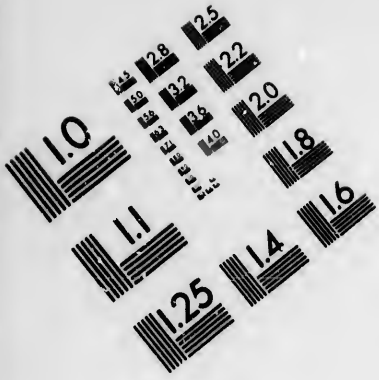

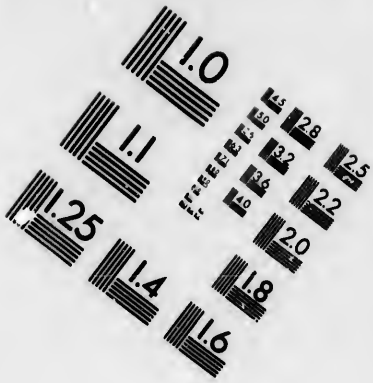

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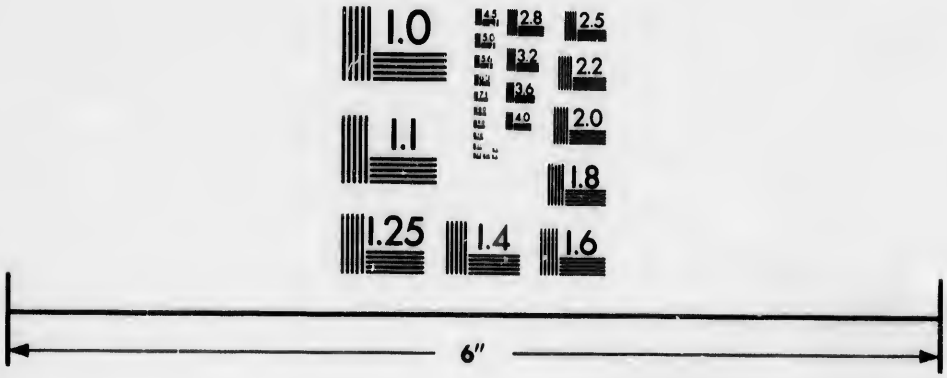

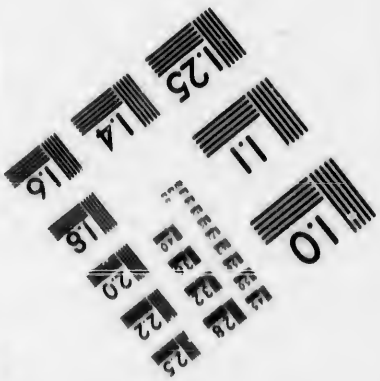

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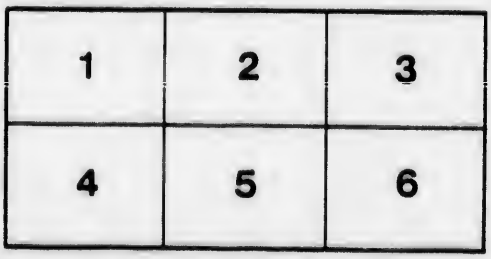

ECONOMY OF GAS AS A FUEL

FOR

COOKING PURPOSES

BY

WM. W. GOODWIN.

GAS COOKING STOVE, No. 3.

With front tin reflector to pan.

Size, 16 in. high, 16 in. wide, 11 in. deep, with burner for boiling.

Will roast a fowl, grill chops, steaks, bacon, etc., toast bread, boil water, stew and fry. Movable copper reflector for radiating the heat into the room.

THE

ECONOMY OF GAS AS A FUEL

FOR

COOKING PURPOSES.

AS SHOWN BY ACTUAL TESTS

MADE BY

WM. W. GOODWIN.

FROM A PAPER READ BEFORE THE A. G. L. ASSOCIATION, AT PHILADELPHIA, OCTOBER 16TH, 1879.

