PRACTICAL RATE MAKING AND APPRAISEMENT

WILLIAM D. MARKS

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BY

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Des Moines, Iowa (Gas), 1911
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CONTENTS

PREFACE

The eager mind and brain is learning new things every day and this fact makes one hesitate in the attempt to collate, digest and systematize this new branch of engineering science, "Rate making and appraisement" for undoubtedly there remains much of value to be originated and added to it.

The fact that the writer has been without precedents in his work and has been obliged to originate almost all of it so far as rate making is concerned makes him hesitate, but on the other hand, the fact that 6,500 copies of his book, "The Finances of Gas and Electric Light and Power Enterprises," have been sold and the demand for it still continues urges him to extend it by a work which is up to date, and which will enable others to practically execute in detail what he has so far in print only discussed in disconnected reports.

The writer most gratefully acknowledges his indebtedness for practical data to the admirable reports of the Massachusetts Gas and Electric Light Commission. Even in its lack of aggressiveness it appears to have proved itself, on the whole, both safer and wiser than other commissions. Its reports are invaluable for their lucidity and brevity, as well as comprehensiveness.

But when I point out the facts that Boston took the adjustment of its gas rates out of the hands of its Gas and Electric Light Commission, that the present (1913) deplorable condition of electric rates in New York City has the approval of its Public Service Commission, and that the City of New York settled its gas rates before the appointment of this commission, and further that most of our larger cities have themselves reached fair and reasonable rates without state commissions, I may be pardoned for my frank criticism of partisan public service commissions as at present appointed, and justified for my earnest belief that better results will be reached by a larger measure of home rule in our metropolitan communities.

CHAPTER I

GENERAL CONSIDERATIONS

The aim of this work is to be entirely practical and as brief as the topic considered will permit.

To print all my reports and appraisements made for some of our larger cities would require thousands of pages and of course result in too large a work, but each selected report will be briefly recapitulated and the cost of it and its local peculiarities mentioned.

A few of the briefer reports are printed in full and then will follow a general discussion of the principles involved in rate making and appraisement with practical examples of their application.

Such reports require a practical technical experience in the construction and operation of the kind of works considered and also experience in their business and methods of keeping accounts.

The power to collate, digest, classify and combine, the many factors affecting the cost of public utilities involves a capacity for the most laborous drudgery besides a keen perception of the controlling factors. A perfectly fair and open attitude of mind must always be preserved and in matters of doubt the producing concern shoud be favored.

Personally the author in making appraisements avoids any line of thought leading to forecasts of final results and adding factor to factor has frequently reached unexpected final results.

No single set of figures or method of computation should form the basis of an opinion, but every final result should be checked by some different method of reaching it. Go slow, check every step.

It is not always necessary or advisable to include these check methods in a report, as frequently on cross examination they are useful to the courts as proving anew the correctness of the results and the painstaking care given in a different way.

To reach practical profitable and judicially fair prices for a public utility often requires difficult and intricate computations even when an accurate appraisement of its present structural cost of reproduction is had and the present value of the plant has been learned from it by the deduction of past depreciation.

In considering the appraisement of the present value of works we again must subdivide it into used and useful and not required land, buildings and apparatus. For instance, owing to the introduction of natural gas into Cleveland and Buffalo about one fourth only of the original artificial gas works were used and useful.

In Omaha ten per cent of the gas works sales were outside of the City limits and the present value of the gas works had to be pro-rated.

Not infrequently the public utility's capacity far exceeds its present sales and the useful though unused present value of the works must be reduced pro-rata to be fair to consumers, who rightfully ought not to be forced to carry the cost of future extensions until they are needed, or to pay for over-built works.

To attempt to fix an invariable basis for future prices without also being able to fix the future prices of raw material and productive labor will surely lead to injustice to a public utility or to its consumers.

To attempt to fix future prices for a term of years and then subject them to revision is a better plan for natural monopolies such as public utilities.

But this plan has not always produced good results, for the commissions or Courts entrusted with this revision usually have not the intimate knowledge of details required to prevent them from falling into pitfalls (often intentionally prepared) and therefore rendering absurd decisions. (See Dubuque Waterworks Arbitration 1899.)

After a prolonged experience with and consideration of the records and reports of the Interstate, the Massachusetts, New York, Wisconsin and other public service commissions, I am convinced that until political partisanship can be completely eliminated from consideration in the appointment of national and state commissioners it will be wiser to confine these commissions if appointed to the publication only of the reports of the operations of public utilities and that better results will be obtained for the public by so doing. For with pitiless publicity promptly furnished there is sufficient ability and fairness to be found in every community to cause rates to be fairly adjusted at home, with the aid of the Courts if necessary. A municipality knows best its own needs and limitations and how to deal with them.

It is rarely that a public service commissioner has had any technical training or experience. The consequence is that they blunder in technical reports or as an alternative avoid as much as possible an exhaustive examination of public utilities.

The English deal with these matters of public utilities far more wisely than we do, for each public utility requiring legislation is met by a special parliamentary committee (assisted by a guild of engineering experts and accountants) who after making an exhaustive examination fix the rates and so they have reached an almost Utopian relation with their public utilities.

To demand of an expert superhuman impartiality is to ask the impossible, but a consulting engineer must bear in mind that under proper cross examination predjudiced views or results in scientific matters cannot possibly be sustained.

Further when an expert has once given his figures it is too late to change them or to substitute an alternative set of figures.

There is but one right way and a thousand wrong ways of making a report on rates. Extreme caution in every step is required.

The technical expert has not the latitude of a lawyer in his work—he must decide upon the one right method and then correctly compute his results and prove them.

In 1910 the Census reports 225 cities in this United States as having over 25,000 population. The public service utilities serving these cities are large natural monopolies, and hence not subjected to the healthy corrective of competition in their rates for electricity, gas, water and transportation.

There are also many hundred of cities having less than 25,000 population and public utilities, but the probability of extortionate prices in these smaller cities, towns and villages appears to be less because the public utilities there are small and render a service as a servant of the public often at a loss, instead of growing into vendors of a commodity on a large scale, which much reduces its costs per unit.

A legislative body granting such a virtual monopoly as a franchise to a pubic utility has not done its whole duty either to the public served, or to the public utility serving, until it has established fair and reasonable rates for the particular utility concerned.

No concern, no public utility is of any ultimate value to its community unless it makes an honest profit, but the growth of any community is seriously retarded by haphazard or extortionate rates, for public utility monopolies.

Careful and laborious studies involving years of labor have convinced me of the blind regularity with which communities respond to rates. Altough the action of any individual can rarely be predicted, the action of a community can be relied upon with certainty. It is as sure as the law of gravity.

When a City exceeds 75,000 population (and particularly when located as a metropolis) the habits of its citizens change so that the demand for public utilities per capita increases markedly.

In recent years, in a number of cases, a reasonable reduction of rates forced upon a public utility in spite of its urgent protestation of resulting ruin, and often of its vigorous and prolonged defence in the courts, has resulted in such an increase of its total profit as has caused the public utility itself to express its satisfaction with the rate fixed at the end of a year. The Consolidated Gas Co. of N. Y. is a famous instance of this. This is usually due to three points overlooked by its managers.

Not only is a larger quantity sold at a smaller profit per unit, but also the investment required per unit sold is largely reduced. Besides this so very large a proportion of the operating expenses of a public utility are independent of the amount of sales and dependent wholly on the passage of time, that the operating costs per unit are largely reduced by increased sales, per year.

On the other hand utility rates are sometimes fixed so low in cities which have not grown to metropolitan populations as not to yield a fair and adequate profit to a public utility.

When we consider the sales per capita of a public utility we are forced to recognize a point of satiation for each price fixed in any community, and if this community is not large enough to return a total more than covering the time expenses (which are independent of the amount of sales) and the commodity costs, there is an incurable deficit at the rate fixed. Common justice requires that a proper higher rate be computed and allowed to unprofitable utillties if a loss is due to rates.

This point of satiation per capita for a given price varies with the population and characteristics of a community. Although the population is the controlling factor still there are other and often obscure causes of variation requiring careful research before reaching a correct result, in individual cases.

These statements apply with equal force to gas, electricity, transportation, and water if it is metered.

The profit to a public utility can always be assured by the use of meters and a correct uniform rate to both large and small consumers, but such a method (flat rates) is unjust to the large consumers and prevents the growth of the utility, because the small cusumer receives a service, whose cost is principally due to time charges proportional to his greatest possible demand, and the large consumer often costing the same or but little more for time charges, pays the same rate per unit for a large amount of a commodity whose proportional operating commodity cost per unit is usually very small.

Thus we see for metered consumers:

The consumer whose demand is small usually costs high for service and requires very little of the commodity delivered.

The consumer whose demand is large, usually costs but little more for his service and requires a great deal of the commodity delivered. A meter measures only the commodity.

The proportional cost of the commodity varies principally with the productive labor and raw material consumed in its delivery.

The time costs of a plant consist principally of the interest (or profit) depreciation, rent, insurance, salaries of its staff of unproductive accounting, and managing employes, and other expenses not rising and falling with the volume of its commodity delivered, but necessary to the proper operation of the plant when placed at the service of its consumers.

The exact fair and reasonable rate to be paid by each consumer to a public utility must therefore be a properly apportioned amount as follows:

For the service his proportion of the time costs.

For the commodity, his proportion of the commodity costs.

The results of these computations based on the above statements have been variously called "sliding scales" "stepped rates" and "differential rates".

While a community which has become accustomed to paying to paying so much a yard, or so much a pound for its commodities may prefer a like uniform rate for public utilities, still it must be obvious, after a little thought, that the large purchaser always pays too high a price for his commodiites, whatever they may be, if he pays a uniform rate regardless of quantity.

The uniform rate has the popular advantage of great simplicity and apparent justice, and so persists in use in the majority of public utilities.

If the public utilities will make a proper distinction between their consumers requiring service and a small quantity of their commodity only for luxury and convenience, and those requiring their commodity in large quantities for industrial uses, they will largely increase their own business and also increase the commercial growth of any community which they may serve.

It was the realization of this fact by the writer after much study of the operating expenses of the Philadelphia Edison Electric Light Company, that made him finally put in operation in 1890 a stepped rate for electricity (given on page 251 of the Finances of Gas and Electric Light and Power Enterprises) in the year 1891, after a successful trial of it for over one year. (See Journal Edison Ill. Association, 1891).

This scientific and rational scale of prices proved very profitable to the Company for the ensuing four years. (See Edison's letter June 4, 1892, page 260, Finances of Gas and Electric Light and Power Enterprises) when the writer was obliged to relinquish his position as president rather than become an accomplice in the issuance of watered securities by a group of colossal thieves in control of the company.

The accounts of the operating management of a public utility must have very close scrutiny from one attempting to fix fair and reasonable rates for it, particularly in distinguishing between necessary operating expenses, (without which the utility company could not produce its commodity) and deductions from income often made as a matter of policy or because of bad management, such as contributions of a political or charitable nature, unnecessary salaries, bad debts, excessive advertising, etc., etc.

These items are often presented in the endeavor to swell the apparent cost of a commodity.

In a number of instances also the attempt has been made to include interest on borrowed money, either on a floating debt or on a mortgage, in the costs, but it must be obvious, that if a concern has not sufficient capital to transact its business, it should pay its interest on its borrowed money out of its own profits.

When we come to the appraisement of a public utility, it is necessary to distinguish carefully between used and useful assets, and assets not required for the production of its commodity.

As for book assets the Interstate Commerce Commission makes the following statement as to the deceptiveness of these records in its report of December 24, 1908. "Every balance sheet begins with the cost of property against which is set a figure which purports to stand for investment. It is sufficient to refer to the well known fact, that no court or commission or accountant or financial writer would for a moment consider that the present balance sheet statement purporting to give the cost of property, suggests even in a remote degree a reliable measure, either of money invested or of present value."

This wholesale scathing criticism of the accounts of the public service corporations of the United States with which it is concerned should be sufficient to prove that the utmost caution and thorough research must be exercised by an appraiser, and that an appraisement must be made regardless of book values, in most instances.

It is by adding to a fair and reasonable profit upon the appraisement of any property, the necessary operating costs of it, that a correct basis for rates is reached.

CHAPTER II.

RECAPITULATION OF REPORT UPON GAS RATES AND PRICES FOR THE CITY OF SPOKANE

This report was for the purpose of fixing fair and reasonable rates for gas upon the complaint of the citizens of Spokane that $1.50 uniform rate per 1,000 cu. ft. was extortionate.

The uniform reasonable rate recommended was $1.20 per 1,000 cu. ft. with a minimum charge of 25c. per meter per month as sufficient to protect the Gas Company.

As a fairer method between consumers a stepped rate as follows was recommended.

A net rate of $1.40 per 1,000 cu. ft. for the first 1,000 cu. ft. per meter per month.

And a net rate of $1.00 per 1,000 cu. ft. for all excess over 1,000 cu. ft. per meter per month.

The appraisement of the works made by the engineers to the Washington State Public Service Commission is said to have required the services of three or four engineers for about six months and was furnished to city.

An abstract of the book accounts was furnished to city by the Spokane Gas and Fuel Company.

The following report occupied about thirty days, required one assistant and cost the City of Spokane about $2,100 for travelling expenses subsistence, and services before the State Commission. This gas company is an excellent example of stock watering and manipulation and its results.

TABLE OF CONTENTS

REPORT UPON GAS RATES AND PRICES FOR THE CITY OF SPOKANE, WASHINGTON

By William D. Marks, *Consulting Engineer*
Park Row Building, New York City.

Section 1.—Object of this Report.

The object of this report is to obtain from the data of the Spokane Gas and Fuel Company as furnished by the engineering corps of the State Public Service Commission and by the Spokane Gas and Fuel Company three systems of rates:

1. A uniform Flat Rate price applicable as a straight charge without any addition of any kind for the gas consumed at each meter.

2. To obtain a stepped rate, often called a "Differential Rate," which has different prices charged for successive amounts as measured by each meter.

3. To apply the London Sliding Scale to the conditions existing in Spokane and from the data obtained to fix a standard price and a standard rate of dividend (or interest) and also to fix the reduction of the price of gas which shall entitle the Gas Company to raise its dividend one per cent.

I have been furnished with the itemized appraisement of the gas plant as made by the engineers of the Washington Public Service Commission and have used the same for the purpose of adding an overhead charge and deducting accrued depreciation.

The land upon which the gas works is situated has been appraised by Messrs. Fred E. Baldwin and S. E. Hege and I have used the higher valuation of $109,402.99, given as the value of the land, for the purpose of gas making adding 12½% thereto.

No buildings or structures of any kind are included in this valuation of land.

The operating expenses for the year 1912 have been furnished by the officials of the Spokane Gas and Fuel Company. As sufficient time and assistance to audit the books, examine the vouchers and check stubs and for recomputing has not been granted, I have accepted for investigation the various figures, footings and segregations used in the method of bookkeeping of the Spokane Gas and Fuel Company and collated and arranged them in a simplified form.

From these results I have formed an opinion and submit for your consideration the various expurgations required to compute the cost of gas on the basis of the ordinary organization and expenditure of conservative gas companies.

Should the figures of the appraisement or the figures derived from the books be altered by a more thorough and detailed examination it may result in a change in the computed price of gas, but the methods used need not be changed.

In fixing the price of gas it would be as impossible as it would be insincere to claim scientific accuracy, but I believe my results to be commercially adequate to the protection of the Gas Company in a fair and reasonable return upon its true investment and its proper operating cost, being as close as it is possible to obtain them in the operation of gas works.

I am indebted to the courtesy and prompt assistance of both the engineers of the Public Service Commission and of the officials of the Spokane Gas and Fuel Company for the

prompt rendering of whatever assistance and information I have asked of them.

SECTION 2.—LAND.

The land occupied by the Spokane Gas and Fuel Company and the Spokane Falls Gas Light Company has at the request of Commissioner Fassett been valued by the real estate experts, F. E. Baldwin and S. E. Hege, as follows:

	F. E Baldwin	*S. E. Hege*
Tract occupied by gas works, Erie and Bradley Streets, 107,338 sq. ft.	$53,669.16	$64,402.99
Railroad Avenue between Stevens and Washington Streets	50,000.00	45,000.00
Totals	$103,669.16	$109,402.99

SECTION 3.—PUBLIC SERVICE ENGINEERS. COST OF REPRODUCTION OF NEW PLANT, SPOKANE GAS & FUEL COMPANY AND SPOKANE FALLS GAS LIGHT COMPANY

WORKS EQUIPMENT

October 1st, 1912.

8 Main buildings, manufacturing plant	$45,759.00	
9 Shops and miscellaneous structures	13,784.00	
		$59,543.00
16 Coal gas benches (2 stacks)		....
1 Standard 9 foot Lowe Water Gas Set		74,560.00
2 P. & A. tar extractors, 1 purifier set		10,465.00
4 Condensers, 3 scrubbers and 1 wash box		20,559.00
2 7 ft. station meters		4,700.00
4 Boilers (455 H.P.) and 1 feed water heater		7,192.00
	Forward,	$177,019.00

Brought Forward,	$177,019.00
2 Electric generators 35 and 25 K.W.	3,647.00
3 Compressors, complete erected	4,818.00
3 Blowers, complete erected	2,667.00
3 Exhausters, complete erected	4,011.00
2 Governors, complete erected	820.00
1 Stroh & Caius ammonia concentrator	1,500.00
1 Fairbanks gas engine 4½ H.P.	240.00
10 Pumps, erected	1,030.00
2 Regulators	205.00
1 De Brower coal projector	3,076.00
2 Coke pushers (Williams)	3,100.00
1 Coke crusher, rolls and engine	719.00
1 Coal conveyor and crusher complete	8,465.00
	$211,317.00

SECTION 4.—YARD EQUIPMENT.

