same nature as the gas we just now obtained from the voltaic battery; it would be far too much to burn at once; I have therefore arranged to blow soap bubbles with it and burn those bubbles, that we may see by a general experiment or two how this oxygen supports the combustion of hydrogen. Frst of all we will see whether we can blow a bubble. Well, there goes the gas [causing it to issue through a tobacco pipe stem into some soap suds.] Here I have a bubble. I am receiving them on my hand, and you will perhaps think I am acting oddly in this experiment, but it is to show you that we must not always trust to noise and sounds, but rather to real facts. [Exploding a bubble on the palm of his hand.] I am afraid to fire a bubble from the end of the pipe, because the explosion would pass up into the jar and blow it to pieces. This oxygen will then unite with the hydrogen, as you see by the phenomena and hear by the sound, with the utmost readiness of action, and all its powers are then taken up in its neutralization of the qualities of the hydrogen.

So now I think you will perceive the whole history of water with reference to oxygen and the air, from what we have before said. Why does a piece of potassium decompose water? Because it finds oxygen in the water. What is set free when I put in the water, as I am about to do again? It sets free hydrogen and the hydrogen burns; but the potassium itself combines with oxygen; and this piece of potassium, in taking the water apart—the water, you may say, derived from the combustion of the candle—takes away the oxygen which the candle took from the air, and so sets the hydrogen free; and even if I take a piece of ice, and put a piece of potassium upon it, the beautiful affinities by which the oxygen and hydrogen are related are such that the ice will absolutely set fire to the potassium. I show this to you to-day, in order to enlarge your ideas of these things, and that you may see how greatly results are modified by circumstances. There is the potassium on the ice, producing a sort of volcanic action.

It will be my place, when next we meet, having pointed out these anomalous actions, to show you that none of these extra and strange effects are met with by us—that none of these strange and injurious actions take place when we are burning, not merely a candle, but gas in our streets, or fuel in our fireplaces, so long as we confine ourselves within the laws that Nature has made for our guidance.

WATER-WORKS OF AMERICA.

BOSTON, MASS.

OFFICE OF THE COCHITUATE WATER BOARD,
Boston, January 15th, 1861.

TO THE CITY COUNCIL:

The Cochituate Water Board respectfully submit to the City Council their Annual Report for the year 1860. In compliance, also, with the City Ordinances, they submit the Reports of the City Engineer, the Water Registrar, and the Clerk of this Board, all of which are worthy of attention from those who are interested to know the condition and workings of this department.

It is believed that the works were never in a condition more safe and efficient than at the present time.

* * * * * *

CONSUMPTION OF WATER.

In the last Annual Report, the following language was used: "It seems as if we might now fairly conclude that the individual consumption had come to its maximum,—the variation in three years not exceeding one gallon;" say 72½ to 73 gallons. But the present year is a fearful example of the fallacy of such calculating. By the Report of the Engineer, hereto annexed, it appears that the average daily consumption of water has been 17,238,000 gallons. By the census returns, it appears that the number of inhabitants is 177,902. *This shows a consumption of* 97 *gallons for each individual—an amount believed to be without parallel in the civilized world.* Of course there is nothing in the sales of the water that could lead to the expectation of such a monstrous increase; *and we must again resort to the old story of extravagant and inordinate waste.*

The past year has afforded the first opportunity ever enjoyed to test the capacity of the lake. During the year, not a pint has been allowed to escape that could be retained. It has been impossible to fill the lake to the height of the dam, so the whole has been drawn to the city. The fall of rain has been unusually large; say 55¼ inches; while the average of nine years has been 48¾. The actual daily delivering of water has been 17,238,000 gallons, and the water in the lake, January 1, this year, being ten inches higher than a year ago, would give an additional supply of about one-half a million gallons daily, or about 17,700,000 gallons. It would seem to be a safe inference that, in years when we have 55¼ inches of rain, the maximum yield of the lake will be 17,700,000 gallons, and no more. But as in the average of years only 48¾ inches fall, we can safely rely upon only a proportional diminished supply.

In bringing this enormous quantity of water to the city, the Board can but express the opinion that the capacity of the aqueduct has been put to the severest test that ought ever to be applied to it. To work it under any increased head must be attended with the utmost hazard.