NEW YORK:
PUBLISHED BY THE AMERICAN GAS LIGHT JOURNAL,
No. 42 Pine Street.

1879.

THE

ECONOMY OF GAS AS A FUEL

FOR

COOKING PURPOSES.

THE following facts and figures were brought out in the discussion upon cooking by means of gas stoves at the recent meeting of the American Gas Light Association, held in Philadelphia, Oct. 15th, 16th and 17th, 1879, and are the results obtained by actual comparative tests made by Wm. W. Goodwin, Esq., of Philadelphia, between the ordinary kitchen range and a No. 7 Sun Dial Gas Stove. We believe it is the first time that reliable data of this kind have been published in this country, and that all gas consumers will find that a study of the figures here set forth will well repay their attention.

Mr. GOODWIN,—Mr. President and Gentlemen of the Association: I have not prepared a regular paper to be read, but I have a statement of facts, the result of some experiments in cooking, which I will present to the Association without comment. I have also prepared a tabulated record of tests made by boiling a given quantity of water over a flame composed of different portions of gas and air under varying conditions, in order to determine which was the best quantity of air to introduce with the gas to secure the most favorable results. My standard was 8 pounds of water. The gas was consumed at the *rate* of 10 feet per hour; the time required to raise 8 pounds of water from 73 degrees to the boiling point was $28\frac{1}{2}$ minutes, consuming $4\frac{466}{1000}$ feet of coal gas. I would say here that I designed an apparatus for furnishing air in a *measured* quantity, and mixing it with the gas before burning. That apparatus is so arranged that the gas and the air can be put into the burner in their normal condition, or the gas and the air can be heated both together or separately. In the *first* test, the gas was cold and the temperature of the water was $77\frac{1}{3}$ degrees F.

After determining the quantity of coal gas required to boil 8 pounds of water, I mixed various quantities of air with the gas, and obtained the following results, each test named being an average obtained from three trials, viz.:

In the *second* test, 8 pounds of water were used and one volume of air and one volume of gas. The quantity of gas consumed was 3.6 feet. In that case the boiling point was reached in $22\frac{833}{1000}$ minutes, being twenty per cent. less time required and 19 per cent. less gas than in test No. 1.

The *third* test was $1\frac{1}{2}$ volumes of air, 1 volume of gas and the same quantity of water. Time 22.08 minutes; gas consumed 3.46 feet, or $22\frac{1}{2}$ per cent. less time, and 22 per cent. less gas than in the first test.

The *fourth* test was two volumes of air and one of gas; time 21.3 minutes, gas consumed $3\frac{32}{100}$ feet, or 25 per cent. less time, and $25\frac{1}{2}$ per cent. less gas required than in test No. 1.

The *fifth* test was $2\frac{1}{6}$ volumes of air and 1 of gas. I will state that I found the best results were obtained with this mixture. It has been found, in Europe, that $2\frac{1}{3}$ volumes produce the most favorable results; the candle power of the gas has something to do with it, I presume. This is certainly a very close comparison. In this test, the quantity of gas consumed was 3.3 ft., the time occupied was 21.4 minutes, or 26 per cent. less time, and 26.1 per cent. less gas required than test No. 1.

In the *sixth* test, the gas was *heated*, and the time went up to 27 minutes; gas consumed, 3.92 feet, reducing the time to $5\frac{2}{10}$ and the gas to 11 per cent.

The *seventh* test was *heated* gas and *heated* air; the time required was $26\frac{3}{4}$ minutes; quantity of gas consumed, 3.93 feet, or 6 per cent. less time and 11 per cent. less gas.

The *eighth* test was *heated* air and cold gas; time $26\frac{1}{4}$ minutes; consumption of gas, 3.83 ft., or 7.08 per cent. less time, and 12 per cent. less gas.