1 Tar well in yard	$1,320.00
1 Water tank and tower	525.00
3 Ammonia storage tanks	1,500.00
2 Oil storage tanks	2,710.00
1 Brick ammonia well	1,038.00
2 Tar separators	160.00
1 Receiver tank for gas	750.00
1 Receiver tank for air	90.00
1 Derrick crane	695.00
1 Hunt Industrial Railway	5,000.00
1 Hose reel and hose	130.00
2 Platform Fairbanks Scales	454.00
1 Craig-Ridgway Steam Hyd. Elev.	1,600.00
32 Coke quenching hoppers	2,464.00
Coal bunkers and crusher house	6,422.00
Coke trestle	2,380.00
Forward,	$27,238.00

Brought Forward,	$27,238.00	
Elevator Runway	311.00	
Coal elevator, boiler house	505.00	
8 Coal hoppers	3,080.00	
8 Coal hoppers	2,320.00	
Yard Paving	1,035.00	
Seal's sumps and drip pots	500.00	
		$34,989.00
Plant piping and fittings		9,317.00
All tools and implements		2,405.00
All testing apparatus		1,670.00
All furniture and fixtures		15,634.00
Total valuation manufacturing plant (new).		$275,332.00

SECTION 5.—HOLDERS.

3 Gas Holders

1 Two lift	110,000	cu. ft.	capacity	$17,500.00
1 Single lift	50,000	"	"	15,950.00
1 Three lift	305,000	"	"	36,000.00
Cost new	465,000	"	"	$69,450.00

Average per 1000 cu. ft. capacity, about $149.00.

STREET DISTRIBUTING SYSTEM

Tabulations from Washington Public Service Commission Engineers Report. Total Length of Street Mains. 126.3 miles.

Size Inches	Cast Iron Length Feet	Cast Iron Cost	Black Merchant Length Feet	Black Merchant Cost	Black Line Length Feet	Black Line Cost	Kalamein Le gth Feet	Kalamein Cost	Totals Length Feet	Totals Cost
½					710	$226			710	$ 226
¾					250	53			250	53
1			510	$ 112	440	209			950	321
1¼			4,887	1,253					4,887	1,253
1½			5,950	1,796	14,060	4,333			20,010	6,129
2			175,819	60,889	132,674	46,819			308,493	107,708
3	6,490	$3,764	6,600	3,663	25,733	12,998	880	$ 431	39,703	20,856
4	8,280	6,233	168,186	101,575	1,980	1,208	42,620	24,594	221,066	133,610
6	5,740	6,197	27,230	25,347			23,580	22,257	56,550	53,801
8	1,010	1,172	4,000	5,180					5,010	6,352
10			534	908					534	908
12			8,661	19,422					8,661	19,422
Totals	21,520	$17,366	402 377	$220,145	175,847	$65,846	67,080	$47,282	666,824	$350,639

For laying pipe under tracks	324
For street railway crossings	430
For miscellaneous pipe fittings (estimated)	6,672
Final Total	$358,065

Recapitulating the above tabulation of mains we have:

Cast iron street mains	21,520 ft.......	$17,366.00
Black merchant street mains	402,377 "	220,145.00
Black line " "	175,847 "	65,846.00
Kalamein " "	67,080 "	47,282.00
Total	666,824 "	$350,639.00
Undistributed extras......................		7,426.00
Total....................................		$358,065.00

SECTION 6.—SERVICE PIPE CONNECTIONS.

Service connections complete	7,441.......	$105,920.00
Less amount paid by consumers	....	53,000.00
Stub services	2,166.......	17,099.00
Total the property of company	9,607.......	$70,019.00

SECTION 7.—GAS METERS INSTALLED.

Ordinary			
3 Light (meter lights	7,629)	2,543......	$16,275.00
5 " (" "	29,835)	5,967......	43,261.00
10 " (" "	4,130)	413......	3,816.00
20 " (" "	1,500)	75......	1,030.00
30 " (" "	2,370)	79......	1,537.00
45 " (" "	405)	9......	228.00
60 " (" "	1,020)	17......	644.00
100 " (" "	100)	1......	64.00
Prepay			
3 Light (meter lights	1,371)	457......	4,469.00
5 " (" "	1,625)	325......	3,650.00
10 " (" "	120)	12......	159.00
20 " (" "	40)	2......	34.00
	50,145	9,900......	$75,167.00

SECTION 8.—GAS METERS IN STOCK.

Ordinary			
	3 Light	1,167	$6,127.00
	5 "	277	1,676.00
	10 "	182	1,438.00
	20 "	15	178.00
	30 "	8	138.00
	45 "	1	22.00
	60 "	3	103.00
	200 "	1	112.00
Prepay			
	3 Lights	82	708.00
	5 "	44	440.00
	10 "	28	335.00
Total in stock		1,808	$11,277.00

SECTION 9.—GOVERNORS AND REGULATORS.

Three 3 in. district station governors	$737.00
938 Reynold's Service Regulators No. 1	6,003.00
104 " " " " 2	744.00
Total	$7,484.00

SECTION 10.—GAS ARC LIGHTS, ETC.

1345 gas arcs	$12,806.00
Small lights and heating appliances	2,689.00
Total rental equipment	$15,495.00

SECTION 11.—TEAMS AND VEHICLES FOR STREET SERVICE.

11 Horses	$2,550.00
13 Wagons and harnesses	2,105.00
5 Motor cycles	1,025.00
2 Automobiles	2,530.00
3 Bicycles	128.00
Total	$8,338.00

Section 12.—Depreciation.

Depreciation arises from physical decay, inadequacy and obsolescence. Depreciation is cured by repairs and renewals. The more thorough the repairs the less the residual depreciation remaining. But there is always a residual depreciation no matter how thorough the repairs. Residual depreciation is like the failing of an ageing man. No matter how good his present condition each year brings his end nearer. So it is with manufacturing plants.

After years of practical trial the Massachusetts Gas and Electric Light Commission has fixed 3 per cent as a fair average allowance for annual residual depreciation of municipal gas and electric works for cases where the repairs have been as thorough as possible.

In the case of the Spokane Gas Works, the quality of the buildings and machinery and the present condition of them is very good.

I am advised that the present buildings and machinery have been built about seven (7) years, which makes the average accrued residual depreciation 21 per cent. This will be very low for the wrought iron street mains.

Section 13.—Overhead Charges.

In considering the overhead charges on an inventory of a completed works it must be recollected that all of its items are included in the inventory if the work is thoroughly done and therefore no allowance is required for "omissions," etc. also that such items as "bond discount," etc., relating to the Company's method of borrowing money, instead of furnishing it from the sales of its stock to its own stockholders, is outside of the province of an appraiser.

Since two summers or eighteen months should suffice for the complete erection of these works and the laying down of its street system of mains, etc., we are justified in an estimate for interest of nine (9) months average at 6 per cent or 4½ per cent of its new cost. Two (2) per cent will provide the drawings and engineering supervision required. Since taxes are rarely assessed upon buildings in course of constructions, but only on the land, 2 per cent has been found to more than provide for them in most cases.

The expenses of "organization" are a very uncertain quantity, and often are little or nothing, but to be on the safe side they are assumed at twice the cost of engineering drawings and supervision, or four (4) per cent.

Recapitulating, we have for

Overhead Charges

Interest	4.5%
Engineering drawings and supervision	2.0%
Taxes	2.0%
Organizing	4.0%
Total	12.5%

The Wisconsin State Railroad Commission in some cases has fixed 12 per cent for this, after elaborate research.

SECTION 14.—PRESENT VALUE OF THE SPOKANE GAS PLANT.

The structural cost (new) of the various items of the Spokane Gas Plant is given as related above from the appraisement of the State Public Service Engineers, but in being brought together these items, as a connected whole, ready to operate, should have added to them 12½ per cent and then be depreciated on the basis of years of usefulness, save in the case of land, which is not depreciated, the land's present value being determined for the purpose of gas making by competent local real estate experts and 12½ per cent being added to this amount, to obtain the total structural cost of the plant ready to operate and connected up. If now from the total structural cost of the plant (new at present prices) we subtract the depreciation we obtain its *present value* as a basis for the computation of future profit and depreciation, and thence the proper price of gas by adding profit and depreciation to the cash operating cost of gas making and delivering.

Recapitulating for October 1st, 1912

Works equipment—manufacturing	$275,332.00
Gas holders	69,450.00
Street distribution system	358,065.00
Service pipe connections	70,019.00
Gas meters installed	75,167.00
Gas meters in stock	11,277.00
Gas arc light	15,495.00
Teams and vehicles	8,338.00
Governors and regulators	7,484.00
Total as per Public Service Commission	$890,627.00
Overhead charge, 12½ per cent	111,328.00
Total structural cost (present prices)	$1,001,955.00
Residual depreciation, 21 per cent	210,411.00
Present value (land omitted)	791,544.00
Land, present value	109,403.00
Land, 12½ per cent overhead charge	13,675.00
Working capital, 193,110 *M* at 13c	25,104.00
Total *present* investment *value*	$939,726.00

Section 15.—The Operating Expenses as Per Company's Books.

Tabulated Operating Expenses, Spokane Gas & Fuel Co. 1912.

Total Gas Sales,—193,109,700 cu. ft.

Items		Operating expenses Fixed	Operating expenses Proportional	Per 1000 cu. ft. Sales
(1) Coal carbonized, 20,739.9 tons at $5.28			$109,345.99	56.62c.
(2) Fuel under retorts, 4,125.7 tons at $3.67			15,141.27	7.84c.
(3) Generator fuel, 427.34 tons at $3.67			1,568.35	0.81c.
(4) Boiler fuel, coal gas	$13,549.92			
Labor and misc. water gas	601.96		14,151.88	7.33c.
(5) Gas oil, 54,218 gals. at 4.455c.			2,415.89	1.25c.
(6) Superintendence coal gas	$2,558.84			
Superintendence water gas	173.85	$2,732.69		1.42c.
(7) Labor mfg. coal gas	$16,183.55			
Labor mfg. water gas	669.87		16,853.42	8.73c.
(8) Purification labor Coal gas	329.48			
Water gas	28.29		357.77	0.18c.
(9) Purification supplies			2.88	0.00c.
(10) Water (see boiler fuel)				
(11) Expense at works		2,391.00		1.24c.
(12) Maintenance coal gas apparatus			5,247.16	2.72c.
(13) Maintenance water gas apparatus			1,498.67	0.77c.
Forward,		$5,123.69	$166,583.28	88.91c.

Brought Forward,	$5,123.69	$166,583.28	88.91c.
(14) Maintenance buildings apparatus..................	201.39	....	0.10c.
(15) District holder expense.....	4,414.04	....	2.28c.
(16) Distribution, supt. offi. exp. and street expense........	4,799.56	....	2.48c.
(17) Consumers premises and arc light expense............	10,393.57	....	5.38c.
(18) Pumping gas.............	4,517.35	....	2.33c.
(19) Setting and removing meters	3,545.53	....	1.84c.
(20) Maintenance of street mains.	3,049.12	....	1.58c.
(21) Maintenance of services....	1,767.03	....	0.92c.
(22) Maintenance of meters.....	2,982.98	....	1.55c.
(23) Meter department expenses.	1,961.77	....	1.01c.
(24) Commercial supt. and expenditures..............	25,495.70	....	13.20c.
(25) Commercial office salaries...	13,890.77	....	7.19c.
(26) Commercial bill collection expense.................	5,240.90	....	2.71c.
(27) Reading meters...........	2,609.79	....	1.35c.
(28) Office expense (general)....	4,708.56	....	2.44c.
(29) General executive salaries..	8,443.38	....	4.37c.
(30) Insurance, legal and miscel. expenses................	21,164.36	....	10.96c.
(31) Taxes and royalty.........	11,388.57	2,850.63	7.32c.
Totals (fixed 70.27c.)......	$135,698.06	$169,433.91	158.01c.
Variation due to decimals..........................			.11c.
Credits—For residuals.			
(32) Coke, 13,704.9 tons at $3.67.	50,269.71		
Tar 205,178 gals. at 3¼c...	6,668.26		
Ammonia 80,414 at 3.09c...	2,484.07		
Retort carbon............	30.00		
(33) Duplicate gas charges to depts...................	1,849.25	61,301.29	31.74c.
(34) Balance of proportional op. exp.........		108,132.62	55.99c.

The above totals of operating expenses are the same as those of the Spokane Gas and Fuel Company's books.

Depreciation is omitted from them.

The above figures of the operating expenses were furnished by the manager of the Spokane Gas and fuel Company, but the items were segregated by myself. The fixed expenses may be said to be for service rendered. The proportional expenses are for the commodity furnished.

Segregating the Gas Company's figures, the cost of gas in 1912 appears to have been stated as follows:

SECTION 16.—MANUFACTURING COST.

		Per 1000 cu. ft. Sold
(1) Coal carbonized	$109,345.99	56.62c.
(2) Fuel under retorts	15,141.27	7.84c.
(3) Generator fuel	1,568.35	0.81c.
(4) Boiler fuel	14,151.88	7.33c.
(5) Gas oil	2,415.89	1.25c.
(6) Superintendence	2,732.69	1.42c.
(7) Labor manufacturing	16,853.42	8.73c.
(8) Purification labor	357.77	0.18c.
(9) Purification supplies	2.88	0.00c.
(10) Expense at works	2,391.00	1.24c.
(11) Maintenance of coal gas apparatus	5,247.16	2.72c.
(12) Maintenance of water gas apparatus	1,498.67	0.77c.
(13) Maintenance of buildings	201.39	0.10c.
	$171,908.36	89.01c.
(32) Less residuals	61,301.29	31.74c.
Cost of gas in holder	$110,607.07	57.27c.

This 57c. is so unusually high that even coal at $5.28 per ton does not explain it.

A thorough examination of the items of the operating accounts and of the method of operation would be necessary before accepting as final, a cost of 57.27c. per 1,000 cu. ft. sold as a proper cost, for it far exceeds almost any instance I have met with.

With the usual methods of handling coal and present local prices, coal gas should be produced at about 45c. to 50c. holder cost in Spokane—perhaps even less.

SECTION 17.—DISTRIBUTING COST.

		Per 1000 cu. ft.
(15) District holder expense	$4,414.04	2.28c.
(16) Distribution supt. offi. exp. and st. exp	4,799.56	2.48c.
(18) Pumping gas	4,517.35	2.33c.
(19) Setting and removing meters	3,545.53	1.84c.
(20) Maintenance of street mains	3,049.12	1.58c.
(21) Maintenance of services	1,767.03	0.92c.
(22) Maintenance of meters	2,982.98	1.55c.
(23) Meter department expenses	1,961.77	1.01c.
Cost of distributing gas to meters	$27,037.38	13.99c.
(17) Consumers premises and arc light expense and repairs	10,393.57	5.38c

This item 17 is due to the fact that this Gas Company loans and keeps in repair some 1,345 gas arc lights for its consumers.

It does not appear proper to overcharge other consumers to carry their arc lights for a specially favored class.

SECTION 18.—COMMERCIAL SUPERINTENDENCE AND EXPENDITURES.

Item 24—$25,495.70 is a charge for promoting new business and adds 13.2c. per 1,000 cu. ft sold to the apparent cost of gas. It was estimated as follows for 1912:

Advertising	$11,341.65
Circulars	55.17
Demonstrating	100.30
Exhibition expenses	40.35
Salaries and bonus	16,238.88
Loss on appliances	1,236.95
Connecting appliances	16,834.72
Miscellaneous expenses	10,159.45
Total	$56,159.45

Of this amount $25,495.70 was charged to 1912 operating expenses and $30,663.75 charged to Suspense Account. As being a deduction from income ordered by the management and in no way unavoidably necessary to the manufacture of gas, I have eliminated it from the cost of gas. The proper per cent of one's profits advisable to spend in seeking new business is a question for the personal judgment of the management.

(25) Commercial office salaries $13,890.77 (per 1,000 cu. ft. sold 7.19c.) in addition to the $16,238.88 partially covered in item (24) should be analyzed before being admitted.

Section 19.—General Office Expense and Administration.

		Per 1000 cu. ft.
(26) Bill collection expense	$5,240.90	2.71c.
(27) Reading meters	2,609.79	1.35c.
(28) General office expense	4,708.56	2.44c.
(29) General executive salaries	8,443.38	4.37c.
(30) Insurance, legal and misc. exp	21,164.36	10.96c.
(31) Taxes and royalty	14,139.20	7.32c.
Totals	$56,306.19	29.15c.

Item 30—Insurance, etc., $21,164.36 or per 1000 cu. ft. sales 10.9c. is very large and should be analyzed before being finally accepted as unavoidably necessary to the manufacture and supply of gas.

Section 20.—Estimate of the Proper Cost and Price of Gas.

This review and scrutiny of the salient figures of the operating expense enables me to form an opinion only as to the proper cost of gas delivered at the consumer's meter in

Spokane, for I have not audited the books or appraised the works.

Being careful to be more than liberal I would fix the reasonable operating costs at not more than the following:

Cost of gas in holder..........	0.50	per 1000 cu. ft. sales
Cost of distribution...........	.14	" " " "
Cost of general expense........	.25	" " " "
Cost at consumer's meter......	.89	" " " "

SECTION 21.—ALLOWANCE FOR NEW BUSINESS.

Much discussion has arisen as to whether there should be any allowance in the manufacturing cost of gas for the promotion of new business.

The Gas Committee of the City Council of Minneapolis in its now standard adjustment with and franchise for, its Gas Company agreed upon 2½c. per 1,000 cu. ft. sales as reasonable and allowable, so I would be inclined to recommend 3c. per 1,000 cu. ft. as an allowance for new business expense for Spokane and have included it in general expense above.

SECTION 22.—COMPARISONS WITH TACOMA AND SEATTLE GAS.

From the report of the Public Service Engineers of the State of Washington upon the Tacoma Gas plant I take the following figures (pages 138 and 140) derived from their audits of these companies' books.

Item	Tacoma	Seattle	Spokane
Cost of coal, per ton..........	$3.35	$3.26	$5.10
Cost of manufacturing.........	37.22	28.00	50.77
Cost of distribution...........	8.84	9.20	21.30
Cost of general expense........	27.98	16.30	32.95

The average cost of Seattle and Tacoma coal is $3.30 or $1.80 less than Spokane. Since 10,000 cu. ft. is the average yield of gas per ton this would increase the cost of manufacturing about 18c. per 1,000 cu. ft., unless the price of coke and residuals is correspondingly increased, which is not probable. The average cost of manufacturing for Tacoma and Seattle is 32.61c. giving for Spokane about 50c. per 1,000 cu. ft. sales. The average cost of distribution for Tacoma and Seattle is 9.02c.