Two conclusions seem to this Board now to be reached of a practical character. The *first* is, that the lake can be relied on for no greater supply of water than has been drawn from it this year; and the *second* is, that the aqueduct can convey no more water than it has done this year.

These conclusions are of a nature to arrest public attention, and to induce inquiry what is to be done. What use shall we make of the present quantity, in view of the great difficulty and expense of increase? Every effort should be made to guard against *waste.* The people can economize in its use, for they have done so. When the break took place at Needham, the consumption was reduced near three-fourths.

This Board was in hopes that some latitude might be indulged in in playing the public fountains, and in supplying opportunity for skating. But nothing of these indulgences can be entertained. Any considerable quantity drawn for skating, must put in jeopardy the supply on Beacon Hill and all the high service. If at all, and under any circumstances, this object is to be thought of, it should be done with the greatest care not to interfere with the regular and necessary supply.

When all the unnecessary uses of the water are stopped, then, in case of insufficient quantity, it would become the policy of the city to cut off, one after another, the classes of takers for mechanical purposes. It is to be hoped, however, that the time is not near at hand when this will be necessary; it is only alluded to as indicating what would undoubtedly become the policy of the city, at all times in order to supply a full and needful quantity of pure water for domestic use.

This state of facts would seem to settle all idea of annexing other municipalities to the city of Boston.

Meters of WORTHINGTON'S construction continue to give entire satisfaction, and will be more extensively used.

Details of hydrants, stop-cocks, and extension of the work will be found in the Report of the City Engineer, annexed.

By reference to the Report of the Clerk of this Board, it will be seen that the expenditure for the year has been $146,304 55. Of this amount, $34,880 71 was for the new main, $17,398 26 for raising pipes on Tremont and Dover streets, $4,491 27 for extending the 12-inch pipe on Beacon Street; and for extension of the work $59,120 98—leaving $30,413 33 as the expenses of the year.

All of which is respectfully submitted.

EBENEZER JOHNSON, *President.*
SAMUEL HALL,
GEORGE P. FRENCH,
CLEMENT WILLIS,
G. E. PIERCE,
GEORGE DENNIE,
L. MILES STANDISH.

ABSTRACT OF THE REPORT OF JAMES SLADE, ESQ., CITY ENGINEER.

OFFICE OF CITY ENGINEER,
Boston, January, 1861.

EBENEZER JOHNSON, ESQ.,
Pres. of the Cochituate Water Board:

Sir,—The usual Annual Report of matters connected with the Water Works is herewith submitted.

* * * * * *

RAISING THE DAM AT LAKE COCHITUATE.

During the past year Mr. Knowlton has kept a record, as hitherto, of the daily heights of water at the lake. By condensing and summing up these heights, we find that during 4 days the water stood at a level of only *five* feet in the lake. 29 days it stood *above five* and *less than six* feet. 64 days stood *above six* and *less than seven* feet. 173 days *above seven* and *less than eight* feet. 42 days *above eight* and *less than nine* feet. 54 days *over nine* feet, and 7 days it has been *up* to *nine feet seven inches* in the lake.

Until the latter part of 1859, when the dam and roads about the lake had been raised two feet, the extreme depth of water which could be made available from the lake by gravitation, was only eight feet. Two feet being then added, would give us an available depth of ten feet when the lake is full, provided we used no more water than originally expected. But as our increase of consumption has been largely over what was expected when the works were constructed, we must deduct the difference in depth required to keep up such a supply as we now require, which leaves but about six and a half feet of really available depth when the lake is full. During the past year we have been benefited by the raising for the full period of 103 days. To this we may add a few days when the water was so nearly up to eight feet that we should have been compelled to waste the water from the lake to avoid the danger of its breaking over the dams, had there been a sudden freshet. We have therefore been benefited nearly one-third of the year, because the dam, roads, and gate-house were raised. The extra amount of water which we have been enabled to save on this account equals about 1,500,000,000 gallons, which would have supplied the city 88 days at the rate of 17,000,000 gallons per day. It is also equal to a depth of about seven feet over the entire surface of the lake.

