphur per hundred feet. No sulphuretted hydrogen, and not more than ten per cent of carbonic oxide, is allowed to remain in the gas. All companies making more than fifteen million feet of gas are required to furnish photometers away from the works. The law also requires that every meter in use in the State shall be inspected by one of the inspectors.

The new law took effect the first of July as regards the inspection of meters, and the first of September as regards gas.

Some twenty-two companies were required to provide photometers satisfactory to the inspector. On the first of September only the Boston, Charlestown, Lawrence, and

Lynn companies were so provided; and the Brookline, Lowell, Roxbury, Springfield, and Worcester companies were provided with photometers, requiring generally only minor modifications to make them approved instruments. A large proportion of the other companies had ordered instruments of an approved design; but the orders generally were given but a short time before September. In the ordinary course of events, the photometers would have been ready in September, or early in October at the latest, and very little delay to the inspections would have resulted; but the candle balances recommended were not supplied by the manufacturer who kept promising them.

After a month or so it was plain that there was no certainty when the desired balances could be obtained; and another make of balance was substituted. After the balances were obtained, there was considerable delay in getting the photometers into working order.

The photometers of the New Bedford and the South Boston companies were ready in October; those of Salem and Fall River, the last of November; those of Cambridge, Newton, and Taunton, in December. The following companies were not provided with the required photometers on January first: Chelsea, Dorchester, East Boston, Holyoke, and Jamaica Plain. There has been considerable correspondence, verbal and written, with these companies; and the case stands thus: Chelsea and East Boston probably by this time have their photometers in the required condition. Dorchester, Holyoke, and Jamaica Plain have photometers, but do not know where to put them. The law requires that the photometer shall be at least a quarter of a mile from the works: and at Dorchester there is no office away from the works; but I am assured by the president of the company that there is every probability that before the year is far advanced the company will have an office away from the works, where they will place their photometer.

At Holyoke and Jamaica Plain the offices are on the "dead ends" of mains. The companies naturally wish to have their gas show as well as possible, and so do not wish to locate their photometers in their present offices.

In September an accident occurred to one of the small meters used in determining sulphur and ammonia, and about a month was required for its repair.

These delays put back the whole inspection, and made it very difficult, and, in some cases, impossible, to make the number of tests required by law. But counting from the time the photometers were provided by the companies, the required number of inspections has been made.

All of the inspections of the gas of the companies manufacturing less than fifteen millions a year have been made by means of a portable photometer. The gas of those companies who provided photometers was inspected with more or less regularity from September first; the other inspections were almost all made during November and December, which is the time of the greatest consumption of gas, and is therefore the best time in the year to make the test.

I think that, with three exceptions, the gas of every company in the State supplying fifty or more consumers has been inspected. The exceptions are Nantucket and two other companies who did not furnish photometers. These will be inspected early in the year.

No notice has ever been given when the tests were to be made, and the inspections have been distributed in such a manner that it was impossible for the company to tell when they would occur. Whenever practicable, the tests were made at some distance from the works, and only at the following places were the tests made at the works: Amesbury, Arlington, Brockton, Chicopee, Dedham, Dorchester, East Boston, Easthampton, Gloucester, Marblehead, Natick, Plymouth, Wakefield, and Westfield.

The greater part of the gas used in this State is made from coal; and for testing this gas Sugg's "London" Argand burner was used, usually No. D, but sometimes Nos. E and . . . For testing the gas made at Amesbury, Ipswich, Leominster, Lexington, and Southbridge, which is a mixture of petroleum gas and air, and the gas at Middleborough, which is made from rosin, a steatite "batswing" burner was used. The gas was burned at the rate of about five feet per hour with the Argand burner, and not far from three feet per hour with the "batswing." Attention was always given that the candle was burning properly, and the results are given corrected to a rate of burning of five feet per hour for the gas, and of one hundred and twenty grains per hour for the candle, on the supposition that the light given is directly proportional to the amount of combustible consumed.

Rather more than half the inspections have been made by myself, the remainder being made by the assistant inspector, Charles R. Fletcher. At every place requiring more than one inspection, it was intended to have an equal number of tests performed by each of us.

The results given in the following table are the average of inspections made since my last report. The number of tests made at any one place varied from one at the small places, to thirty (Boston), according to the amount of gas used.