In tests Nos. 6, 7, and 8, the air and gas were heated separately in coils of copper pipe over separate flames, arranged so that the air or the gas could pass through the coils or not, as was desired. Each of these coils had a heating surface of 472 square inches, and in the tests the tubes were heated to redness. The conclusion is that the best condition for burning gas, according to these tests—is $2\frac{1}{6}$ volumes of air and 1 volume of gas, and both of them in their normal condition or cold.

COOKING TEST

Made Between a No. 8 Peerless Range and a No. 7 Sun Dial Gas Stove.

I have also copies of tests that were very carefully made a few days ago—made as carefully as I knew how to make them, of the difference in cooking between a regular range and a No. 7 gas stove. The articles cooked were twelve in number, and were cooked so that they were all ready to place upon the table at once. The range used was a No. 8 Peerless Range." The articles were weighed before cooking, and also after cooking, and the percentage of loss in weight, and the time re-

quired, were carefully ascertained. For instance, a 3 pound blue fish weighed 2 pounds and 1 ounce *after* cooking in the range, being a loss of 32 per cent.; time, 31 minutes. In the case of the gas stove, it weighed, after cooking, 2 pounds 6 ounces. To be more explicit, I took 2 blue fish, each weighing 3 pounds, and cooked one in the range and one in the gas stove, with the results I state. The time required for the cooking of the fish in the gas stove was 35 minutes, 4 minutes longer than the time required for cooking it in the range. The loss was 20 per cent., or a saving of 12 per cent. in favor of the gas stove. A rib of beef weighing 9 pounds 7 ounces, weighed 6 pounds 8 ounces when cooked in the range; a loss of 32 per cent.; the time was 1 hour 37 minutes. In the gas stove the time was 1 hour and 25 minutes; loss, 17 per cent. To show how close these tests are with some made in England, I will state that the average was found to be 33 per cent. loss in cooking in the ordinary way, and 15 per cent. on the gas stove. My tests show a loss of 32 per cent. on the range and 17 per cent. on the gas stove, another very close comparison. A 3 pound 1 ounce chicken, cooked in the range, weighed 2 pounds and 2 ounces when cooked; loss 30 per cent.: the time was 1 hour and 6 minutes. In the gas stove, time 1 hour; weight when cooked, 2 lbs. 10 oz.; loss 14 per cent. A 1 pound 2 ounce beefsteak weighed, when cooked in the range, 13½ ounces; loss 25 per cent.; time 11 minutes. An equal weight of beefsteak cooked in the gas stove weighed when cooked 15 ounces; time, 8 minutes; loss, 16⅔ per cent. Each of these articles, as I have said, was weighed carefully before cooking, and was weighed immediately after being brought out of the stove and out of the range. Lamb chops weighing 1 pound and 1 ounce, weighed 11 ounces after being cooked in the range; a loss of 35 per cent.; time 12 minutes. In gas stove, an equal weight of lamb chops, after cooking, weighed 13½ ounces; time, 10 minutes; loss 15 per cent. There was also in each case 3 pounds and 5 ounces of sweet potatoes, 3 pounds and 8 ounces of white potatoes, 3 pounds and 12 ounces of cauliflower, and 4 pounds of tomatoes. These articles were all cooked in a steamer. Bread baked in the range, 5 pounds and 2 ounces, in 46 minutes; in the gas stove 37 minutes. Sago pudding, 3 pounds 5 ounces, 27 minutes in the range; in the gas stove, 28 minutes. Lemon pie, 2 pounds 14 ounces, 30 minutes in the range; on the gas stove, 22 minutes. In these articles no change of weight was noted. There were also prepared, sauces for the fish, the beef and cauliflower. The total time from the lighting of the fire in the range until

everything was ready to serve was 2 hours and 40 minutes. Of this time, 30 minutes were required to heat the oven, leaving 2 hours and 10 minutes as the actual cooking time. The weight of the coal, including the lighting of the fire, was 44 pounds. At the end of that time the fire was ready or more coal. The 44 pounds of coal, at $5.50 per ton, cost 10$\frac{95}{100}$ cts., the kindling wood one cent, making a total of 11$\frac{95}{100}$ cts.