WASTE WATER, CONSUMPTION OF WATER, AND CAPACITY OF THE LAKE.

In my report for the year 1859, it was shown that during the early part of that year, and up to July the 8th, a large amount of water was wasted from the lake into Sudbury River.

From July 8th, 1859, to January 1st, 1861, there has not been any water wasted in that direction. All the water drawn from the lake has been brought to the city.

By reference to the table of *consumption* of *water* it will be seen that the amount used during the past year, has averaged over 17,000,000 gallons daily, an average increase of more than 4,000,000 daily, over the amount used in 1859, and about twice as much as was brought to the city in 1853.

Much of this additional increase of consumption is owing, no doubt, to the increased effective head on the pipes caused by the new 40-inch main. This new main was connected with the 30-inch main crossing the Common in the latter part of December, 1859. The consumption of water in that month was a little rising of 14,500,000 gallons daily. In January following, the amount used averaged nearly 18,900,000 gallons daily, and in February nearly 19,000,000 gallons were used daily, it being in January over 3,900,000 gallons, and in February over 4,000,000 gallons more than had ever been used in any previous month since the introduction of the Cochituate water.

On the first of January, 1860, the water stood at the height of 7 feet 6 inches in the Lake. On the first of January, 1861, the water stood at the height of 8 feet 4 inches in the Lake, a depth of 10 inches gain, equal to 187,000,000 gallons over and above the total consumption in the year, equal to a daily average of about 500,000 gallons. Adding this to the daily average amount used, we have a trifle over 17,700,000 gallons as a total daily amount afforded by the lake during the past year.

The average annual rain-fall at the lake during the past nine years has been 48 77-100 inches. For the year 1860 the total rain-fall was 55 44-100 inches at the lake; for 1853 the total rain-fall was 55 86-100 inches—the rain-fall in 1853 and in 1860 being very nearly the same, and the amounts of water afforded by the lake in these two years being also very nearly the same.

The commissioners of 1845, after a very careful se-

pick. Total, one hundred and thirty-four in pipes of four inches and upwards.

Of the leaks that have occurred in service pipes and two-inch pipes, sixty-five were caused by fish, forty by defective pipes, twenty-five by frost, fourteen by defective cocks, thirty-one by stiff connections, eighteen by rust, one hundred and twenty-seven by the settling of earth, seventeen struck by picks, two destroyed by the soil, thirty-nine by defective couplings, thirty by builders and drain diggers, one stopped by paper, nine by cocks blowing out, three by rats, four by boxing cellars, one stopped by gasket, three by tenants, two by driving piles, three stopped by dirt, and twenty-four by defective joints.

Total, four hundred and fifty-eight in service and two-inch pipes.

Statement of the Number of Leaks, 1850–1860.

YEAR.	LEAKS IN PIPES OF A DIAMETER OF		Total.
	Four inches and upwards.	Less than four inches.	
1850	32	72	104
1851	64	173	237
1852	82	241	323
1853	85	260	345
1854	74	280	354
1855	75	219	294
1856	75	232	307
1857	85	278	363
1858	77	324	401
1859	82	449	531
1860	134	458	592

WATER REGISTRAR'S REPORT.

OFFICE OF WATER REGISTRAR, CITY HALL,
Boston, January 1, 1861.

E. JOHNSON, ESQ.,

Pres. of the Cochitutate, Water Board:

SIR,—I herewith submit the following Report, prepared according to the 16th section of the ordinance, passed Oct. 31, 1850.

The total number of water-takers, now entered for the year 1861, is 24,316—being an increase, since January 1, 1860, of 1,045.

During the year there has been 1,085 cases where the water has been shut of; of these, 1,067 were for non-payment of water rates, and 18 were for unnecessary waste of water.

The number of cases where the water has been turned on is 1,661; of these, 759 were cases which had been shut off for non-payment of rates; 11 were shut off for unnecessary waste, and 891 were turned on for the first time.