For Spokane we have extra expenses, viz.:

(15) District holder expense....	2.28	per 1000 cu. ft. sales
(18) Pumping gas.............	2.33	" " " "
	4.61	" " " "

This gives about 14c. per 1,000 cu. ft. sales. Spokane appears to labor not only under the disadvantage of high priced coal but also under the remediable disadvantage of an expensive poorly designed method of street distribution.

The average of cost of general expense for Tacoma and Seattle is 22.14c. per 1,000 cu. ft. sales. This is about 3c. per 1,000 cu. ft. less than the 25c. fixed by myself independently. My own figures for the reasonable Spokane cost of gas were fixed without any knowledge of Tacoma and Seattle costs, this comparison being made subsequently, and confirming the liberality of my mental attitude toward the Spokane Gas Company.

Section 23.—Profit and Depreciation Costs per 1,000 Cu. Ft.

In estimating the annual capacity of gas works; engineers by common consent multiply the work's daily capacity of 200 days rather than 365, since this gives an ample margin of 165 days while repairing retorts and other gas making machinery, and covers the maximum daily demand for the long winter nights.

The daily capacity of the Spokane gas works appears to be as follows:

One 9 ft. Lowe water gas set, cu. ft.	750,000
96 Coal gas retorts at 8000 cu. ft.	768,000
Total daily capacity	1,518,000

The yearly capacity is 200 times the daily or 303,600,-000 cu. ft. The water gas set could be urged to 1,000,000 cu. ft. daily capacity, and the retorts which are estimated at 6 hour 400 lbs. charges could be operated on 4 hour charges and higher heats—at 12,000 cu. ft., per day with good economical results.

There is an ample margin of time allowed for repairs, and for very moderate operation in my estimate of 303,-600,000 cu. ft. We have previously found the present value of the works to be $939,726. Dividing this by 303,600 per 1,000 cu. ft. we have as the investment per 1,000 cu. ft. capacity $3.09. To the operating cost of gas per 1,000 cu. ft. should be added the profit and depreciation on its investment per 1,000 cu. ft. capacity.

Net profit per 1000 cu. ft, 7 per cent of $3.09	$0.216
Residual depreciation 3 per cent of 3.09	0.093
Total	$0.31

Frequently gas companies compute their investment per 1,000 cu. ft. of sales. In this case with 193,109.7 1,000 cu. ft. sales 1912 it would be about $4.50 per 1,000 cu. ft. but if for any reason a corporation has too far anticipated its needs and has over-built or over-invested for them it should not expect the public to carry an unreasonable burden, due to the company's own blunders or extravagance.

SECTION 24.—FLAT RATE PRICE FOR GAS.

We can now recapitulate the costs givinig a fair and reasonable return per 1,000 cu. ft. of sales of gas for Spokane:

Manufacturing (holder cost)	cost per 1000 cu. ft.	$0.50
Distribution.	" " " " .	0.14
General expense	" " " " .	0.25
Net profit	" " " " .	0.216
Residual depreciation	" " " " .	0.093
Total fair and reasonable price	" " " " .	$1.20

You will recall that I have mentioned an allowance of 2½c. per 1,000 cu. ft. made for new business expense in Minneapolis and suggested 3c., but this is a matter of personal judgment and liberality. The general expense (25c.) exceeds the Tacoma and Seattle average (22c.) by 3c.

One thing all experience in the gas business teaches—reduction of price and that only increases gas sales *per capita*—without it all advertising and solicitation appear to be futile piffle.

SECTION 25.—STEPPED RATE PRICES FOR GAS.

In this system consumers using more than a certain fixed amount per month are given a lower price for the excess.

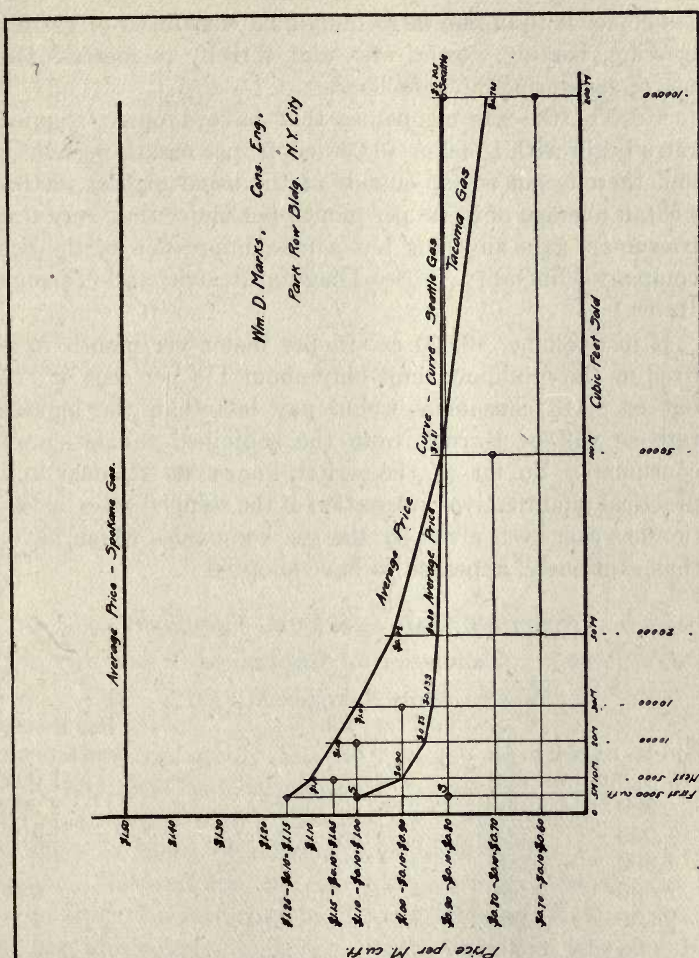


Diagram Seattle and Tacoma Rates.

Its object is to obtain large individual consumers of gas for cooking, heating, power, etc., and thereby to increase the use of gas during daylight hours.

Most of the gas companies that have adopted stepped rates begin with 5,000 or 10,000 cu. ft. per month per meter and thereby get so far outside of the usual highest metropolitan average of 3,000 per month per meter that very few consumers gain anything but a false impression of the gas company's liberality. (See Diagram Seattle and Tacoma Rates.)

If in Spokane, 10,000 cu. ft. per meter per month were fixed as the minimum limit only about 1½ per cent or 127 out of 8,443 consumers would pay less than the highest rate as will be learned from the subjoined tabulation of consumers. So far as the writer knows no rational and practical quantitative explanation of the stepped rates operation has ever been given by the gas companies which have, thus cautiously, appeared to have adopted it.

Spokane Gas and Fuel Company

Tabulation of Consumers

Year Ending October 31, 1912.

Cu. ft.		Cu. ft.	Per meter per month
0	to	500	1,009
500	"	1,000	2,207
1,000	"	1,500	1,425
1,500	"	2,000	1,645
2,000	"	2,500	634
2,500	"	3,000	423
3,000	"	3,500	238
		Forward,	7,581

Cu. ft.		Cu. ft.	Per meter per month
		Brought Forward,	7,581
3,500	"	4,000	152
4,000	"	4,500	128
4,500	"	5,000	98
5,000	"	5,500	76
5,500	"	6,000	60
6,000	"	6,500	59
6,500	"	7,000	31
7,000	"	7,500	24
7,500	"	8,000	24
8,000	"	9,000	39
9,000	"	10,000	43
10,000	"	12,500	57
12,500	"	15,000	
15,000	"	17,500	20
17,500	"	20,000	9
20,000	"	25,000	33
25,000	"	50,000	6
100,000	"	200,000	2
			8,442

By means of expurgations from the accounts of the Spokane Gas and Fuel Company of unnecessary expenditures, what in the writer's opinion is a judicially fair flat rate price, has been obtained. It is $1.20 per 1,000 cu. ft. for all consumers but confessedly this rate is only an average price protecting the Gas Company in a fair profit. Many small consumers pay too low a price and the company must recoup its losses on them, by making large consumers pay too high a price. The rational and practical reason for stepped rates arises from the fact that in the operating expenses of gas making and supply the items of cost should be segregated into two classes, *viz.:*

(1) Service or fixed operating expenses regularly accruing

with the passage of time regardless of any temporary variation in the sales of gas.

(2) Commodity or proportional operating expenses increasing or decreasing with the increase or decrease of gas sales.

Subjoined is an expurgated segregation of the fixed and proportional operating expenses for Spokane.

Stepped Rate System.

Expurgated Segregation of the Fixed and Proportional Expenses Required for the Cost of Supplying Gas in Spokane, 1912.

If we add the residuals per 1,000 cu. ft. (31.74c.) to 50c. the gross holder cost per 1,000 cu. ft. sales (deduced from the Seattle and Tacoma average (32c.) by adding 18c. per 1,000 cu. ft. to it) we obtain 81.74c. as compared with 89.01c. gross holder cost per 1,000 cu. ft. sales given by Spokane Gas Company.

Hence the gross cost estimated (81.74c.) is 8.17 per cent less than the book cost 89.01c. offered.

Again if we subtract 25c. estimated general expense from 29.15c. book cost offered we reduce this cost 14.24 per cent.

From the books of the Spokane Gas and Fuel Company.

	Total fixed operation expenses as stated by gas company...........................			$135,698.06
(6)	Less 8.17 per cent of	$2,732.69		
(11)	" 8.17 per cent of	2,391.00		
(14)	" 8.17 per cent of	201.39		
	" 8.17 per cent of	5,325.08....	435.06	
(17)	Consumers premises and arc light ex.		10,393.57	
(24)	Commercial supt. and expenditures.		25,495.70	
(25)	Commercial office salaries.........		13,890.77	
(26) to (31)	Less 14.24% 56,306.19 gen. offi. exp.. Less Taxes 2,850.63	$53,555.56	7,626.31	57,841.41
	Expurgated fixed operating exp.............			$77,856.65
	or 193,109.7 1000 cu. ft. sales at 40.31c.			

From the books of the Spokane Gas and Fuel Company.

Total proportional operating expenses as stated by company			$108,132.62
Less 8.17% of 171,908.36	5,325.08	165,583.28	$13,528.15
(31) Less 14.24% of 2,850.63 taxes		405.93	13,934.08
Expurgated proportional operating expense			$94,198.54

193,109.7 1000 cu. ft. sales at 48.79c.
(Check) total operating cost 89.1c.

From the above it would appear probable that $71,775 had been unnecessarily spent in 1912 as follows:

For fixed operating expenses	$57,841.41
For proportional operating expenses	13,934.08
Total	$71,775.49

The proportion of this Company's present value investment ($939,726) required to supply annually 193,109,700 cu. ft. of gas at $3.0953 per 1,000 cu. ft. capacity is:

Used and useful investment	$597,732.45
And profit and depreciation (7 plus 3) 10 per cent	59,773.24

We will in this case regard gas as a commodity with a margin of 31c. on each unit rather than as a public service (until very small consumers are reached) and successively vary the annual sales starting with the proper regimen of the year 1912 after expurgation, of its accounts.

1912. Total Annual Sales in 1000 cu. ft., 193,109.7.

		Per 1000 cu. ft.
Fixed operating expenses	$77,853.65	40.31c.
Proportional operating expenses	94,198.54	48.79c.
Profit and depreciation	59,773.24	30.95c.
Total price	$231,828.43	$1.2005

Average gas sold 1912 per meter per month cu. ft., 1,906.

The above presents the proper practical conditions under which $1.20 per 1,000 cu. ft. gas should have been sold in 1912 at a fair and reasonable profit. Since the stepped rate is for the primary purpose of increasing the sales per meter under the existing regimen; for the purpose of fixing quantity rates we can assume with commercial adequacy that the total annual gas sales of works and the average monthly sales per meter vary in the same proportion for the stepped rate analysis until we reach about 500 cu. ft. per meter per month or about 6,000 annually per meter or about 50,658,000 cu. ft. total annual sales of works, after which a minimum monthly bill of 15c. per meter light is necessary to cover fixed cost only or 26c. to cover fixed cost, profit and depreciation per meter light.

This will be more fully explained hereafter in the paragraph on minimum charges.

1912. The Total of Variables for 193,109.7 1,000 cu. ft. sales is

		Per 1000 cu. ft.
Proportional operating expense	$94,198.54	48.79c.
Profit and depreciation	59,773.24	30.95c.
Gives total variable	$153,971.78	79.74c.

This varies with the load while the fixed operating expenses, $77,856.65, do not, if we sell gas as a commodity.

We can now vary the total annual sales of gas and obtain proper corresponding rates for it.

Total Annual Sales in 1,000 cu. ft. (assumed) 100,000.

		Per 1000 cu. ft.
Fixed operating expense	$77,856.65	77.86c.
Proportional operating expense, profit and depreciation	79,732.80	79.74c.
Total price	$157,589.45	$1.5760

Average gas sold per meter per month per cu. ft., 987.

For commercial purposes we may consider this to be about 1,000 cu. ft.

Total Annual Sales in 1,000 cu. ft. (assumed) 50,000.

		Per 1000 cu. ft.
Fixed operating expense	$77,856.65	155.71c.
Proportional operating expense, profit and depreciation	39,866.40	79.74c.
Total price	$108,723.05	23 .44c.

Average gas sold per meter per month cu. ft., 493.

Total Annual Sales in 1,000 cu. ft. (assumed) 200,000.

		Per 1000 cu. ft.
Fixed operating expense	$77,856.65	38.93c.
Proportional operating expense, profit and depreciation	159,465.60	79.73c.
Total price	$237,322.25	118.66c.

Average gas sold per meter per month, cu. ft., 1,974.

Total Annual Sales in 1,000 cu. ft. (assumed) 300,000.

		Per 1000 cu. ft.
Fixed operating expense	$77,856.65	25.95c.
Proportional operating expense, profit and depreciation	239,198.40	79.73c.
Total price	$317,055.05	105.68c.

Average gas sold per meter per month cu. ft., 2,961.

Total Annual Sales in 1,000 cu. ft. (assumed) 500,000.

		Per 1000 cu. ft.
Fixed operating expense	$77,856.65	15.57c.
Proportional operating expense, profit and depreciation	398,664.00	79.74c.
Total price	$476,520.65	95.31c.

Average sold per meter per month cu. ft., 4,935.

Total Annual Sales in 1,000 cu. ft. (assumed) 1,000,000.

		Per 1000 cu. ft.
Fixed operating expense	$77,856.65	7.79c.
Proportional operating expense, profit and depreciation	797,328.00	79.75c.
Total price	$875,184.65	87.54c.

Average gas sold per meter per month, cu. ft., 9,870.

The necessary assumption for a commodity rate is that with any given regimen (say of 1912) that its total annual sales are in direct proportion to each individual sale or average meter record for one month.

Diagram 2 graphically depicts this natural law of prices, by means of the commodity curve shown. This curve provides for a constant margin of profit and depreciation of 10 per cent on the necessary investment ($3.09 per 1,000 cu. ft. capacity) or 31 cents per 1,000 cu. ft. and also for the fixed and proportional operating expenses for each assumed rate of delivery to consumers.

So long as the regimen used does not change this commodity curve will give consistent prices.

Again I must call your attention to the fact that it is not a scientifically exact curve but may be used as commercially adequate and as our only means of computing rationally and practically approximate stepped rates.

Any point on this curve fixes the fair price per 1,000 cu. ft. for the total annual sales corresponding to it, provided the works are not over-built.

The area of the rectangle having this point for its upper right hand corner and the vertical and horizontal axis as sides is proportional to the total revenue or gross earnings of the plant.

This latter fact permits us to adjust the stepped rates so

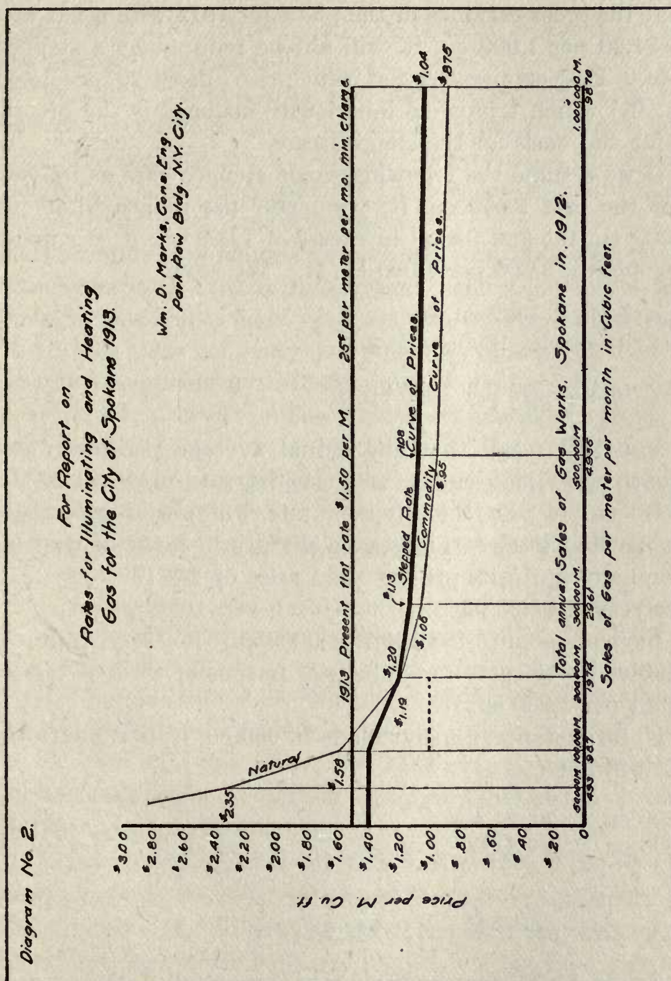


Diagram No 2.
For Report on
Rates for Illuminating and Heating
Gas for the City of Spokane 1913.
Wm. D. Marks, Cons. Eng.
Park Row Bldg. N.Y. City.
1913 Present flat rate $1.50 per M. 25¢ per meter per mo. min. charge.
Natural
Stepped Rate
Curve of Prices.
Commodity Curve of Prices.
Total annual Sales of Gas Works, Spokane in 1912.
Sales of Gas per meter per month in Cubic feet.
Price per M. Cu. ft.
$3.00
$2.80
$2.60
$2.40
$2.20
$2.00
$1.80
$1.60
$1.40
$1.20
$1.00
$.80
$.60
$.40
$.20
0
$2.35
$1.58
$1.19
$1.20
$1.06
$1.13
$.95
$1.08
$1.04
$.875
50,000M. 433
100,000M. 987
200,000M. 1974
300,000M. 2961
500,000M. 4936
1,000,000M. 9870

that the gross earnings of the plant for 1912 with a flat rate of $1.20 per 1,000 cu. ft. will not be reduced by a stepped rate. This expurgated flat rate price (of $1.20 per 1,000 cu. ft.) which I have so laboriously deduced is the pivotal point and basis for the stepped rate.