GAS STOVE.

Gas Stove.—The total time from lighting the gas until everything was ready to serve on the table was one hour and fifty minutes; the consumption of gas, by a test meter, was 38 feet. At the price of $2.15 the gas cost 8.17 cents, against 11.95 cts. in the case of the range. The gas was lighted in the roasting chamber at 11 o'clock; 4 minutes after lighting, the beef and chicken were put in the roasting chamber; at 7 minutes past 11, the bread was put in the oven on the lower shelf; at 10 minutes past 11, the pie was put in on the upper shelf; at 16 minutes past 11, the water was put in the steamer cold, for cooking the vegetables; at 25 minutes past 11, the vegetables were put in, the cauliflower being in the bottom of the steamer, and the potatoes on the shelves; this steamer was over one of the burners of the hot plate, the other being used to stew the tomatoes and make the sauces. After the pie was baked, the pudding was put in on the lower shelf, the bread was removed to the upper shelf to brown on top; after the bread was baked the fish was put in the oven. After the meat and chicken were roasted the steak and chops were broiled. You will observe that so far as the actual cost or expenditure for fuel is concerned—and that it seems to me is one of the points that we are considering—the comparison is as 8.17 cents is to 11.95 cents. But there is another very important question connected with these tests, and that is the comparison in the percentage of loss in the food that was cooked in the range as against that cooked on the gas stove. The cost of the fish was 35 cents. It showed on the range a loss of 10$\frac{1}{4}$ cents; on the gas stove it showed a loss of 6$\frac{1}{2}$ cents; consequently, there was a saving in the weight of the fish as between 6$\frac{1}{2}$ cents and 10$\frac{1}{4}$ cents—a saving of 3$\frac{3}{4}$ cents on the weight of the fish. The beef cost $1.69. After it was cooked on the range, it was worth $1.17, showing a loss of 42$\frac{7}{8}$ cents. On the gas stove the loss was 28$\frac{1}{8}$ cents, or a saving in the favor of the gas stove over the range of 14$\frac{3}{4}$ cents. The loss in the weight of the chicken was 17$\frac{1}{2}$ cents; in the gas stove it was 8$\frac{3}{4}$; showing a saving over the range of 8$\frac{3}{4}$ cts. The steak lost 6$\frac{3}{16}$ cents in the range, and 4$\frac{1}{2}$ cents in the gas stove—a saving of 2$\frac{1}{16}$ cents. The loss on the chops was 7$\frac{1}{2}$

cents in the range, and $3\frac{1}{8}$ on the gas stove—a saving of $4\frac{3}{8}$ cents. The total saving of the gas stove over the range, in food lost was $33\frac{11}{16}$ cents. These are the facts. (Applause.)

The following are the foregoing facts, in tabular form, arranged for comparison :

RECORD OF PEERLESS RANGE No. 8.

ARTICLE.	How Cooked.	Weight.		Loss per cent.	Time.
		Before Cooking.	After Cooking.		
Blue Fish....	Baked.	3 lbs.	2 lbs. 1 oz.	32	31 m.
Rib of Beef	Roasted.	9 lbs. 7 oz.	6 lbs. 8 oz.	32	1 h. 37 m.
Chicken.....	Roasted.	3 lbs.	2 lbs. 2 oz.	30	1 h. 6 m.
Beef Steak	Broiled.	1 lb. 2 oz.	$13\frac{1}{2}$ oz.	25	11 m.
Lamb Chops.....	Broiled.	1 lb. 1 oz.	11 oz.	35	12 m.
Sweet Potatoes.....	Steamed.	3 lbs. 5 oz.			
White Potatoes.....	Steamed.	3 lbs. 8 oz.			
Cauliflower.....	Boiled.	3lbs. 12oz.			
Tomatoes	Stewed.	4 lbs.			
Bread.....	Baked.		5 lbs. 2 oz.		46 m.
Sago Pudding	Baked.		3 lbs. 5 oz.		27 m.
Lemon Pie..... ...	Baked.		2lbs. 12oz.		30 m.