The total amount received from December 31, 1859, to January 1, 1861, is		334,544 86
Of the above there was received for water used in previous years the sum of	1,041 91	
Leaving the receipts for water used during the year 1860, the sum of	333,502 95	
In addition to the above, there has been received for letting on the water, in cases where it had been turned off for non-payment of rates, the sum of		1,517 50
Total amount		$336,062 36
The increased amount of receipts in 1860, over the previous year, is		19,771 39
The amount of assessments now made for the present year is		278,389 20
The estimated amount of income from the sales of water during the year 1861 is		350,000 00
The expenditures of my Department during the year 1860 have been		3,429 75

The items of this expenditure are as follows:

Paid Chas. L. Bancroft, for services as clerk	$867 50
" Stephen Badlam for services as "	867 50
" Chas. E. Dunham, for services as inspector	743 50
" Noah P. Burgess, for services as inspector	678 50
" Rand & Avery, for printing	110 50
" Eayres & Fairbanks, for stationery	94 25
" M. Lyon, for distributing water bills	24 00
" J. R. Barry, " "	22 00
" Geo. S. Carpenter " "	22 00
Amount	$3,429 75

ANNUAL REVENUE FROM WATER.

The following table exhibits the yearly revenue received from the sales of Cochituate water, since its introduction into the city, Oct. 25, 1848:

From Oct. 25, 1848, to Jan. 1, 1850	72,043 20
Jan. 1, 1850, to " " 1851	98,367 90
" " 1851, to " " 1852	161,299 72
" " 1852, to " " 1853	179,486 25
" " 1853, to " " 1854	196,352 32
" " 1854, to " " 1855	217,007 51
" " 1855, to " " 1856	266,302 77
" " 1856, to " " 1857	282,651 84
" " 1857, to " " 1858	289,328 83
" " 1858, to " " 1859	302,409 73
" " 1859, to " " 1860	314,808 97
" " 1860, to " " 1861	334,544 86
	$2,714,603 90

Statement showing the average daily consumption of Cochituate water in the leading hotels, together with the amount of water-rate charged to each respectively.

	Galls. pr day	Dollars.
Tremont House, from Oct. 1, 1859, to Jan. 1, 1861.	25,230	1,740 93
Revere House, " " " "	24,410	1,728 54
Parker House, " " " "	20,515	1,459 79
American House, from Jan. 1, 1860, " "	16,448	981 92
United States Hotel " " "	11,725	979 74
Winthrop House, from Oct. 1, 1859, " "	7,537	862 28
Marlboro' House, from Jan. 1, 1860, " "	8,261	711 80
Coolidge House, " " " "	4,462	606 66
Pearl St. House, " " " "	3,131	454 49
Totals		9,525 60

This amount of $9,526 60 for the use of Cochituate water in the above-named hotels, remains uncollected, owing to an injunction having been procured by the proprietors of these establishments to prevent the water being shut off from their premises. Sept. 15, 1860, the case was argued in the Supreme Court, but as yet no decision has been made known.

Statement showing the number and kind of water fixtures contained within the premises of water-takers in the city in 1858, 1859 and 1860.

1858	1859	1860	
4,326	4,475	4,714	Taps. These have no connection with any drain or sewer.
26,631	29,190	31,008	Sinks.
7,729	9,358	10,141	Wash-hand basins.
3,334	3,498	3,910	Bathing-tubs.
3,827	3,699	4,210	Pan water-closets.
3,845	4,476	5,071	Hopper water-closets.
173	409	583	Self-acting water-closets.
654	910	1,070	Urinals.
2,015	2,450	3,006	Wash-tubs. These are permanently attached to the buildings.
12	21	18	Shower-baths in houses where there is no tub.
9	10	10	Rams.
612	612	594	Private hydrants.
77	110	106	Slop hoppers.
52,744	59,218	64,526	

LIGHT WITHOUT HEAT.—Great heat without much light is produced by the combustion of hydrogen gas; and this fact has been successfully applied in the arts to the reduction of metals. Still we think that if the case were reversed, and great light produced without much heat, a boundless field would be presented for its application to the most useful purposes. In deep mines, for example, when the danger arising from explosions by common lamps is most imminent, this cold light would at once revolutionize the whole art of mining. Such a light could be employed in powder magazines, the holds of ships, and also in warehouses and manufactories containing combustible materials. Light and heat are different in their nature, and science seems to have settled that under certain circumstances they may be separated; but, for practical purposes, artificial light without heat has not yet been applied. The fire-fly emits a soft and beautiful light without its being apparently accompanied with equivalent heat. May not some mode be yet discovered for obtaining independent light without heat, and rendering it applicable to the purposes we have pointed out?—*Chemical News.*

GREENSBORO, N. C.—One of Aubin's gas-works, of Albany, N. Y., for rosin. Our report is an old one, before the works were fairly in operation.