If we assume the following single stepped rate as follows: For the first 1,000 cu. ft. per meter per month $1.40 per 1,000 cu. ft., and for all in excess of 1,000 cu. ft. per meter per month, $1.00 per 1,000 cu. ft. We have

For the first 1000 cu. ft.	$1.40
For the second 1000 cu. ft.	1.00
For the average per 1000 cu. ft.	$1.20

You will recall that the actual average per meter per month was 1,906 cu. ft. and the flat rate price, $1.20 per 1,000 cu. ft. So this stepped rate will not commercially change the total earnings save slightly in favor of the Gas Company up to its present total sales of 193,109,700 cu. ft. per year at $1.20 flat.

Beyond about 193,109.7 1,000 cu. ft. total sales it enables lower rates for industrial purposes, without loss of profit per 1,000 cu. ft.

If, for instance, a meter reads 10,000 cu. ft. per month the bill will be:

1000 cu. ft. at $1.40	$1.40
9000 cu. ft. at $1.00	9.00
Total	$10.40

Average per 1000 cu. ft., $1.04.

Below $1.20 the stepped rate suggested for increased sales is a little higher than the natural commodity curve of prices. Diagram 2.

Probably the company will find it advantageous to offer a secondary rate much lower than $1.00 since we have found proportional expense, profits and depreciation to properly aggregate about 80c. and the fixed expenses really almost vanish with very large consumers.

The minimum charge for stepped rates should have our consideration. Although gas has been treated as a commodity yielding a fixed profit of 31c. on each 1,000 cu. ft. sold, still a gas company is a public servant particularly for patrons requiring a small amount of gas and they should pay for such service. The fixed operating expenditures are $77,856.65.

The meters reported in active operation, 8,443, averaging 5.065 lights, each.

The total number of lights is 42,764. We have

Yearly fixed cost per meter light..........	$1.82
Monthly fixed cost per meter light........	0.15

If we could superadd these meter light minimum charges to the straight meter gas bill the Gas Company could charge a flat rate of 79.73 (80c.) per 1,000 cu. ft. sales and still obtain its regular margin of 31c. per 1,000 cu. ft. covering profit and depreciation.

It is *very important to note this fact* for if the public knew how to be fair it would intelligently insist on this method of making rates, for all fixed expenses would be covered by 15c. per month per meter light and the price of gas be a matter of raw material and productive labor, with profits and depreciation added, thus providing them for enlargement of the works as it might be required.

Repeating, we would in this case only pay 15c. per meter light per month and 80c. per 1,000 cu. ft. flat rate.

Further the Gas Company would make a margin of 31c. on each 1,000 cu. ft. after defraying its proportional operating expense of 49c. per 1,000 cu. ft.

The obstinate hostility of the public to a fixed minimum charge for cost of service which in Spokane's case would average 5 lights at 15c. or 75c. per month per meter appears to require the stepped rate to conceal it.

In the deduced flat rate of $1.20 per 1,000 cu. ft. as also in the derived stepped rate you will see that the proper fixed expenses are covered and so there is no necessity of a meter charge of 15c. per meter light per month or 75c. average per meter per month to protect the Gas Company, but as I have said there always remains the uncertainty of a possible change of regimen requiring a margin and 25c. per meter per month now permitted allows a possible margin of not more than $25,329 per year for the Spokane Gas and Fuel Company to come and go upon, (8,443 meters in use).

I beg leave therefore to submit for your consideration as a step rate system of prices suitable for the city of Spokane and protecting its Gas Company.

First. A charge of 25c. per meter per month, as a minimum, but not to be charged if the actual gas bill at $1.40 net per 1,000 cu. ft. equals or exceeds it in amount.

Second. A gross rate of $1.50 per 1,000 cu. ft. for the first (1,000) one thousand cu. ft. per meter per month.

Third. A gross rate of $1.10 per 1,000 cu. ft. for all excess over (1,000) one thousand cu. ft. per meter per month.

Fourth. A deduction of (10) ten cents per 1,000 cu. ft. from all gas bills paid within (10) ten days after presentation which is to be made by the Spokane Gas and Fuel Company.

Referring back to tabulation of consumers and Diagram 2, we find:

Paying $1.40	3,216	consumers
Paying 1.20 or over	3,070	"
Paying 1.13 or over	1,057	"
Paying 1.08 or over	616	"
Paying 1.04 or over	356	"
Paying 1.00 or over	127	"
	8,442	"

This total obtained from the Public Service Commission varies slightly from the 8,443 obtained from the Gas Company but serves just as well to show that 6,286 consumers of 8,442 (8,443) will pay $1.20 or over per 1,000 cu. ft. under the stepped rate system submitted.

It is too obvious to again require emphasis that all large users of gas for commercial purposes will pay about $1.00 per 1,000 cu. ft., and that the Spokane Gas and Fuel Company may even find it advantageous to give as low as an 80c. rate in case of very great consumers.

SECTION 26.—FINANCES, SPOKANE GAS AND FUEL COMPANY.

Capital stock, preferred	$300,000.00
Capital stock, common	2,000,000.00
Bonds	1,345,000.00

Due 1944, 5 per cent interest.

SPOKANE GAS AND FUEL COMPANY, SPOKANE, WASH.

Incorporated November 15, 1909, under the laws of the State of Washington. Owns all the stock of the Union Gas Company, which owns all of the preferred stock and 992. per cent of the common stock of the Spokane Falls Gas Light Company. Operated by the Doherty Operating Company. Acquired on the Cities Service Company, September, 1910.

Franchise.—Dated June 14, 1904. Forty-one years.

Capital Stock.—Authorized and outstanding: Common, $2,000,000; 6 per cent preferred, $300,000. Total $2,300,-000. Preferred is cumulative after July 14, 1912. Shares $100. In September, 1910, the Cities Service Company acquired the entire common stock of this company, giving in exchange for each $100 of common stock, $15 of its own common and $30 of its preferred stock. Transfer agents Henry L. Doherty and Company, New York, N. Y.

Funded Debt.—$795,000. First and refunding mortgage, 5 per cent thirty-five year sinking fund bonds, dated December 1, 1909, due August, 1944; interest payable February 1, and August 1, at office of Henry L. Doherty and Company, New York. Trustee Central Trust Company, New York. Coupons, $1,000. Registerable as to principal. Redeemable on any interest date at 105 and interest. Sinking fund on all outstanding bonds, including prior lien, July each year; 1911–1916 ½ per cent of bonds; after July, 1916, 1 per cent of bonds until all bonds are redeemed. Secured on all property. Authorized: $5,000,000, of which a sufficient amount is reserved to retire prior liens at par.

Union Gas Company.

(Controlled by Stock Ownership)

Incorporated October 6, 1904, in Virginia. Owns 99 per cent of the stock of the Spokane Falls Gas Light Company. Franchise expires June 14, 1945.

Capital Stock.—Authorized and outstanding, $600,000 common and $300,000 6 per cent cumulative preferred; par $100. Dividends on preferred, payable semi-annually at office of N. W. Halsey and Company, New York, transfer agents. Entire stock is owned by Spokane Gas and Fuel Company.

Bonded Debt.—$550,000 First and Collateral Trust Gold 5s. dated July 1, 1905; due July 1, 1935; interest J & J. I. at N. W. Halsey and Company, New York. U. S. Mortgage and Trust Company, New York, and G. M. Cummings, Trustees. Coupon (principal may be registered), $1,000. Secured on all property and pledge of 1,486 shares of stock of Spokane Falls Gas Light Company. Sinking fund, 1 per cent of outstanding bonds from July, 1911 to 1916, and 2 per cent thereafter. Authorized, $1,000,000.

Spokane Falls Gas Light Company.

Controlled by stock ownership by the Union Gas Company. Stock issue $50,000 preferred and $200,000 common, of which all preferred and $99,400 of the common is outstanding. Transfer agents, Henry L. Doherty and Company. Franchise date, May 6, 1902, for forty-three years.

Cities Service Co., New York City.

Office, 60 Wall Street.

Capital stock, pref., auth., $30,000,000; issued $8,844,090; com., auth., $20,000,000; issued, $4,979,045; ann. div., pref., 6 per cent, com. 3 per cent.

Controls Through Ownership of Stock:

Brush Electric Light and Power Co. Galveston, Tex.
Denver Gas and Electric Co.
Empire District Electric Co.
Spokane Gas and Fuel Co.

Doher y Operating Co., New York City.

60 Wall Street.
Capital stock, auth., $100,000; issued, $55,000.

Companies Operated.

Bristol Gas and Electric Co., Bristol, Tenn.
Carthage Gas Co., Carthage, Mo.
Citizens' Gas, Electric and Heating Co., Mt. Vernon, Ill.
Denver Gas & Electric Light Co., Denver, Colo.
Pueblo Gas & Fuel Co., Pueblo, Colo.
Spokane Gas & Fuel Co., Spokane, Wash.
Lincoln Gas & Electric Light Co., Lincoln, Neb.
Lebanon Gas & Fuel Co., Lebanon, Pa.
Knoxville Gas Co., Knoxville, Tenn.
Meridian Light & Ry. Co., Meridian, Miss.
Montgomery Light & Power Co., Montgomery, Ala.
Fremont Gas & Electric Co., Fremont, Neb.
Webb City and Carterville Gas Co., Webb City, Mo.
Trumbull Public Service Co., Warren, O.
Hattisburg Traction Co., Hattisburg, Miss.

Only Electrical Properties.

Empire District Electric Co., Joplin, Mo.
Spring River Power Co., Galena, Kan.

Massillon Electric & Gas Co., Massillon, O.
Massillon Electric & Gas Co., Navarre, O.
Cumberland and Westernport Electric Railway Co., Cumberland, Md.
Summit Co. Power Co., Dillon, Colo.
Brush Electric Light and Power Co., Galveston, Tex.

The apparent original structural cost of these Spokane gas works is about $1,000,000 and their present value a little over $939,000.

Section 27.—Increased Sales Due to Lowered Price of Gas.

Although very large sums of money are reported to have been spent in securing new business, probably through the agency of some of this company's allied organizations, there has been no increase of gas sales for 1912 over 1911.

In the writer's opinion, this is due to the fact that the solicitation of new business was not accompanied by a reduction in the price of gas. It is a fact universally acknowledged, and which can be proved that the public immediately respond to any reduction made in the price of gas and this price of gas is the controlling factor in fixing its sales *per capita.*

So, assuming the population of Spokane to be about 100,000 people, the sales per capita for the year 1912 were about 2,000 cu. ft.

In the state of Massachusetts we have a large number of gas companies operating in cities under practically identical conditions as to cost of production, labor and raw material. Taking the facts of these gas companies for the year 1907

(See Chapter XV Gas Sales per Capita) we have the following average results:

Price $2.00, sales per capita, 722 cu. ft.
Price $1.75, sales per capita, 898 cu. ft.
Price $1.50, sales per capita, 1395 cu. ft.
Price $1.25, sales per capita, 2535 cu ft.
P ice $1.00, sales per capita, 3824 cu. ft.

In the state of Massachusetts for cities over 75,000 population, excluding Boston, but including eight cities with prices ranging from 98c. to 84c. per thousand cu. ft., the average annual sales per capita is 4,330 cu. ft. and the average increase in sales per capita for one cent decrease or reduction in price appears to be about 40 cu. ft. As the average flat rate obtained for Spokane is $1.20 per thousand, this would mean a reduction of 30c. in each thousand and an increase in sales per capita of 1,200 cu. ft. annually. If we multiply this 1,200 by 100,000, we have 120,000,000 cu. ft. as the probable increase under ordinary conditions in the annual sales of the Spokane Gas Company if it reduced its price to $1.20. If we add this 120,000,000 cu. ft. to the 193,000,000 cu. ft. of 1912, we would obtain for 1914 sales 313,000,000 cu. ft. and the practical exhaustion of the full capacity of the present works, which at present prices are over-built.

Section 28.—Qualities of Gas Required.

Of late years the use of gas for illumination, save by means of incandescent or Welsbach burner, has very much decreased so that at present perhaps 10 per cent of the gas sold only is burned in open fish tail or bat's wings burners. The remainder of the gas sold is used principally for cooking, heating, welding and power, and its price must be such that it can be purchased as a commodity and not as a luxury. Under this condition, largely affected by the price of other fuel in any locality, the sales of gas increase with amazing rapidity when this gas is offered at reasonable rates, and of fairly good quality. As a matter of fact, the illuminating value of artificial gas is getting less and less important in the eyes of consumers, for those desiring a brilliant illumination can avail themselves of electricity, but the heating power of gas is becoming of greater importance than it ever has been before; and where natural gas with a heating value of 1,000 British Thermal Units is not available, artificial gas should have a heating value of something over 600 B. T. U. For the same reason the pressure at which gas is furnished has been steadily raised to facilitate its use in gas stoves and meters and in incandescent burners until now the pressure insisted upon in most cities as at the level of the distributing gas holder, is a maximum pressure of four inches and a minimum pressure of 2 inches water column; and for each 100 feet rise above the level of the holder ½ inch to 1 inch is added to the limits of pressure at the holder.

In Minneapolis its recent franchise prescribed 18 candle power for the gas and an average thermal value of 600 B.T.U. with a reduction from the monthly bills proportionate to any deficiency of heating power in the gas below 600 B. T. U. and a fine if at any time gas falls below 550 B. T. U. per cu. ft.

Section 29.—The London Sliding Scale for Gas.

See Chapter XVI.

The Utopian miracle of the universal prosperity of gas companies in England, of companies paying ten to fifteen per cent dividends on first issues of stock, or proportionate dividends on those stocks after conversion into lower dividend stocks, the fact that the contented consumers of these companies receive and pay for gas at prices ranging from 48c. (South Metropolitan) and upwards, and in some few cases below this price, appears to have been wrought by the sliding scale. Further, the remaining companies not having the sliding scale appear to have been led by example to the greater economies set before them by those companies operating under the sliding scale.

As a matter of fact, about two-thirds of all the capital invested in English Gas Works is subject to the sliding scale.

Before taking up the mathematical discussion of the London sliding scale, it should be understood that the English method of issuing capital stock differs widely from our American methods, or lack of methods. In England, gas corporations make separate, successive issues of stock, each issue bearing a separate fixed dividend. Further, watering stocks or issuing stocks which have not back of them their actual value in fixed investment is impossible in England, save as happened to be the case in some English companies of London where the amount of an old issue of stock has, by permission of the Parliamentary Committee, been doubled because of the excessive profits resulting from the sliding scale and the fact that the price of these stocks did not rise pro rata.

In permitting this doubling of the amounts in certain issues of stock, the Parliamentary Committee were careful to specify that in case of condemnation by the municipality no account should be taken of the additional stock, and no increase in the value of the plant be argued from it.

In England it is the practice to closely and immediately divide up all profits in dividends, and to make and to sell by public auction such new issues of stock as may be required for the extension or addition to the working plant, whenever they may be needed. From a usually small initial issue of capital stock at 10 per cent, or under the sliding scale, the rates of interest on the subsequent issues of the stock of a going company are reduced to fixed dividends of 7, 5, 4, or even 3½ per cent as capital is required for expansion of business.

Further, the public auction sales of these stocks usually result in cash premiums, and these premiums must be used on the plant to increase the capacity of the works, and thereby increase the value of the works beyond the total face value of the securities issued, without increasing the requirements for dividends.

No established general plan of the sliding scale is stated by the English, and oddly enough the only explanation given is that it means an indefinite division of extra profits between the company and its consumers, the company receiving an increase of its dividend and the consumer a reduction in the price of gas.

Each time that the price of gas is lowered below a standard price the dividend is increased above a standard rate of dividend, corresponding to this price. For a 10 per cent standard dividend each penny (two cents) reduction in the price of gas gives the company the right to increase the dividend one-fourth of one per cent; that is to say, using American money terms, each one cent in the reduction of the price of gas allows an increase of dividend of one-eight of one per cent. There are a great many variations from this older arrangement in England, but perhaps the widest variation known is to be found in Boston, Massachusetts, when, after many years of competition and duplication of plants and of litigation and dispute, it was finally decided to, if possible, adopt the London sliding scale in Boston as the solution of their apparently interminable arguments as to the fair price for gas.

Representatives of both the city and of the gas companies were sent abroad to investigate the operation of the London sliding scale.

The Massachusetts Gas and Electric Light Commission had the matter of this adjustment of the Boston Gas Companies taken out of their hands by legislation.

The gas companies retaining a number of experts had their various gas works appraised and brought in a valuation of some $25,000,000. The way in which this appraisement was made would be very closely imitated if one were to appraise a scrap heap of old machinery at the price of the new machines which had been worn out and thrown into it.

Although then in the employ of the City of New York I was requested (and furnished with the documents) to investigate the results in Boston. After carefully going through all of the figures, and visiting Boston and the works, I placed the present value of all the Boston gas works in 1905, so far as they were used and useful, at about $9,000,000.

In the meantime the dispute as to the values and as to prices amongst the various companies in Boston resulted in attempts at special legislation in the Massachusetts Legislature from all sides of the parties in dispute, and then it is said the Governor of the State sent word that he would veto every bill introduced in the Legislature until all parties should agree upon a valuation of the gas works.