Sauces for fish, beef and cauliflower.

Total time from lighting of fire until everything was ready to serve 2 hours and 40 minutes. Of this time 30 minutes was required to heat the oven, leaving 2 hours and 10 minutes actual cooking time. Weight of coal including lighting of fire 44 lbs. At the end of the time the fire was ready for more coal. Cost of coal, 44 lbs., @ $5.50 per ton, 10.95 cents. Kindling 1 cent. Total, $11\frac{95}{100}$ cents.

RECORD OF NO. 7 GAS STOVE.

ARTICLE.	How Cooked.	Weight.		Loss per cent.	Time.
		Before Cooking.	After Cooking.		
Blue Fish.....	Baked.	3 lbs.	2 lbs. 6 oz.	20	35 m.
Rib of Beef.....	Roasted.	9 lbs. 4 oz.	7 lbs. 11 oz.	17	1 h 25 m.
Chicken	Roasted.	3 lbs. 1 oz.	2 lbs. 10 oz.	14	1 h.
Beef Steak.....	Broiled.	1 lb. 2 oz.	15 oz.	16⅔	8 m.
Lamb Chops.....	Broiled.	1 lb.	13½ oz.	15	10 m.
Sweet Potatoes....	Steamed.	3 lbs. 5 oz.			
White Potatoes....	Steamed.	3 lbs. 8 oz.			
Tomatoes.....	Stewed.	4 lbs.			
Cauliflower.....	Boiled.	3 lbs. 12 oz.			
Bread.....	Baked.		5 lbs. 7 oz.		37 m.
Sago Pudding.....	Baked.		3 lbs. 3 oz.		28 m.
Lemon Pie.....	Baked.		2 lbs. 14 oz.		22 m.

Sauces for fish, beef and cauliflower.

Total time from lighting of gas until everything was ready to serve, 1 hour 50 minutes. Consumption of gas by test meter, 38 feet. At $2.15 per thousand feet, cost, $8\frac{17}{100}$ cents.

TABLE OF COMPARISON OF PERCENTAGES IN LOSS AFTER COOKING.

		GAS STOVE.	RANGE.
Fish,	Cost,	35 c.	35 c.
	Product,	28½ c.	24¾ c.
	Loss,	6½ c.	10¼ c.

Saving of gas stove over range, 3¾ cents.

Beef,	Cost,	166 ½c.	169⅞ c.
	Product,	138 ⅜c.	117 c.
	Loss,	28⅛ c.	42⅞ c.

Saving of gas stove over range, 14¾ cents.

Chicken,	Cost,	61¼ c.	60 c.
	Product,	52½ c.	42½ c.
	Loss,	8¾ c.	17½ c.

Saving of gas stove over range, 8¾ cents.

Steak,	Cost,	24¾ c.	24¾ c.
	Product,	20⅝ c.	18 9/16 c.
	Loss,	4⅛ c.	6 3/16 c.

Saving of gas stove over range, 2 1/16 cents.

Chops,	Cost,	20 c.	21¼ c.
	Product,	16⅞ c.	13¾ c.
	Loss,	3⅛ c.	7½ c.

Saving of gas stove over range, 4⅜ cents.

Total saving, 33 1/16 c.