ANSWERS TO CORRESPONDENTS.

G. P. B., of Conn.—*Hydro-carbon or water-gas, is not by any means a new thing. A patent was taken out in England as early as 1830 by one Donovan, who decomposed steam by passing it over red hot coke or charcoal, and mimgled the resulting gases with the vapor of oil of turpentine or naphtha. Patents have since then been obtained by a number of individuals for making gas by a similar process, but no practical results of any moment have ensued.*

G. T. I., of Pa.—*It is a question of engineering rather than one of chemistry. It is one of those practical points which unfortunately are overlooked in most books on the subject. Your conclusion is right, and you ought to feel consoled for you trouble in arriving at it, from the fact of owing your success entirely to your own efforts.*

C. H., of Pa.—*With some exceptions, cannel coals contain more sulphur than is found in bituminous coal.*

A. G. R., of Va.—*You should use a gas thermometer which would afford you a ready means of detecting the inequality you speak of. The cost is trifling, and you will soon appreciate the beneficial effects of always knowing the exact temperature of the gas as it leaves the condensers.*

O. E. L., of N. C.—*Döbereiner's lamp is a very useful article to have at hand. You can procure them at any of our chemical apparatus stores at a cost varying from $1 50 to $5 00.*

A. R. E., of Ala.—*It would be vain to hazard an opinion on the question you propound, without thoroughly investigating the matter. It is a question upon which mere theorists are divided, and probably will remain so until the facts are adduced.*

GAS-LIGHT IN MINES IN ENGLAND.—In several portions of England, gas is used for the purpose of lighting mines. It is much more economical and satisfactory in every way than any other illuminating agent. It is generally passed through iron pipes, attached to the ceilings of the galleries, and consumed in ordinary burners, without glass chimneys. Among other places, gas is largely used in the mining districts of Lancashire and Northumberland.

At the Pendleburg colliery, near Manchester, gas from the city works is burned. A small gas-holder placed on the surface is connected with the distributing mains, and is so weighted that the gas is caused to descend to the bottom of the mine, where it is conducted to thirty-two burners. This gas-holder is filled every twenty-four hours.

At the Seghill colliery, in Northumberland, gas is made at the surface, purified only of its condensible products, and received into the gas-holder. Instead of being forced into the mine by pressure, it is made to descend by means of a falling column of water.

At Seaton the gas is produced in the interior of the mine, in an oven of five retorts, situated in a large opening near the outlet. The coal from which the gas is distilled comes directly from the mine, and the coke which results, is burned under the retorts.

In some places even fire-damp has been made to serve a useful purpose, by being employed as an illuminating agent. In Northumberland it has been collected from crevices, whence it issues, by means of funnels, and conducted through pipes to burners.

Fire-damp is also collected and burned for the purpose of illumination, at the colliery of Deep-Duffryn, in the south of Wales; thus this highly explosive compound, which has heretofore been dreaded by the miner, is now, by the application of modern science, not only rendered harmless, but capable of performing a useful service.

GAS IN ENGLAND.—The works of the Coleshill Gas Company are nearly completed. The town has been lighted for two months.

A public meeting of gas consumers at Elgin has been recently held to discuss grievances respecting their gas-light. The gas, according to the *Courant*, is bad in quality, and of a high price—16s. per 1000 feet. The Directors have expressed themselves willing to comply with the wishes of the community as far as practicable. The Directors have called a meeting of the shareholders to consider the matter.

The works for the lighting of Jarrow with gas have just been completed. They were planned by Mr. J. H. Little of Newcastle.

FULTON, N. Y.—Rosin Gas-Works built by N. B. Rice, and are satisfactory. Iron retorts used, with Samuel Down's meter; Rice's gas-holder. Pittston coal, costs $3.86 per 2,000 lbs.