Finally, these parties being thus blocked in their attempts to over-reach each other, agreed upon a valuation of about $15,000,000 all of which was to be in capital stock of the Boston Consolidated Gas Company.

At that time the annual sales of the various gas companies in Boston amounted to 3,000,000,000 cu. ft. and this meant a capitalization of $5.00 for each 1,000 cu. ft. annual sales, which appears too high.

At that time the price of gas in Boston was $1.00, but the arbitrators agreed upon 90c. per 1000 cu. ft. as a standard price for gas, and upon 7 per cent as the standard rate of dividend.

Further, they agreed that for each five cents reduction in the price of 1,000 cu. ft. of gas, the Boston Consolidated Gas Company should be allowed to increase its dividends by one per cent above seven per cent.

The result of these negotiations was that in 1912 the price of gas in Boston was fixed by the Company at 80c. and the dividend of the Boston Consolidated Gas Company was 9 per cent.

In England, as the result of entire and pitiless publicity and of vigilant regulation, the first issues of securities are always not more than equal to and often less than the actual investment in the plant.

In Spokane we have a gas works whose original structural cost was about $1,000,000 upon which the gas company has placed $1,345,000 in 5 per cent bonds, $300,000 of 6 per cent preferred stock and $2,000,000 of common stock, or a total of $3,645,000 securities against a present value of about $939,000.

In England the dividend was further increased 1 per cent for each 8c. reduction in the price of gas, and in Boston the dividend was increased 1 per cent for each 5c. reduction in the price of gas.

With the capitalization of the Spokane Gas and Fuel Company as it is, it appears to be quite impossible to accept it as a basis for computations.

In the present state of the capitalization of the company and until the operating expenses of this company and the prices paid for raw material and productive labor have become more stable, it appears to be impracticable to safely consider the establishment of a sliding scale.

I do not wish to be understood as saying that a sliding scale is impracticable, but to be understood as saying that it would require great changes in this company's capitalization as well as a far more elaborate consideration of the factors involved in the production of gas.

SECTION 30.—RECAPITULATION.

The present value of the works of the Spokane Gas and Fuel Company and its controlled companies appears to be $939,726. Its used and useful investment required for 193,109,700 cu. ft. 1912 annual sales is $597,732.

It is almost certain that with the price of gas at $1.20 per 1,000 cu. ft. flat or with the stepped rates of $1.40 and $1.00 the total annual sales will increase to 300,000,000 cu. ft. within a year or eighteen (18) months and its present value of $939,726 be required and used.

The capacity of the almost idle Lowe Carburetted Water

Gas set is nearly sufficient to take care of the present demands upon this company. With oil at 4½c. or perhaps less, the cost of oil per 1,000 cu. ft. of water gas would be about 20c. as against 56.62 less 30.8c. residuals, or 25.8c. net for coal per 1,000 cu. ft. for coal gas with less labor required per 1,000 cu. ft. manufactured. A probable saving of 5c. per 1,000 cu. ft. from water gas.

The fact that only 21,520 lineal feet of a total of 666,824 feet of street mains is cast iron pipe will very greatly increase the loss by depreciation and repairs of the street mains which for cast iron mains is nearly nothing and for wrought iron mains which are used in Spokane for all the rest of this system, is 6 or 7 per cent annually.

The use of compressors for the gas renders its distribution more costly by just the expense of compressing it.

By a proper level of location for the gas works it would appear to have been possible to avoid much cost for pumping.

Perhaps very good excuses might be given for some of these defects in engineering construction but there can be no excuse for the relatively enormous expenditures of 1912 in soliciting new business and at the same time keeping the price of gas at $1.50 net per thousand.

All experience proves that the price of gas is the controlling factor in its sales, and that reducing the price of gas is the first requisite in increasing its sales per capita or what is the same thing increasing the total annual sales in a city with fixed population.

The regimen of a gas works, meaning by that the status of the costs of raw material and productive labor, the total sales and the relations of fixed and proportional operating expenses to each other vary so greatly with the intelligence of the management that it is not fair either to the Gas Company or to the public to fix prices for any considerable period of time ahead.

I have passed over the item of working capital without comment merely fixing it at $25,000; since the items, meters in stock and gas arc lights which generally are included in it are by the Washington Public Service Commission Engineers included in their appraisement of assets $25,000 is more than ample to cover 30 days' requirements of coal, gas oil, payroll, petty cash, etc.

The consumers' deposits of cash not mentioned here frequently cover a considerable part of the free cash working capital used in public service corporations.

In gas monopolies doing a cash business, there is never any lack of credit if it is required by a reputable management.

If a franchise has any capitalization value the City should receive it from the Company in its securities.

In the case of older cities some allowance must be made for street pavements lifted and replaced, if it can be shown that this has been done in laying new mains, but in so new a city as Spokane, the great bulk of the mains are down before the City at its own expense lays pavements on the streets, over them.

In case of repairs the cost of lifting and replacing pavements very properly goes into operating expense and so to the cost of gas at the consumer's meter.

The City's pavements act as a barrier to possible competition with the present Gas Company by increasing the future cost of laying street mains; but as a gas company does not own its ditch or any specified portion of a street, merely having an easement in it, whose locality can be changed by order of the City's officials, it does not appear reasonable or legal for it to claim any property right in pavements not paid for by the Gas Company.

The cost of lifting and replacing pavements in Spokane can well be omitted as inconsiderable and probably is more than covered by the liberal prices for street main work fixed by the engineers of the Washington Public Service Commission.

In the present case until the tangled capitalization of the Spokane Gas and Fuel Company is uprooted and a simpler form of capitalization nearer the true present value of the plant is substituted it will be very difficult to apply the principle of the London Sliding Scale equitably to Spokane.

The stepped rate system appears to be free from the present objections to the London Sliding Scale, and to offer a more equitable range of prices to consumers than the flat rate does and to encourage manufacture by lower rates.

Very respectfully,

(Signed) WILLIAM D. MARKS,

Consulting Engineer.

To Hon C. M. Fassett,

Commissioner of Public Utilities,

Spokane, Washington.

CHAPTER III.

RECAPITULATION OF

REPORT UPON THE FAIR AND REASONABLE PRICE OF A 6.6 AMPERE MAGNETITE ARC LIGHT PER YEAR.

Through the courtesy of Messrs. Stone and Webster and their consulting engineers an appraisement in detail by the City of Minneapolis was not necessary, and only a verification in gross was made of the appraisement offered.

From this appraisement and the operating expenses of the General Electric Company for 1910 the natural law of even profit prices was deduced and graphically shown in Diagram 1, as the "even profit curve of prices."

The most interesting point developed is that owing to the small amount of the variable expense the flat monthly maximum use rate per K. W. installed from 0 hours to 12 hours per day increased only from $2.84 to $3.40. Without any steam plant it would have been constant regardless of hours of use.

Water power plants with excess power could therefore profitably omit K.W. hour meters and base their uniform rates on the K.W. capacity of a consumer's installation.

No assistance was required in this report; it occupied 33 days and cost about 2,300, and saved the City over $27,000 for the first year.

The Minneapolis General Electric Company acceded to the $65 rate deduced and after one year's test offered to accept $62.50 per year for an increased number of street arc lights of the same kind.

TABLE OF CONTENTS

REPORT UPON THE PRICE OF 6.6 MAGNETITE ARC LIGHTS.

MINNEAPOLIS, Dec. 2, 1911.

Report Upon the Fair and Reasonable Price of a 6.6 Ampere Magnetite Street Arc Light per Year Under the Conditions Existing in the City of Minneapolis, Minnesota, by Wm. D. Marks, Consulting Engineer, Park Row Building, New York City.

Section 1. *Object of this Report.*—The object of this report is to determine the fair and reasonable price, or prices, to be paid by the City of Minneapolis for 6.6 ampere magnetite arc lights furnished, erected and operated in the streets of the city.

Sec. 2. *General Conditions.*—The question of the proper price to be charged for a street arc light of the character above stated admits of several methods of treatment and solution, but it is obvious, as in all other matters, there is one way which is right and which should be preferred, and there is an indefinitely great number of ways which are wrong, approximating more or less nearly to the one right method.

In addition to the selection of the proper and judicially fair method of solving this problem, it is important that the exact facts, so far as they can be determined from practical operation of the plant in any locality, shall be the basis of this proper method.

In the present case we have not an electric station generating electricity solely for the purpose of furnishing street arc lights and excluding all other forms of electric service, but we have, on the contrary, a station endeavoring to furnish electric service in all its forms, such as incandescent, house and street lighting, motive power service from as large a unit as 2,500 H.P. down to a motor of only a fraction of a H.P. and also street arc lighting such as is proposed above.

Besides the complication of this multifarious service, the Minneapolis General Electric Company has had as its sources of power the Hydro-Electric Station upon the St. Croix river, 40 miles away, and conveying electricity to Minneapolis by means of a pair of high tension lines, and as a further source of power in emergencies it had a local steam plant within the limits of the city of Minneapolis of 6,000 to 7,000 K.W. capacity in 1910.

There is no doubt of the necessity of this supplemental steam capacity, since, during the present month, a sudden Arctic gale and a freezing temperature coming together, caused an almost complete cessation of the flow of the Mississippi river at Minneapolis, and also very largely diminished the flow of the St. Croix river at Taylors Falls.

While such a vagary as this will not cause great inconvenience to a factory or a mill which can shut down for a day or two without great loss, it is fatal to the usefulness of an electric lighting plant, which must be prepared at every instant to generate and to deliver whatever electricity may be demanded by its consumers.

When considering the fixing of prices to be charged for each of the different departments into which the sales of the electric supply is divided in a public service corporation supplying all forms of electricity required by the city, it is necessary to at once recognize and accept the fact that the method of averages is the only one which can be used.

Following naturally along the process of manufacture we realize that the generating station supplies and distributes a great pool or store of electricity which is drawn upon as from a common fund, for the purpose of incandescent lighting, motive power, street lighting or heating, and it is perfectly natural to assume that the average cost of this electricity is the same to all consumers and that motive power requiring only its admission to the motor will be dealt with fairly if only charged the profitable price at which electricity can be furnished from the common fund. (See diagram.)

On the other hand, incandescent lighting requires incandescent lamps, and to the cost of the power current should be added the cost of the incandescent lamps used.

In the same way for arc lighting, to the cost of the power current should be added such extras as the special operating labor, carbons or electrodes and the maintenance of the same.

Thus it appears as if in order to get the proper price for street arc lighting, we should obtain the cost of the power current per K.W. hour, in which should be included the average cost due to the residual depreciation of the plant after all repairs are made as well as is possible. When this cost per K.W. hour of the common store of electricity is obtained, it should then have added to it such extras as arise from the peculiarities of the street arc lighting, and also a fair and reasonable profit upon the investment required for arc lighting.

In distributing electricity for all purposes, it is obvious that poles and underground conduits thus used can conveniently be used in part also for the street arc lighting system, and therefore somewhat reduce the cost of the investment required to erect the arc lamps wherever they may be desired.

The officials of the Minneapolis General Electric Company have furnished me, upon request, such data as I have asked from their books of account, and also such physical data regarding the operation of the plant as I have requested.

In addition to this, they have placed in my hands a most elaborate and exhaustive report made by the Messrs. Jackson, consulting engineers of Chicago, which I am told has occupied their time and that of a dozen assistants for a couple of months or more, and further that they have been furnished by this company's employes with all of the data as to cost, both for machinery and plant and operation, to any extent which they may require.

Upon examining this report, I have found myself obliged to differ from it, more particularly as to methods.

It is proper for me to say that, judging from the internal evidence, the work of appraisement done by the Messrs. Jackson has been most conscientiously and thoroughly carried out in the minutest detail, and results in a valuation per street arc light from which I do not largely differ, but when it comes to estimating the cost of the current, these engineers have accepted and used a contract said to exist between the Taylors Falls plant and the City of Minneapolis plant, which fixes the price of all power delivered at Station "A" in Minneapolis at $18 per ampere capacity demanded, and also 0.4 cent per K.W. hour measured.

Taking the figures of 1910, this raises the basic cost of current to the City of Minneapolis plant from about $55,000 to nearly $400,000 for the variable cost of current rising and falling with the amount of current delivered.

The operating expenses for the year 1910 furnished to me by the Minneapolis General Electric Company included the operating expenses both at Taylors Falls and in the City of Minneapolis, and I have therefore been able to give you the underlying facts as to the cost of current, regardless of the interposition of this artificial method by contract of raising the apparent cost of current to the Minneapolis plant.

Returning now to the question of averages, I would say that when we contemplate a detailed investigation of each department of an electric company it will at once be recognized that the detail of real estate, buildings, machinery and of the ducts, poles, wires and multifarious operatives of a distribution plant of such a company is almost too intricate to admit of analysis by the human mind. Carried to the extreme of analysis, we at once recognize the fact that each light, each motor would, under such conditions, have its separate rating as to cost and price of electricity. For this reason, in commercial practice it is necessary by some method to use averages of the cost, and the question to be decided is, *at what point must the segregation of departments cease and averages be used in fairness alike to both the company and the consumer of electricity?*

Recognizing the practical futility of such an attempt to segregate the investments in plant or each department, or, except in a general way for any one department, I have computed the complete cost of electricity in the common pool or fund and, taking so much of it as is required for each department at the average price resulting, have, by a careful consideration of the actual extras resulting from the peculiar demands of arc lighting, endeavored to fix a fair and reasonable price for a single arc light for one year.

With 8 per cent profit on the actual investment, this price appears to be $65.68, with a lump profit of $21.16 on each arc, as will presently be shown. The actual cost of this light without any profit at all appears to be $44.52; and if we allow a profit on the current only, the price appears to be $53.98, with a profit on each light of $9.46.

As may be inferred from what goes before, it will be found that, according to the point of view taken and the method pursued, a number of different prices will result for the arc lights (or for that matter for any other form of lighting), and the price to be fixed upon for any given arc light must be that in which the method used in reaching it appears to be the nearest to a judicially fair and reasonable return upon the investment, which in this case happens to have been fixed by the committee of City Councils at 8 per cent.

SEC. 3. *Financial Condition of the Minneapolis General Electric Company.*—This company has been claiming a rate of $84 per arc light, but the city has fixed the rate till within a short time at $70 per street arc light and has paid this rpice, the company receipting for it on account.

Recently this $70 price has, by action of the City Council, been reduced to $65 for each 6.6 ampere magnetite arc light.

To make a thorough and exact appraisement of the property of this company would require a dozen employes and three to six months' time.

To make a thorough audit of the books and accounts of this company, verify check stubs and vouchers, would require an equal number of accountants and length of time, at the very least, and cost many thousands of dollars.

In making an estimate of the present value of these plants, I have been guided by such information as to costs in a general way as I have gathered elsewhere in my professional labors, and I have accepted for the year 1910 the structural cost of the Taylors Falls plant to Station "A" at $3,000,000, and I have also estimated by analogy the present value (1910) of the city plant within the limits of Minneapolis, at about $3,500,000. The total valuation, then, amounts to $6,500,000 present value (1910).

In my work I have not made use of any of the figures for 1911, but should add that since the fire of January 6, 1911, this company has completed a steam station known as the Riverside Station, having 12-thousand K.W. nominal capacity, and has rebuilt its Main Street Station, burned down, as a central distributing station.

Both of these stations are up to the most advanced state of the art of generating and manipulating electricity, and place the company in a much better position than it was before the fire occurred.

The organization of the company and its business management appear to be good, but the most important factor in its future financial prospects is the irresistible tide of growth of wealth and of progress in manufacturing setting in upon Minneapolis, which renders it only necessary that this company shall avail itself of its opportunities to render it immensely valuable and profitable to its owners.

The best method of placing before you the views of these owners is an open letter from Messrs. Stone & Webster, dated October 2, 1911, which is subjoined.

"Dear Sirs: We submit the following particulars regarding the $1,000,000 first mortgage, 30-year, 5 per cent gold bonds, due December 1, 1934, of the Minneapolis General Electric Company, which you have purchased, and of the company's condition.

Organization.

"The Minneapolis General Electric Company is organized under the laws of the State of New Jersey, and does the entire electric lighting and power business in the City of Minneapolis, Minnesota. It also does the lighting and power business in several smaller towns adjacent to Minneapolis. It owns all of the bonds and stock of the companies which have developed the water power on the St. Croix river to the extent of 20,000 H.P., with an ultimate development of 25,000 H.P.

Capitalization.

	Authorized	Issued
Stocks: Common stock (paying dividends quarterly) at the rate of 7 per cent per annum..............................	$3,375,000	$3,375,000
Preferred stock (6 per cent cumulative)..	1,000,000	1,000,000
Bonds: of First mortgage, 30-year, gold bonds due Dec. 1, 1934, callable at 110 and interest on any interest day......	8,000,000	*6,747,000

*Including the bonds sold to you.

"Sinking Fund: 1 per cent per annum of bonds issued, payable April 1, and waivable until 1912.

"Note: The issued bonds bear interest at the rate of 5 per cent per annum, but the authorized and unissued bonds may bear interest, at a lower rate, as determined by the Board of Directors.

"The bonds are dated December 1, 1904, are due December 1, 1934. Interest is payable June 1 and December 1, at the office of the Old Colony Trust Company, Boston, Trustee.

"The unissued bonds are reserved in the hands of the trustees and can be issued only for permanent additions and improvements at not exceeding 80 per cent of the cash cost of such additions and improvements.

"Of the above common stock, $2,875,000 has been issued within the past two years, all at par, $100 per share.

Security.

"These bonds are secured by a first mortgage upon all the property, rights and franchises now owned, and which may hereafter be acquired, by the Minneapolis General Electric Company in the City of Minneapolis, Minnesota. This property comprises a complete electric lighting and power system, entirely covering the city, the power being generated both by steam and water. The distribution system is very complete, the sub-stations being of ample capacity and all of the wires in the principal business portions of the city being underground. Through the ownership of all of the stock and bonds of the St. Croix Falls (Minnesota) Improvement Company, which securities are held by the Old Colony Trust Company, as trustee, these bonds are practically a first mortgage on the water power at St. Croix Falls on the St. Croix river already developed by these two companies to the extent of 20,000 H.P., the ultimate development being more than 25,000 H.P.