MR. HARBISON,—I have listened with the greatest interest to the statement which Mr. Goodwin has just made. I think it has really been of more value than any subject that has come up during this meeting. We have got here some practical information, and it seems to me that every engineer and every man connected with gas works who desires to increase his consumption should give the most careful attention to the subject that has been presented in so interesting a manner by Mr. Goodwin. I think, Mr. President, it would be well if we could get this statement from Mr. Goodwin in such a form as that it could be printed and distributed; and I think if we can do that, it would be better to pass a resolution directing that a certain number of copies be printed and distributed among the members of the Association, then each of us can personally take such action as we think best. I think it would be well for the Association to print 500 copies, and for each member to have two copies of this valuable information; then each of us can make such tests and ascertain such results as he feels disposed. I therefore move, Mr. President, that the Secretary be requested to obtain this statement of facts from Mr. Goodwin, and that it be published at an early day, and two copies be distributed to each member.

Carried.

MR. GOODWIN,—I have simply given you the figures. I do not propose to comment upon them at all.

The firm of W. W. Goodwin & Co. have received the following letter since the meeting of the Association :

(Copy.)

London Hospital, London, Eng.,
October 8th, 1879.

Dear Sir,—I find that my last complete and reliable experiments and calculations as to cost and saving with reference to our system of gas and steam cooking (of which you have full particulars), were made for the year 1876. I will put them down for you as briefly as I can.

In that year our daily average of occupied beds or daily number of in-patients was	630
And our daily average of officers, servants, nurses, &c., cooked for in our kitchen was, approximately	160
Together,	790

In the same year the waste of meat in cooking was reduced as under, viz. :

In roasting beef from	(on the old system)	33⅓ to 24.33	per cent.
In roasting mutton from	(do)	33⅓ to 16.95	do
In boiling mutton do	(do)	25 to 13.86	do

The actual quantities of meat dealt with were,

Raw beef purchased	25,357	lbs.
do mutton do for roasting	40,206	do
do do do for boiling	23,360	do

Of these were ordered for anticipated waste,

Beef, 6,339 lbs. *under old system would have been*	9,509	lbs.
Roasting mutton, 6,701 lbs. *under old system would have been*	16,752	lbs.
Boiling mutton, 3,337 lbs. *under old system would have been*	6,675	lbs.

The difference—viz.:

On roasting beef	3,170	lbs.
On do mutton	10,051	do
On boiling do	3,337	do
Or in total,	16,558	lbs.

valued at the contract price of $8\frac{1}{8}$d. per lb. (say $16\frac{1}{4}$ cents), shows a money savings in the value of this reduced waste, amounting to £541 13*s.* 4*d* (about $2,700), or more exactly to £505 18*s.* 4*d.* (say $2,525), it having been found necessary in order to allow full quantities for the ward diets, to purchase for loss in gravy to the extent of 4 lbs. of meat per diem, which reduced the previous saving by £55 15*d* (about $275.)

We cannot estimate the cost of steam used in heating the boiling apparatus for 2 hours on 2 days a week, as the boilers are always generating steam at a higher pressure than we should ever require for kitchen purposes, and the cost of such steam is doubtless very small for engines; but as to gas from careful experiments (including the 2 days weekly when a part of the cooking is done by steam), we found that in 1876 we used approximately 1,821 cubic feet per day, or 12,750 cubic feet per week, which at 3*s.* 9*d.* (say 93 cents) per 1,000 cubic feet, the price in 1876, gave a daily cost of gas for cooking amounting to barely 7*s.* ($1.75) per day.

I am, dear sir,

Faithfully yours,

WM. J. NIXON,

House Governor.

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IMPROVED GAS COOKING STOVE, No. 7.

Size, 30 in. high, 15 in. wide, 12½ in. deep. Hot plate 18 in. wide, 15 in. deep, with one oval and one ring burner, with sliding tray under hot plate.

Will roast a joint 7 lbs.; oven, grill, chops, steaks, bacon and fish, toast bread, bake pastry, rice puddings, potatoes, &c., boil, fry, or stew. Movable copper reflector, for radiating the heat into the room.

The roasting chamber of this [illegible] with bright tin plate, and is fitted with a movable trivet for supporting the pan at various heights; an oblong burner is also inserted in the hot plate with a separate tap.

COMPLETE GAS COOKING STOVE, No. 9.
With Copper Boiler.