PLACE OR COMPANY.	Candle Power.	GRAINS PER 100 FEET OF GAS.	
		Ammonia (N H ₃).	Sulphur (S ₂).
Adams	15.6	2—	15.6
Amesbury	17.7	2—	12
Arlington	15.7	1	19.4
Athol	16.7	1.4	10.7
Attleborough	19.6	2.1	15.1
Beverly	18.2	5.3	11.5
Boston	18.86	5.68	12.06
Brockton	17.4	10.6	11.2
Brookline	17.5	11.3	6.9
Cambridge	16.7	3.7	9.2
Charlestown	16.94	5.8	12.56
Chicopee	16.8	0.7—	12.4
Clinton	17.3	2.6	8.9
Danvers	17.3	3.9	13.0
Dedham	17.7	2.7	13.9
Dorchester	17.1	16.4	17.2
East Boston	18.0	6.7	19.4
Easthampton	17.8	38.5	14.2
Fall River	16.0	50.1	12.1
Fitchburg	16.8	0.8—	13.1
Gloucester	18.4	5.0	—
Great Barrington	16.5	2—	8.1
Greenfield	16.0	2—	17.8
Haverhill	17.7	4.5	13.5
Holyoke	17.2	0.8—	11.0
Ipswich	24.7	0.5—	11
Jamaica Plain	16.9	39.0	8.4
Lawrence	16.94	5.02	14.20
Leominster	28.4	—	—
Lexington	29.7	1—	5.7
Lowell	15.90	7.43	12.48
Lynn	17.02	1.0	8.2
Malden	16.6	2—	7.7
Marblehead	17.4	4.2	12.5
Marlborough	16.3	0.7	9.9
Middleborough	25.0	—	—
Milford	15.0	1—	10.4
Natick	16.5	2—	8.1

PLACE OR COMPANY.	Candle Power.	GRAINS PER 100 FEET OF GAS.	
		Ammonia (NH ₃).	Sulphur (S ₂).
New Bedford	17.8	15.0	8.0
Newburyport	16.6	1.8	15.2
Newton	16.1	6.1	11.2
North Adams	16.6	2—	7.7
Northampton	16.7	1.2	11.1
North Attleborough	16.6	2.7	10.9
Pittsfield	16.5	2—	10.2
Plymouth	18.1	2.4	18.9
Quincy	18.2	29.4	13.9
Roxbury	18.50	4.77	11.05
Salem	17.3	4.8	11.2
Southbridge	28.8	3—	—
South Boston	18.32	7.85	9.35
Springfield	16.3	2—	9.0
Taunton	17.0	5—	18.4
Wakefield	17.7	6.5	14.2
Waltham	16.5	7.7	11.6
Webster	18.5	2—	5.5
Westfield	16.7	2—	15.6
Woburn	16.0	1.2	16.3
Worcester	15.8	2	16.2

The preceding results show that the gas furnished the people of this State is usually of fair illuminating power, and generally well purified. Up to the first of January, no gas tested was found to be below the legal standard of fifteen candles, although quite a number of the results were below sixteen candles. Much gas is wasted by burning it through improper burners, or, if good burners have been procured, they are frequently allowed to become clogged. Slit burners can be cleaned by a thin strip of brass, or sometimes a strip of writing paper will answer the purpose. Steatite ("lava") is one of the best materials for gas-burner tips, as it does not corrode, and conducts heat slowly.

It is impossible to say, from simply looking at a flame, just when it is giving the best effect per unit of gas; but the general conditions are, that the flame should have a rounded outline, and no distinct rays in the centre; or, in other words, that the gas should be burned from comparatively large burner apertures and at low pressures. If this method of burning gas is carried to an extreme, the flame flickers or is smoky.

Only one inspection has been made that showed more than twenty grains of sulphur per hundred feet of gas, and then the excess was only a fraction of a grain; but several have shown more than nineteen grains. It is satisfactory to know that the companies are able to keep the amount of sulphur in their gas within the legal limits.

Most of the companies use lime purification, and to this fact may be attributed the small amount of sulphur generally present in the gas. Some few companies use iron purification, and I have observed that when they were producing large quantities of gas it contained considerable sulphur.

Thorough condensation and scrubbing take out considerable sulphur as well as ammonia, and thus decrease the work left for the purifiers.

The only coal-gas company whose gas was found to contain sulphuretted hydrogen was at Great Barrington, and there the total amount of sulphur was low. At Amesbury, Lexington, and Southbridge traces of sulphuretted hydrogen were detected. At these places a mixture of air and petroleum gas is used, which is washed and condensed, but is not passed through lime or oxide of iron for purification from sulphur compounds. It seems, from the few inspections made, that petroleum gas does contain sulphur compounds, but in small quantity.