"The power generated at St. Croix Falls is conveyed to Minneapolis, a distance of about 40 miles, by a duplicate transmission line or private right of way 60 feet in width, also owned by the above mentioned company.

"The cost of completing this development will be only for water wheels and electrical apparatus, the hydraulic construction being already finished.

"The steam station in the City of Minneapolis was destroyed by fire in January, 1911. A new station has been built on a new site, two miles distant from the center of the city, well located on the bank of the Mississippi river and served directly by a railway connection. The land selected is of ample size for all future requirements. A thoroughly modern steam station of 16,000 H.P. capacity has been completed and is now in operation, at a cost of approximately $1,000,000, the transmission lines from this station to the center of distribution being entirely underground. The high efficiency expected of this station will undoubtedly serve to improve the company's earnings.

"In addition to the water power at St. Croix Falls and the steam station above referred to, the company owns a second water power station in Minneapolis at St. Anthony's Falls, having a capacity of more than 1,000 H.P., and also owns a small station of a capacity of 800 H.P., in connection with one of its sub-stations in the center of the city. A storage reservoir on the St. Croix river above Taylors Falls is also owned by the company.

EARNINGS.

Gross earnings for years ending December 31:

1897	$253,013.23	1906	$805,632.46
1899	284,053.87	1907	920,606.53
1901	405,634.03	1908	1,008,415.35
1903	558,044.64	1909	1,108,756.36
1905	724,581.91	1910	1,276,041.02

INCOME ACCOUNT.

	Report for 12 Months Ending July 31, 1911	July 31, 1910	Increase
Gross earnings...........	$1,384,888.47	$1,191,341.87	$193,546.60
Operating expenses (including taxes).............	639,897.24	557,642.12	82,255.12
Net earnings.........	$744,991.23	$633,699.75	$111,291.48
Interest charges..........	300,046.19	290,107.66	9,938.53
Balance.............	$444,945.04	$343,592.09	$101,352.95
Bond sinking fund........	21,153.33	....	21,153.33
	$423,791.71	$343,592.09	$80,199.62

"As seen, the company's earnings have increased rapidly. At the present time more than 30 per cent of the gross earnings are from commercial power, and this proportion is rapidly increasing. The city lighting represents less than 10 per cent of the company's gross earnings. During the past year a number of large contracts for wholesale power have been made, the largest being with the City of Minneapolis for pumping purposes. For this more than 2,500 H.P. will be used.

DIVIDENDS.

"The company has paid dividends of 6 per cent per annum on its preferred stock continuously since August 1, 1899, and has paid dividends on its common stock of 4 per cent from February 1, 1906, to August 1, 1909, and of 6 per cent to May 1, 1910, and since that date dividends have been paid at the rate of 7 per cent per annum.

FRANCHISES.

"The franchises owned by the company were originally granted to separate companies which were afterwards consolidated to form the present company. In addition, the company owns a great many permits granted directly to it by the city from time to time, covering extensions of its lines. These franchises, under which the company has operated satisfactorily since its organization in 1899, have been the subject of negotiations between the city and the company, with the view of substituting a general franchise, limited in duration, in place of the several existing franchises. This franchise situation you are entirely familiar with.

The City of Minneapolis.

"Minneapolis, the largest city of the Northwest, is located at St. Anthony's Falls on the Mississippi river. It is the center of a rich agricultural district and the natural gateway for the products of the western portion of Wisconsin, all of Minnesota, North Dakota, the eastern half of South Dakota, and Northern Iowa. The advantage afforded by the Falls of St. Anthony and the excellent transportation facilities have been the great factors in the industrial development of Minneapolis.

"Minneapolis is the largest flour manufacturing city and grain market in the world. Many other industries are located in the city, including the manufacture of agricultural implements, machinery, carriages, wagons, furniture and shoes.

Railroads.

"The transportation facilities are excellent, the city being served by ten trunk lines: Chicago, Milwaukee & St. Paul;

Chicago & Northwestern; Minneapolis & St. Louis; Wisconsin Central; Great Northern; Northern Pacific; Chicago & Great Western; Chicago, Burlington & Quincy; Minneapolis, St. Paul & Sault Ste. Marie, and the Chicago, Rock Island & Pacific. Six of these railroads have terminals in the city.

POPULATION.

Year	Rank	Population	Per Cent
1880 census	37	46,887	...
1890 census............	17	164,738	252
1900 census............	19	202,718	24
1910..................	..	301,408	50

LEGALITY.

"The legal status of the affairs of the Minneapolis General Electric Company, and the validity of the issues of its securities, have been examined by the Messrs. Tyler & Young, attorneys, of Boston.

Very truly yours,

"STONE & WEBSTER."

SEC. 4. *The Cost of Electric Power.*—For the reason that the fire of 1911 not only inflicted considerable damage (largely covered by insurance) upon the company, but also, as in the case of all fires, added to this visible damage a considerable amount of consequential damage, felt principally in the cost of operation, I have chosen to take the operating expenses for the year 1910, as furnished by this company, as the basis of my investigation of the cost of current.

The Minneapolis General Electric Co.

Expenses for Year of 1910

Power plant wages (fixed)	$33,530.91
Fuel for power (variable)	33,947.99
Water for power (variable)	388.00
Lubricants and waste (variable)	1,861.54
Miscellaneous supplies and expenses (fixed)	2,846.99
Hired power from St. Anthony Falls (variable)	18,313.80
Total operating	$90,889.23
Boilers (fixed)	$139.83
Engines (fixed)	294.32
Electric plant (fixed)	2,571.79
Miscellaneous station equipment (fixed)	2,134.50
Buildings and fixtures (fixed)	1,497.26
Dams, canals and tail races (fixed)	886.95
Gates, wheels and governors (fixed)	1,450.98
Total maintenance	$8,975.63
Total cost of manufacture	99,864.86
Automobiles (fixed)	$4,532.27
Operating arc lamps (omitted)	34,192.16
Operating meters (fixed)	12,058.90
Renewal of incandescent lamps (omitted)	25,470.84
Operating sub-stations (fixed)	8,870.28
Miscellaneous distribution of operating expenses (fixed)	6,450.87
Total operating	$91,575.32
Underground system (fixed)	$4,968.07
Overhead system (fixed)	36,102.27
Arc lamps (omitted)	6,273.12
Meters (fixed)	7,854.94
Forward,	$55,198.40

Brought Forward,	$55,198.40
Customers' repairs and renewals (fixed)......	32,076.47
Sub-stations (fixed)........................	12,744.07
Total maintenance........................	$100,018.94
Total cost of distribution..............	191,594.26
Salaries of general officers (fixed)...........	$42,217.61
Salaries of clerks (fixed)....................	26,148.09
Printing and stationery (fixed)..............	8,385.51
Storeroom expenses (fixed).................	4,508.85
Miscellaneous general expenses and office sundries (fixed)..........................	32,511.06
Legal expenses (fixed)....................	6,954.30
Rent of offices (fixed)....................	7,410.49
Insurance (fixed).........................	8,430.40
Logging expense (fixed)....................	9,361.81
Advertising, canvassing and soliciting (fixed)..	55,259.44
Total general expenses of Light and Power Dept..............................	$201,187.56
Total all expenses.......................	492,646.68
K.W.H. generated and purchased..........	40,277,269
K.W. hours sold.........................	29,177,126

The year 1910 will give us a more nearly uniform regimen and approximate more closely to fair costs than 1911 or any part of it.

Referring to the operating expenses given above as they happen to come from the books of the company, I would call your attention to the fact that they are divided into two classes. The first, or variable class, are those expenses which rise and fall with the increase and decrease of the commodity (electricity) delivered. The second class is the fixed operating expenses, which take upon themselves the nature of a service rendered each day by the staff of employes and by the investment of the corporation.

Upon reflection it will be understood at once that no matter whether the amount of electricity delivered in any day is great or small, the staff of employes are there drawing their pay and the investment is requiring allowances for profit and for depreciation.

It will at once be perceived that it makes no difference in this fixed operating expense for the day whether the station be loaded to its full capacity the whole day or whether it be almost idle, the investment is there and the staff of employes is there. With the increase or the decrease of the load only the variable expenses rise or fall.

In steam stations these variable expenses are the fuel, the oil and waste, water for steam, if it is bought, and, should there be a tax upon the gross earnings, this tax.

In the hydro-electric station operated wholly by water it may almost be said that the variable expenses do not exist, provided there is always water enough to carry the load and no supplementary steam station is required for any reason.

For the reasons stated above, it is at once apparent that so far as the source of electric power is concerned, the Minneapolis General Electric Company is the possessor of a mixed steam and water station. I have therefore rearranged and divided the operating expenses for the year 1910 as subjoined.

29,177,126 K.W. hours sold.

MINNEAPOLIS GENERAL ELECTRIC COMPANY.

Annual Expenses.

Expenses variable with power sales:		
Fuel for power	$33,947.99	
Water for power	388.00	
Lubricants and waste	1,861.54	
Hired power	18,313.80	
		$54,511.33
Expenses temporarily fixed:		
Power plant wages	$33,530.91	
Miscellaneous supplies and expenses	2,846.99	
Maintenance boilers	139.83	
Maintenance engines	294.32	
Maintenance electric plant (machinery)	2,571.79	
Maintenance miscellaneous station equipment	2,134.50	
Maintenance buildings and fixtures	1,497.26	
Maintenance dams, canals and tail races	886.95	
Maintenance gates, wheels and governors	1,450.98	
Automobiles	4,532.27	
Operating meters	12,058.90	
Operating sub-stations	8,870.28	
Miscellaneous distribution operating expense	6,450.87	
Underground system	4,968.07	
Overhead system	36,102.27	
Meters	7,854.94	
Customers' repairs and renewals (?) free	32,076.47	
Sub-stations	12,744.07	
Salaries of general officers	42,217.61	
Forward,	$213,229.28	$54,511.33

Brought Forward,	$213,229.28	$54,511.33
Salaries of clerks	26,148.09	
Printing and stationery	8,385.51	
Storeroom expenses	4,508.85	
Miscellaneous general expenses and office sundries (?)	32,511.06	
Legal expenses	6,954.30	
Rent of offices	7,410.49	
Insurance	8,430.40	
Logging expense	9,361.81	
Advertising, canvassing and soliciting (?)	55,259.44	
		$372,199.23
Taxes		91,793.59
Total operating expenses for current		$518,504.15
Omitted operating expenses:		
Operating arc lamps	$34,192.16	
Maintenance arc lamps	6,273.12	
		$40,465.28
Renewal of incandescent lamps		25,470.84
		$584,440.27

Variable expense:

$54,511.33 div.by 29,177,126 K.W.H. 0.187c. per K. W. H.

Fixed expense:

$463,992.82 div.by 29,177,126 K.W.H. 1.590c. per K.W.H.

Total cash operating cost for current only at meter . . . . 1.777c. per K.W.H

The average connected load for 1910 is given as 33,403 K.W., as per Table 1.

Reported Connected Load for Minneapolis General Electric Company, Year 1910.

January	30.315	K.W.
February	30.466	"
March	30.794	"
April	31.272	"
May	32.344	"
June	33.168	"
July	33.947	"
August	34.723	"
September	34.926	"
October	35.569	"
November	36.381	"
December	36.927	"
Total	400.832	"
Average	33.403	"

Annual hours operation of connected load:
29,177,126 K.W. hours divided by 33,403 K.W. 873.49 hours
Daily hours (divide by 307 days) .... 2.845 hours

About the end of 1907 Messrs. D. C. and Wm. B. Jackson made the "total cost of labor and material in system, exclusive of land and supplies, $3,037,777," but did not, apparently, depreciate it to its present value.

I may be pardoned for saying that such appraisement resembles the valuation of a scrap heap at the price of the new machinery from which it came, for much of the machinery was old-fashioned and of approximately scrap value, in 1908.

The Minneapolis General Electric Company states that since the beginning of 1908 the following additions have been made to the Minneapolis city plant:

November 1, 1907, to January 1, 1910	$860,000.00
January 1, 1910, to January 1, 1911	363,000.00
	$1,223,000.00

Taking the fact that the approximate $3,000,000 appraisement of the Messrs. Jackson for value of machinery and productive labor was not the depreciated value, but the original structural cost for material and labor, and further that this company's property was an accumulation of the properties and machinery of several old and unsuccessful electric companies, it appears to me liberal and fair to adopt $3,500,000 as the basis of computation of rates.

To ascertain the exact truth as to the 1910 value of the city plant of the Minneapolis General Electric Company, it will be necessary to have both a thorough audit of its books and a detailed appraisement of the 1910 condition and value of the whole plant.

As a good deal of this plant is burned up, this latter requirement is not possible, and I am forced to ask you to accept a valuation which in my opinion is very liberal to the company, but which cannot now be proved for 1910.

The 1910 tax assessment for this city plant is given as $1,923,445, covering real and personal property, and the estimated $3,500,000 investment gives per K.W. connected load (33,403) about $105.

If any question of 1911 value arises, I would say that until the books of this corporation are completely audited from the vouchers and check stubs to the general ledger no one can learn how many dollars have been invested in this plant or otherwise appropriated by this company, and the $3,500,000 estimated by me for 1910 is but an opinion based on facts learned elsewhere, and a rapid general inspection of the plant of the Minneapolis General Electric Company in Minneapolis.

As to the percentages, 10 per cent, one-half of 1 per cent, 7½ per cent, 6 per cent and 8 per cent, successively added to the Jackson's appraisement, 1907, it will be necessary to verify these assumptions from the books and then decide (if they are found to exist) whether they are fair and just charges allowable upon the property, and also by appraisement to learn the decay, inadequacy and obsolescence to be deducted from the structural cost of the new plant.

The investment outside the city limits known as the Taylors Falls hydro-electric plant is given as about $3,000,000 (1910). I have had no means of investigating its details but am inclined to believe this plant worth all of that sum.

At Taylors Falls are installed six generators of 2,500 K.W. capacity, or 15,000 K.W. capacity. Two more, adding 5,000 K.W., are to be added shortly, making 20,000 K.W. there.

At Nevers Dam can be installed 10,000 K.W. capacity when a dam 30 feet high is completed, making 30,000 K.W. in all.

Taylors Falls storage dam is 10 miles long and Nevers dam is said to be 17 miles long, making an unusually good hydro-electric power on the St. Croix river.

The almost entire cessation of flow in the Mississippi and the great decrease of flow in the St. Croix river during the sudden cold weather of the last week (November 20, 1911) proves the imperative need of a greatly increased investment in a steam plant able to take care of any temporary deficiency of the hydro-electric plant and the peak load when it exceeds the whole power of the St. Croix river at low water stages.

As a fact, this Minneapolis General Electric Company has found it necessary to install a 12,000 K.W. capacity duplicate steam electric plant, costing about $70 per K.W. capacity installed, in order to protect a hydro-electric plant costing about $150 per K.W. capacity installed.

SEC. 5. *Depreciation and Profits.*—Fixing 8 per cent on the actual structural cost of a new plant as the rate of reasonable profit generally accepted in Minneapolis, and using this company's own figures for depreciation, we can fix the reasonable cash margin required for both.

City plant, $3,500.00 at 3% depreciation	$105,000.00
Hydro-plant, $3,000,000.00, at 1½% depreciation	45,000.00
Annual depreciation	$150,000.00
Profit, $6,500,000.00 at 8%	520,000.00
Combined cash margin required	$670,000.00
Compared with	
1910 gross earnings Minneapolis General Electric Co	$1,276,041.02
Operating expenses and taxes	584,440.27
Net earnings (cash margin)	$691,600.75

SEC. 6. *Sliding Scale of Prices for Electricity Computed.* The full connected load operated 2.845 hours per day 307 days:

Annual sales K.W. hours		29,177,126
Variable operating expense	$54,511.33 or	0.187c. per K.W.H.
Fixed operating expense	463,992.82 or	1.590c. per K.W.H.
Profit and depreciation	670,000.00	2.296c. per K.W.H.
Total price	$1,188,504.15	4.073c. per K.W.H.
Flat monthly price per K.W. capacity (72.83 hours per K.W.) ..		$2.97

The full connected load operated 1 hour per day 307 days:

Annual sales K. W. hours		10,255,580
Variable operating expense	$19,160.40	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,153,153.22 or 11.244c. per K.W.H.	
Flat monthly rate per K.W. capacity (25.6 hours per K.W.)		$2.88

The full connected load operated 2 hours per day 307 days:

Annual sales K. W. hours		20,511,160
Variable operating expense	$38,320.80	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,172,313.62 or 5.715c. per K.W.H.	
Flat monthly rate per K.W. capacity (51.2 hours per K.W.)		$2.93

The full connected load operated 3 hours per day 307 days:

Annual sales K. W. hours		30,766,740
Variable operating expense	$57,481.20	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,191,474.02 or 3.873c. per K.W.H.	
Flat monthly rate per K.W. capacity (76.8 hours)		$2.97

The full connected load operated 4 hours per day 307 days:

Annual sales K. W. hours		41,022,320
Variable operating expense	$76,641.60	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,210,634.42 or 2.951c. per K.W.H.	
Flat monthly rate per K.W. capacity (102.4 hours)		$3.02

The full connected load operated 5 hours per day 307 days:

Annual sales K. W. hours		51,277,900
Variable operating expense	$95,802.00	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,229,794.82 or 2.398c. per K.W.H.	
Flat monthly rate per K.W. capacity (128.0 hours)		$3.07

The full connected load operated 6 hours per day 307 days:

Annual sales K. W. hours		61,533,480
Variable operating expense	$114,962.40	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,248,955.22 or	2.03c. per K.W.H.
Flat monthly rate per K.W. capacity (153.6 hours)		$3.12

The full connected load operated 7 hours per day 307 days:

Annual sales K. W. hours		71,789,060
Variable operating expense	$134,122.80	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,268,115.62 or	1.766c. per K.W.H.
Flat monthly rate per K.W. capacity (179.2 hours)		$3.17

The full connected load operated 8 hours per day 307 days:

Annual sales K. W. hours		82,044,640
Variable operating expense	$153,283.20	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,287,276.02 or	1.569c. per K.W.H.
Flat monthly rate per K.W. capacity (204.8 hours)		$3.21

The full connected load operated 9 hours per day 307 days:

Annual sales K. W. hours		92,300,220
Variable operating expense	$172,443.60	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,306,436.42 or	1.415c. per K.W.H.
Flat monthly rate per K.W. capacity (230.4 hours)		$3.26

The full connected load operated 10 hours per day 307 days:

Annual sales K.W. hours		102,555,800
Variable operating expense	$191,604.00	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,325,596.82 or	1.293c. per K.W.H.
Flat monthly rate per K.W. capacity (256 hours per K.W.)		$3.31

The full connected load operated 12 hours per day 307 days:

Annual sales K. W. hours		123,066,960
Variable operating expense	$229,924.80	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,363,917.62 or	1.108c. per K.W.H.
Flat monthly rate per K.W. capacity (307.2 hours)		$3.40

The full connected load operated ½ hour per day 307 days:

Annual sales K. W. hours		5,127,790
Variable operating expense	$9,580.20	
Fixed operating expense	463,992.82	
Profit and depreciation	670,000.00	
Total price	$1,143,573.02 or	22.301c. per K.W.H.
Flat monthly rate per K.W. capacity (12.8 hours)		$2.85

The full connected load operated 12.28 hours per day 307 days:

Annual sales K.W. hours		125,938,522
Variable operating expense	$235,289.70	
Fixed operating expense	463,992.82	
Cash operating expense	$699,282.52 or	0.555c. per K.W.H.
Depreciation	150,000.00 or	0.119c. per K.W.H.
Complete operating cost	$849,282.52 or	0.674c. per K.W.H.
Profit, 8 per cent	520,000.00 or	0.413c. per K.W.H.
Total price	$1,369,282.52 or	1.087c. per K.W.H.

The arc lights are said to operate 3,770 hours per year, or what is the same as 10.33 hours for 365 nights, or 12.28 hours for 307 nights.

Flat rate, monthly price, per K.W. capacity (314.37 hours).... $3.42

The minimum service charge per K.W. capacity of connected load:

No current used.		
Fixed operating expense.......	$463,992.82	
Depreciation.................	150,000.00	
Profit.......................	520,000.00	
	$1,138,992.82	
Total K.W. of connected load..	33.403	
Minimum monthly charge.....	$2.84	per K.W. connected
	2.13	per H. P. connected

or about 15c. per 50 watt 16 C.P. incandescent lamp socket.

For the sake of verifying the above computations of rates, we will make use of the figures of the connected load for 1910 furnished by the Minneapolis General Electric Company.

Total Connected Load and Meters.

Reported by Company, December 31, 1910.

		K.W. CON.	No. Meters
10,862,344 K.W.H.	Coml. inc. meter........	20,544	12,694
49,262 K.W.H.	Mun. inc. meter........	119	74
14,114,833 K.W.H.	Coml. power meter......	15,027	1,467
6,380 K.W.H.	Mun. power meter......	30	18
746,907 K.W.H.	Flat rate inc. meter......	404	......
446,400 K.W.H.	Ornamental lighting.....	186	......
113,000 K.W.H.	Flat rate power, Total Included in power,	36,310	
2,838,000 K.W.H.	City arc...............	710	......
29,177,126 K.W.H.	Total Dec. 31..........	37,020	14,253
	Average...............	32,693	90% of total
	Average of whole year...	33,403	

Rearranging and classifying, we have

Total Connected Load as Corrected.

Minneapolis General Electric Company.

December 31, 1910

Incandescent Rates	K.W. Corrected	Hours Per Year	Hours Per Day	Rate K.W.H.
10,862,344 K.W.H. Com. meter..	18,490	......	......	......
49,262 K.W.H. Mun. meter..	107	......	......	......
746,907 K.W.H. Flat rate.....	364	......	......	......
446,400 K.W.H. Ornamental st. light......	167	......	......	......
12,104,913	19,128	632.83	2.061	5.552c.
Commercial Power	Rate computations below			
14,114,833 K.W.H. Power meter.	13,524	......	......	......
6,380 K.W.H. Power mun...	27	......	......	......
113,000 K.W.H. Flat rate.....	......	......	......	......
14,234,213	13,551	1,050.42	3.421	3.419c.
	Rate computations below			
City Street Arc Lights—(1,239 Magnetite)				
2,838,000 K.W.H. City arc......	710	......	......	1.087c.
	33,389			
Variation....................	14			
Total as per average given...	33,403			

We can now compute the gross earnings on the basis of the tabulated rates.

Incandescent rate 12,104,913 K.W.H. at 5.552c.......	$672,064.77
Lamp renewals (not included).	
Commercial power, 14,234,213 K.W.H. at 3.419c......	486,667.74
Current for arcs, 2,838,000 K.W.H. at 1.087c.........	30,849.06
	$1,189,581.57
Arc maintenance and operation not included.	
Original figures used as basis are..................	1,188,504.15
Variation one-tenth of 1 per cent due to decimals..	$1,077.42

For the full connected load operated 2.061 hours per day 307 days:

Annual sales K.W. hours......		21,136,750
Variable operating expense.....	$39,489.58	
Fixed operating expense.......	463,992.82	
Profit and depreciation........	670,000.00	
Total price..............	$1,173,482.40 or	5.552c. per K.W.H.

Flat monthly rate per K.W. capacity (52.76 hours)........... $2.93

For the full connected load operated 3.421 hours per day 307 days:

Annual sales K.W. hours......		35,084,339
Variable operating expense.....	$65,547.73	
Fixed operating expense.......	463,992.82	
Profit and depreciation........	670,000.00	
Total price..............	$1,199,540.55 or	3.419c. per K.W.H.

Flat monthly rate per K.W. hour capacity (87.58 hours)....... $2.99

SEC. 7. *Tabulation of Rates for Even Profits, Minneapolis General Electric Company, 1910. Relation of Hours of Use to Prices for Electricity.*

Hours of use of full connected load			Price per K.W. hour	Discount from 10 cent base rate fixed	Flat Monthly Maximum Rate per K.W. of Fully used connected load	
Per Year	Per Month	Per Day				
8760	730	24	0.574c.	94.26%	24 hours	$4.19
3684	307.02	12	1.108c.	88.92%	12 hours	3.40
3070	256	10	1.293c.	87.07%	10 hours	3.31
2763	230	9	1.415c.	85.85%	9 hours	3.26
2456	205	8	1.569c.	84.31%	8 hours	3.21
2149	179	7	1.766c.	82.34%	7 hours	3.17
1842	154	6	2.030c.	79.70%	6 hours	3.12
1533	128	5	2.398c.	76.02%	5 hours	3.07
1228	102	4	2.951c.	70.49%	4 hours	3.02
921	77	3	3.873c.	61.27%	3 hours	2.97
614	51	2	5.715c.	42.85%	2 hours	2.93
307	25.6	1	11.244c.	Prem. 12.44%	1 hour	2.88
153.5	12.8	½	22.301c.	Prem. 123.01%	½ hours	2.85
......	......	......	......	......	0 hours	2.84
(1)	(2)	(3)	(4)	(5)	(6)	

Note: The cost of incandescent lamp renewals and of arc light operation and maintenance is omitted from the above sliding scale.

Three hundred and seven work day's use per year are assumed.

Directions for Use of Tabulation.

The metered K.W. hours per month are divided by the K.W. capacity of the consumers' full connected load, as estimated or measured, to obtain his monthly hours of use. The rate per K.W. hour will be found on the same line or can be interpolated for fractional part of an hour.

Minimum charge for no current, $2.84 per K.W.

Sec. 8. *D. C. & W. B. Jackson's Method of Obtaining the Cost of Current for 1,430 Street Arc Lights.* Minneapolis General Electric Company's Report, page 63.

We find by dividing their figures by 1,430 street lights that each lamp is charged with

Maximum demand in K.W.	0.633	
Annual K.W. hours registered	2377.6	
0.633 by $18 per K.W. demand		$11.39
2377.6 K.W. hours at 0.4c		9.51
or 2377.6 K.W. hours at .879c		$20.90

Both the K.W. of demand and the K.W. hours generated are assumed by them at the main switchboard of the city plant.

Section 9.—*The Contract Between Taylors Falls Plant and the City Plant of the Minneapolis General Electric Company.*

This contract provides that the city plant shall hereafter pay the Taylors Falls hydro-electric plant for power measured at the switchboard as follows: Taking the year 1910 for example:

Maximum demand, 12,894 at $18.00.......		$232,092.00
K.W. hours generated, 40,277,269 at 0.4c...		161,109.00
Total, 40,277,269 at 0.976c...........		$393,201.00

This would leave the variable cost of generated current fixed between 0.879c. and 0.976c. per K.W. hour to the city plant and yield gross earnings in the neighborhood of $400,-000 to the Taylors Falls plant in the near future.

The investment left in city plant will be $3,500,000, and we have:

Variable operating expense, city plant.....		$393,201.00
Fixed operating expense, total..	$463,992.82	
Less Taylors Falls expense.....	64,785.92	
Fixed operating expense, city..		399,206.90
		$792,407.90
Total gross earnings, 1910...............		$1,276,041.02
Taylors Falls earnings outside city........		9,988.13
City plant gross earnings..............		$1,266,052.89

Since the actual variable operating expenses in 1910 were $54,511.33, we find the apparent operating expenses will be raised from $518,504.15 to $792,407.90, the arc lights expense and incandescent renewals being excluded as before.

Since the sales of electricity are reported to be about 75 per cent of the quantity generated, this contract will apparently fix the lowest variable cost of current at 4-3 of about 1 cent, or 1.33c. per K.W. hour for the city plant average sales, in the future. Whereas for 1910 this variable cost appears to really be 0.187c. per K.W. hour of sales from the books. It should be noted that all my own figures are based on sales only.

Dividing the earnings of Taylors Falls plant, $9,866.77, by 4.073c. we obtain 242,246 K.W. sales; which, subtracted from 29,177,126, leaves 28,934,880 K.W. hours, average sales in the city.

The use of the special contract rate, 0.879c. for generated current, Jackson's Report, page 63, ($20.85 per lamp), is equivalent to fixing the sale cost of current at nearly 1.2c. per K.W. hour. It should be 0.674c. for street arc lights.

SEC. 10. *The Cost of Arc Lights for 1910 from the Company's Books and Records.*

The cost of operating and maintaining the street arcs of 1910 is given as follows:

Operating arc lamps....................	$34,192.16
Maintaining arc lamps..................	6,273.12
	$40,465.25

For the year ending December 31, 1910:

Overhead service, street arcs....................	1,337
Underground service, street arcs................	47
Overhead service, park........................	8
Total number of arc lights.................	1,392
Average per light per year, for operation and maintenance..............................	$29.07

This $29.07 is not the cost per magnetite 6.6 arc proposed, but is very nearly the cost of the old 9.6 arc, trimmed every day instead of once a week or ten days, and therefore requiring very much more labor for operation; so we are very liberal in assuming it to cover all operation and maintenance of the new magnetite 6.6 arcs to be substituted for the old arc lights.

Barring incandescent and arc lights special expenses, but including expenses, depreciations of the whole plant, arc light circuits and everything else averaged, we find the complete operating cost of current to be 0.674c. per K.W. hour.

By actual measurement in sub-stations on Main street and Garfield avenue, each of these magnetite arcs rated at 510 watts takes 608 watts, and further is said to burn 3,770 hours per year, consuming 2,292 K.W. hours.

2,292 K.W. hours at 0.674c.................... $15.45

If now we accept the very liberal appraisement of the Minneapolis General Electric Company, of $264.50 investment per arc in a proposed installation of 1,430 street lights and accord a profit of 8 per cent we have

$264.50 (see Jackson's Report, page 45) at 8%.... $21.16

Recapitulating for one arc light:

Cost of operating and maintaining old arcs.......	$29.07
Cost of 2,292 K.W. hours, depreciation included..	15.45
Profit per arc, $264.50 at 8%..................	21.16
Total fair and reasonable price, 2,292 K.W. hours at 2.865c.........................	$65.68

Of course, the objection will at once be made to this that $29.07 is based on another type of lamp, and that $35.50 (see Jackson's Report, page 61) is the proper amount. However, this company's books for 1910 contradict this, and presumably are more practically correct than proportions and assumptions (undoubtedly made in good faith) which may or may not prove practically true.

The $15.45 for current differs from the $20.85 claimed by the company (see Jackson's Report, page 63), for the reason that it is carefully deduced from the actual facts of the operations of this company for 1910 as recorded in its books, with an extra allowance for average depreciation cost included, based on the average depreciation of the whole plant.

By the method adopted in Section 6, the complete cost and the complete price of the current is computed for the current in K.W. hours as a whole.

The cost $20.85 claimed is the result of accepting the terms of a contract made with the Taylors Falls plant, which yields to it a profit on all current delivered to the city plant, which in turn must use this profitable price as the cost basis of rates to Minneapolis consumers, who thus pay two profits.

As to the profit 8 per cent on $264.50, or $21.16 for the average investment per arc light, there is no present necessity to investigate it, as the company has fixed upon $264.50 investment per arc, and it would be as impossible as it would be insincere to concede or to claim exact accuracy to be attainable in this case by any one.

On page 57 of Jackson's Report, if we divided operating cost, insurance, taxes, etc........		$31,439.00
By 1,430 arcs, we shall have, for each arc....		21.99
On page 61 of Jackson's Report, if we divide total depreciation of arc system...........		18,679.00
By 1,430 arcs, we have, for each arc..........		13.06
Total operating cost and depreciation per arc (Jackson's)...........................		35.05
This the Minneapolis General Electric Company's book gives as operation and maintenance...........	$29.07	
And general depreciation, 2,292 K.W. hours at 0.12c..................	2.75	31.82
Excess of the Jackson's estimate over book records 1910......................		$3.23

As above explained, this residual depreciation (after complete repairs, reckoned at 3 per cent on the whole plant, is taken care of in computing the cost of current ($15.45), in which it ($2.75) is included, as an average spread over the total sales (29,177,126 K.W. hours).

SEC. 11. *Regarding Street Arc Lights as a By-Product Furnished Without Profit.*—From the foregoing figures, if we omit profit, we shall have:

Cost of operating and maintaining arcs, special accounts	$29.07
Cost of 2,292 K.W. hours, ($2.75, depreciation included)	15.45
Total cost of one 6.6 ampere magnetite	$44.52

Duluth is at present offering to furnish arc lighting at $45 per 6.6 magnetite arc per year, and confirms the above figures by stating that it offers to furnish street lighting at cost.

SEC. 12. *Regarding Street Arc Lights as Furnished on the Basis of the Average Profit Included in the Price of the Current for All Consumers.*

Cost of operating and maintaining arcs, special accounts	$29.07
2,292 K.W. hours at 1.087c	24.91
Price per arc light	$53.98
Profit per year, per arc	9.46

The City of St. Louis purchased its 6.6 magnetite arcs for $49.00 per year for 4,000 from a steam-driven station, and the company was presumably arranging (on the average) to take a little less profit on arc light investment, and recoup itself by a very small excess profit per K.W. hour from its commercial patrons, who required a less investment per K.W. capacity.

Sec. 13. *The Supplemental Steam Plant.*—The Minneapolis General Electric Company found it practical and necessary in 1910 to have about 6,000 K.W. capacity steam plant in addition to its 15,000 K.W. capacity hydro-electric plant at Taylors Falls.

In my estimate of $3,500,000 is included this 6,000 K.W. capacity steam plant, which was burned in the fire of January 6, 1911. The depreciation and the profit on this steam plant are included in the depreciation and profit figured upon $3,500,000 total investment.

The present Riverside 12,000 K.W. capacity steam plant appears to have been built to take care of the burned steam plant capacity, as well as anticipate future needs, and need not be considered in this case, as we are considering merely the facts for the year 1910.

As already stated, at the Fifth street sub-station there is now, and I believe always has been, one 400 K.W. generator held in reserve for emergencies and operated by a 600 H.P. steam engine.

This, too, is included in the estimate of $3,500,000 total present value of residual machinery and plant in the year 1910.

It would naturally be assumed that if the costs of 1910 included the 6,000 K.W. steam plant that these same costs will sufficiently cover, because of the greatly increasing load, any costs arising from the new 12,000 K.W. steam plant.

As a matter of future interest, the new Riverside station has cost this company, complete and ready to run, in the neighborhood of $72 a K.W.

If we take each arc lamp as requiring about 0.6 of a K.W., this would make about $43 investment for each arc light's insurance.

If to this we wish to add the proportional cost of the cables and conduits between the Riverside station and the Main street station, enough investment will be added to raise the total investment for arc lamp insurance to about $52, as stated.

If we reckon the profit 8 per cent and the residual depreciation 3 per cent, we have for the purpose of insurance of continuity of service of the arc lights about $5.70; this sum covering the profit and the depreciation. Or, a smaller sum than this can be reckoned, if less than 11 per cent is fixed upon by the committee.

Personally, it is my opinion that the price $65.68 derived from the conditions of the year 1910 is sufficient without any addition for future possibilities.

SEC. 14. *Extras for Incandescent Lights and Arc Lights.*—It is not very clear to the writer as to the extent to which the furnishing of free incandescent lights is carried.

On page 13 will be found in the operating expenses a charge to the renewal of incandescent lamps of $25,470.84. In computing the cost of current as there explained, this sum has been omitted from the operating expenses temporarily, and therefore wherever incandescent lights are furnished free to users, an additional charge per K.W. hour should be made to the rate obtained, to cover the cost of free incandescent lights.

The ordinary 16 C.P. carbon filament 50-watt lamp costs at the factory about 12½c. and by the time it reaches the consumer may be presumed to have cost the company about 15c.

The life of this lamp is usually taken at 1,000 hours, so that by the time it is burned out it will have consumed 50 K.W. hours.

If now we divide 15c. by 50, we obtain 0.3 (three-tenths) of a cent as the additional cost of incandescent lighting to be added to the rate found in Diagram 1, if lamps are furnished free.