Sulphuretted hydrogen is no more harmful than the other sulphur compounds present in gas, as they all finally form sulphuric acid when the gas is burned. The present law prohibits any sulphuretted hydrogen, because its presence in coal-gas would show that the gas had not been carefully purified; for sulphuretted hydrogen is readily absorbed by lime or oxide of iron. Petroleum gas is used only in small places, and contains only a small quantity of sulphur, a small part of which is present as sulphuretted hydrogen.

In view of these facts, it might be well to exempt the small petroleum companies from complying with this part of the law.

The gas at the following places has been found to contain more ammonia than the legal amount of ten grains per hundred feet: Boston once, Brockton once, Brookline twice, Dorchester once, Easthampton once, Fall River twice, Jamaica Plain once, Lawrence once, Lowell once, Quincy once,

New Bedford twice, and Wakefield once. Most of the other companies, as the table shows, have very little ammonia in their gas, and seem to have little trouble with it. Ammonia can be removed from gas by condensation and washing with water. If both processes are thoroughly conducted, the ammonia can be reduced to a fraction of a grain per hundred feet of gas. The water used for washing the gas is the source of nearly all the ammonia used for industrial purposes.

In Europe they allow very little ammonia to remain in the gas, as it is of considerable value. At present there is not nearly as much demand for ammoniacal salts in this country as there is in England; for there artificial manures are extensively used, and ammonium sulphate is one of their chief ingredients.

One or two manufactories have recently been established in this vicinity for the manufacture of ammonia and its salts, and several of the larger gas companies derive some income from their ammoniacal liquor.

The law allows no gas to contain more than ten per cent of carbonic oxide. In former years I have made quite a number of eudiometric analyses, and the results are given in my reports for the years 1873, 1875, 1877, and 1879. This year I thought it desirable to make a few additional analyses to be sure that there had been no considerable change in the character of the gas. The results are given in the following table:—

COMPANY.	Boston.	Boston.	Cambridge.	Charles- town.	Lowell.
Illuminants (C _n H ₂ N&C).	6.53	5.73	4.34*	4.82	4.15
Marsh Gas (CH ₄) . . .	42.71	37.64	37.71	36.04	35.65
Hydrogen (H ₂)	44.80	46.59	45.16	49.03	51.16
Carbonic Oxide (CO) . . .	3.97	7.22	7.92	7.78	6.51
Carbonic Acid (CO ₂) . . .	0.08	0.95	0.04	0.26	0.00
Nitrogen (N ₂)	1.70	1.87	4.67	1.90	2.40
Oxygen (O ₂)	0.21	0.00	0.16	0.17	0.13

These results show that the gas has the same general composition as in former years. The chief difference seems to be, that these last analyses shows more illuminants than the earlier ones; but I regard this as owing chiefly to the differ-

* This number is somewhat uncertain, as the determination was not satisfactory.

ence in the method of analysis. Formerly the estimation of the illuminants by means of fuming sulphuric acid was a tedious and somewhat uncertain operation. By a modification which I have lately introduced, the accuracy of the method is increased and the time reduced. The Cambridge analysis was performed before the modification was adopted.

In no one of the more than twenty analyses of coal-gas I have published does the carbonic oxide amount to nine per cent, and on the average amounts to about six and one-half per cent.

The office at present occupied is fitted up as a laboratory, and contains meter-provers and other apparatus necessary for the performance of the duties of inspection. The office, although small, would answer fairly well, if it were not for the meters sent for inspection from outside the State. These meters are sent, sometimes sixty at a time, packed in boxes with straw. For want of room these boxes have to be unpacked in the laboratory, which is thus kept dusty much of the time; and, until the meters are inspected and sent away, no other work can be done.

Most of the meters are inspected by the deputy inspector of meters, as the inspector and assistant inspector are fully occupied with testing gas when most of the meters are required to be inspected. Provision is made for the payment of the deputy by means of fees. These fees, although sufficient, are very irregularly distributed through the year. At some seasons there are very few meters to be inspected, and at others the deputy is unable to meet all the demands for inspection.

It would seem to be a much better way to give the deputy a fixed salary, to be levied on the companies in the same manner as the salaries of the inspector and assistant are at present, and to devote the proceeds of the inspection of meters,—first, to providing a suitable office and laboratory, and then to travelling expenses, apparatus, chemicals, &c., any excess to go towards paying salaries, and any deficiency to be made up by a levy on the companies, as at present provided for. The proposed arrangement is at present in operation at Washington, D.C.

Respectfully,

CHARLES W. HINMAN.