Referring to the arc lights for the year 1910, from page 13 it will be seen that operating arc lamps, $34,192.16, and maintenance of arc lamps, $6,273.12, total $40,465.25, have been omitted from the computations for the cost of current, and therefore this sum for the 1,392 arcs reported for 1910 which were mostly of the old-fashioned 9.6 ampere open arc variety, must be added to the current cost (or cost for power) of the arc lights.

This gives us, as heretofore stated, a cost per individual arc light for 1910 from the books of the company for arc lights requiring a great deal more labor in trimming than the proposed magnetite arc lights, of $29.07.

This $29.07 is a very much exaggerated estimate of the probable future cost of magnetite arc lights.

Taking some of the details, for instance, from the published data of the General Electric Company, we have for trimming one lamp one year labor as follows:

For the old 9.6 ampere open arc................		$6.00
For the new 6.6 ampere magnetite arc...........		1.00
And for the carbons for the old 9.6 open arc per year....................................	$5.50	

From the report of Messrs. Jackson, page 46, we have for the proposed 6.6 magnetite arc:

Cost for lower electrodes......................	$2.04
Forward,	$2.04

Brought Forward,	$2.04
Cost for upper electrodes....................	.50
Cost for changing upper electrodes..............	.15
Total..................................	$2.69

An extra expense in the case of magnetite arc lights is the cost of rectifier tubes per year, which is reckoned, Jackson's Report, page 46, at $3.75. Adding these items together we have for the old 9.6 open arc carbon $11.50, as against $7.44 for the 6.6 magnetite arc lights per year.

In other details of labor for street arc lights the cost to the station will not greatly differ, and we see that in taking $29.07 from the books of this company as covering operation and maintenance of arc lamps we have left an abundance of margin in favor of the company.

The investment per K.W. capacity made by the company for the purpose of supplying commercial consumers with power and light is very much less than the investment per K.W. capacity made by the company for the purpose of supplying the city street lights.

It will easily be seen that this company's investment ceases at the meter in the case of commercial consumers, who supply their own interior wiring for lighting or power purposes, but the case is different in the matter of street lighting, for the company has not only to lay its street cable and services, as in the case of commercial consumers, but also has to erect poles, furnish mast-arms, insulating heads, cut-outs and lamps, and also after these are erected it is obliged to keep them in a state of perfect repair, and also to furnish all the labor and material required in the daily operation of these lamps for 365 nights of the year.

The officers of the Minneapolis General Electric Company and Mr. Wm. B. Jackson were untiring in the consideration with which they assisted me to all the facts directly requested, and also in going over the very careful, and exhaustive report of Messrs. D. C. and Wm. B. Jackson.

Referring to this report, I would say that it has had the most careful consideration at my hands, and that I find it impossible to agree with some of the methods of apportionment used in following the apparatus required for street arc lighting from the source of power to the lamp; but I am willing to provisionally accept as not far from correct the following figures as given on page 34: "The present value of the distribution system shown by details in Table 7-A, in which is used the greatest value of the investment. In our estimates of the cost of giving arc light service, and we have not made any addition for an allowance for the cost of selling securities.

"Our figures for cost of giving arc light service are therefore low in this particular, as well as in other particulars," $363,650.

And on page 44: "Investment in 13,000 volt transmission lines from sub-station 'A' to the Main street distribution station. The aggregate of investment in the 13,000 volt transmission lines which reverts to the municipal arc lighting service is $14,610," total $378,260.

If we divide this total by 1,430 arc lights, for which the estimate is made, we obtain $264.50 investment per arc light.

. This section has been added for the purpose of making the way in which my own extras have been added to the cost of current entirely clear, item by item, for arc lighting.

Sec. 15. *Practical Difficulties.*—The practical difficulties of comprehension arising in the attempt to lucidly and clearly grasp the problem of a system of charges which protects the company in an even profit and at the same time places all the consumers on an equal footing in a judicially fair way, seem almost insuperable to the minds of even those actively engaged in the management of electric stations.

For this reason, I will endeavor to make the facts of the operation of an electric station clear by means of comparison with an auditorium filled with individual chairs.

These chairs being supposed to be heated by means of an electric heater set in operation when occupied.

Each K.W. of capacity of an electric station must be represented by one chair of capacity of the auditorium.

In the case of the Minneapolis General Electric Company, its 1910 capacity was about 21,000 K.W., and for this reason the auditorium will be assumed to have a capacity of 21,000 chairs.

The connected load of 1910 was 33,403 K.W., and for this reason it can be assumed that 33,403 chair tickets have been distributed to applicants for seat space in the auditorium.

During the year 1910 it was found by actual observation that on the 21st day of December 12,892 chairs were occupied between half-past 4 and 7 o'clock, and that this was the largest number of chairs occupied at any one time by the 33,403 ticket-holders.

Taking the ticket-holders and classifying them, we find first what might be called the dwelling-house class, who occupied their chairs comparatively very little and used most of them after 7 o'clock.

Occasionally this dwelling-house class would get together for an entertainment and utilize, in certain individual instances, all of the chairs for which they had tickets.

Another class of chair ticket-holders may be called the theater class. This class occupied the chairs to which it had a right every evening in the week for a large portion of the year from the hour of 8 until 11, and during the daytime would occupy its chairs from 2 until 5 in giving matinees, ranging from two to six times a week.

Another class of chair ticket-holders is the restaurant and saloon class. This class occupied its chairs with regularity from 4 to 5 o'clock until midnight.

The churches form a class which occupied their chairs on Sundays and in the evenings from 8 o'clock until 10, but do not form large or frequent users.

The motive power users form a class, which, in the case of factories and machine shops, occupied their chairs, or a portion of them, from 7 o'clock in the morning until 6 o'clock at night.

The great office buildings form a class which occupied their chairs for about one hour during winter afternoons but rarely occupied them at all during the summer months.

The street lights form a class, which, going on at about 5 o'clock in winter and later in summer, occupied its chairs in this auditorium until the following dawn. It is particularly with this class that I am dealing, and I desire to call your attention to the fact that the street lights from midnight on until daylight were almost the only patrons of chairs in this great auditorium.

There is also another peculiarity of the street lights. They were unfailing in their occupancy, going on in a certain quantity every night and all night for the whole year.

At the entrance to this auditorium, the ticket-holders, as to the number of chairs and the hours of occupancy, are registered as they come in or go out, and this registry of chair hours is fitly represented by the electric meter making a record in K.W. hours.

The question now before us is how to divide up the operating expenses, the depreciation and the profit amongst the patrons of this auditorium.

There are certain classes of ticket-holders for chairs which must have special consideration at the hands of the business manager.

You will recall that out of the 21,000 chairs installed, only 12,893 were occupied at one time during one day in the year.

If a certain class of ticket-holders would agree never to occupy their chairs between the hours of 4 and 7 p.m., it is obvious that the business manager could make a large concession to them, because he has found out by practical experience that there will always be plenty of room in the auditorium and no trouble about accommodating them.

Another class is the individual purchaser of a very large number of chair tickets, who might find it cheaper to build an auditorium of his own, and probably will do so if he cannot be shown that it will cost him less to join in the occupancy of the larger auditorium with other ticket-holders.

Speaking of these classes, the former might be called by an electric station manager restricted users of electricity, who do not go on the peak load, and the latter might be called wholesale consumers of electricity who are almost large enough in their demands to compete with the station itself.

Having thus set apart these two classes, the question comes up, what shall we use to divide up the cash operating cost, the depreciation and the profit required to keep our large auditorium going with the rest?

In a commercial matter of this sort it is seen at once that each chair ticket represents the right to enter the auditorium and use a chair at will.

We have called these chair tickets the connected load, and as almost all the operating costs of an electric station are in the nature of fixed expenses, which go on regardless of whether the auditorium is full or empty, it would seem only just that each ticket should bear its share of the annual expenses and profit of the auditorium. That is to say, that if there are 33,403 tickets, we should divide the total expenses found to have actually been for the year 1910, $1,188,504.15, by 33,403, in order to place the burden equally upon all ticket-holders which gives us an annual rate of $35.58 per chair. Or, if we divide this by 12 months, a monthly rate of $2.97 per chair. Or, as will be seen, $2.97 per K.W. capacity of the connected load.

Referring to Minimum Service Charge, No Current Used, if we divide the total of the fixed operating expenses, depreciation and profit, $1,138,992.82, by 33,403, we obtain a minimum monthly charge per chair of $2.84.

If the electric current heating our imaginary auditorium were derived from a waterfall, always amply sufficient and never-failing, there would be no variable expense, as there is in the case where coal is burned, and consequently it would be judicially fair to charge each ticket-holder $2.84 per month and permit him to occupy his chair and operate his electric apparatus for as many hours per day as suited his convenience or needs, regardless of the amount of electricity used.

This situation in the auditorium is equivalent to fixing a flat rate for electricity on the basis of the K.W. of connected load without in any way limiting the length of use of electricity per day, per month or per year.

However, in order to protect themselves from careless waste of current, electric companies have found it necessary to keep a record of the number of hours of use of their K.W., and similarly in the case of the auditorium, if no record were kept of the hours of use of the chairs, in all probability it would soon be over-crowded and the 33,403 ticket-holders would endeavor to occupy 21,000 chairs. However, by charging in the case of the auditorium for occupancy on the basis of the chair hour, and in the case of an electric station on the basis of K.W. hour, consumers are prevented from either occupying seats or demanding K.W. for long hours when they do not really need them.

In fact, the only reason for not adopting a flat rate per K.W. per month, in the case of ample water power, is to prevent wasteful overcrowding of electric machinery or of our imaginary auditorium.

This is not the case where fuel is used to generate electricity. Then the cost of the fuel increases with the amount of electric power taken, and in our imaginary auditorium each chair hour would add to the coal bill; and if, as in the present case, a waterfall is found at times to become insufficient and steam power is required, we must take cognizance of the fuel bill and some smaller appurtenant bills as a variable charge, and when this happens we cannot reach a flat rate or a uniform meter rate applied to all consumers, for the following reasons:

Like the auditorium, an electric station is paid mostly for its service, and not for what it sells as a commodity (electricity, heat).

The fixed expenses consist entirely of payroll, of taxes, of repairs, of depreciation and of profit on the investment, which form an even sum each day and each year, depending almost altogether on the passage of time and independent of the electricity (heat) furnished in small quantities.

In 1910, we find from the records of the company that the variable operating expenses are $54,511.33 on the assumption that the 33,403 ticket-holders occupied their chairs on an average 2.845 of an hour per day, and in so doing registered an aggregate of 29,177,126 chair hours.

If now we wish to find a fair price to be charged per chair hour, we divide the total of the variable and fixed operating expenses and profit and depreciation, $1,188,504.15, by 29,177,126 chair hours and obtain an average price of 4.07c. per chair hour, yielding an 8 per cent profit upon the investment and covering all other expenses.

If now the question arises, what should be the price per chair hour if the 33,403 ticket-holders had averaged an occupancy of only one hour per day, we divide the actual variable operating expenses, $54,511.33, by 2.845 hours and obtain for the variable operating expense for one hour per day $19,160.40, to which we add the fixed operating expense and profit and depreciation, obtaining $1,153,153.22.

In order to obtain the number of chair hours sold, we also divide 29,177,126 chair hours by 2.845 hours, which gives us 10,255,580 chair hours as the amount sold; and if we divide this into the $1,153,153.22 previously found, we obtain 11.24c. as the fair price to be charged per chair hour in order that the auditorium company shall cover its fixed and variable expenses, profit and depreciation, and the burden of payment be distributed with judicial fairness.

It is hardly necessary to add further computations, for the price for any number of hours per day can be obtained in a similar manner, for an electric station.

In order to avoid any fallacy of an incorrect numerical theory, there has been brought together and classified the K.W. hours for incandescent rates for commercial power and for city street arc light as they actually existed in 1910, and the proper price per K.W. hour for each class has been deduced. We have the result, therefore, of reversing the operation of this method, which is shown to check out within a variation of 1-10 of 1 per cent.

It is interesting to note that the average price for incandescent light current proves to be 5.55c., which would rise to 5.85c. if carbon filament lamps are furnished free.

Commercial power in all its various forms averaged a fair price of 3.42c. per K.W. hour, and there should be no addition to this price, since the current is simply delivered to the motor furnished by the consumer.

However, these figures are of only passing interest as having been necessary in order to find the general price and cost of electricity to be used in street arc lighting.

Both these departments of incandescent rates and commercial power should have careful segregation and their details studied before fixing the many rates required by their many phases.

In the matter of street arc lighting, however, we find that the current alone, practically used about $10^1/_3$ hours a night, reaches a fair price of 1.09c., and is produced at a complete operating cost of about 0.67 of a cent.

You will recall (Section 10, and following), I have used this cost, together with the maintenance and special operation and the profit, to obtain the fair price for a street arc light, also using the investment per arc light, $264.50, obtained from the elaborate appraisement of the Messrs. Jackson, and the maintenance and operation, $29.07, obtained from the company's books for 1910, and the cost of current inclusive of residual depreciation of 3 per cent spread over the whole works, amounting to $15.45.

In order that the results of my computations shall be in a concise form, I have prepared Diagram 1, which represents the actual practical facts and the various rates resulting from them in the case of the Minneapolis General Electric Company for the year 1910. It is worthy of note in connection with this diagram that the net earnings of this company for the year 1910 were about $691,000, and the basis of this diagram allows for a net earning of $670,000, a difference of a little over $20,000.

I may be pardoned for saying that in reaching this latter figure of $670,000, I made no forecast and no attempt to alter the valuation based on my own judgment, and that on the whole this near coincidence to the rate of profit fixed by the city's committee would go to show that in the aggregate the profits of this company have not been unduly great, however just may be the criticisms of their rates and methods of making them in individual instances.

My excuse for making this lengthy comparison between an auditorium and its seating space and an electric light and power company and its capacity is because in my experience

I have met with almost innumerable methods of attempting to solve the problem of electric rates, which, in part at least, were both superficial and incorrect.

I trust that I have your full concurrence in this method, which I conceive to be the one right method of attacking this problem, and that I have placed its fundamentals lucidly before you and proved to you that it is rational, practical, judicially fair, giving an even profit to the company from all connected consumers, and placing all consumers on an equal footing in their contributions to the support of the company which serves them.

It seems almost impossible to convince even station managers that an electric light and power company is a servant, giving service and going to a great expense for this service, while the commodity (electricity) which is sold, is relatively very, very small indeed in its cost for the one element which is variable in steam stations, that is fuel, and which, theoretically at least, has no cost at all in water-power stations.

SEC. 16. *Recapitulation.*—It is as impossible as it would be insincere for anyone to claim in so complex a problem as this of the price of arc lights to have reached a scientifically accurate conclusion.

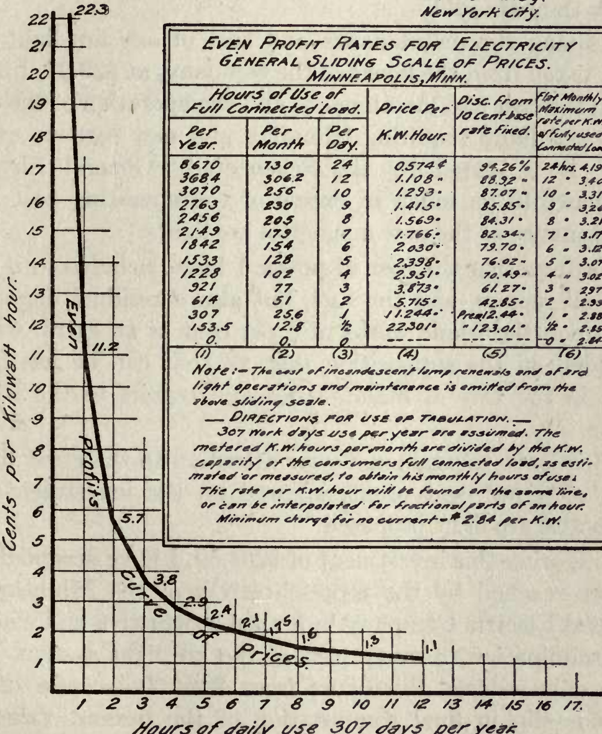
I believe my figures to have been judicially fair, except that in cases of doubt I have always favored the company, feeling that no institution is of any ultimate value to a community unless it makes a fair profit.

For this reason, instead of using the generated K.W. hours 40,277,269, I have used the K.W. hours sold, 29,177,126, to divide the lump sum, cost and profit, of operations for the year 1910 ($1,188,504.15). In doing this, I have placed

DIAGRAM Nº I. FOR EVEN PROFITS.

Exhibiting relations of hours of use of electricity to its prices.
Data given for
MINNEAPOLIS GENERAL ELECTRIC CO. 1910.
The percentage added is 10.3% of the investment per Kilowatt hour sold and covers allowances for profit and depreciation.

SKETCH
Wm. D. MARKS, C.E.
Park Row Bldg.
New York City.



EVEN PROFIT RATES FOR ELECTRICITY
GENERAL SLIDING SCALE OF PRICES.
MINNEAPOLIS, MINN.

Hours of Use of Full Connected Load.			Price Per K.W. Hour.	Disc. From 10 cent base rate Fixed.	Flat Monthly Maximum rate per K.W. of fully used Connected Load
Per Year.	Per Month	Per Day.			
8670	730	24	0.574¢	94.26%	24 hrs. 4.19
3684	306.2	12	1.108 "	88.92 "	12 " 3.40
3070	256	10	1.293 "	87.07 "	10 " 3.31
2763	230	9	1.415 "	85.85 "	9 " 3.26
2456	205	8	1.569 "	84.31 "	8 " 3.21
21·49	179	7	1.766 "	82.34 "	7 " 3.17
1842	154	6	2.030 "	79.70 "	6 " 3.12
1533	128	5	2.398 "	76.02 "	5 " 3.07
1228	102	4	2.951 "	70.49 "	4 " 3.02
921	77	3	3.873 "	61.27 "	3 " 2.97
614	51	2	5.715 "	42.85 "	2 " 2.93
307	25.6	1	11.244 "	Prem 12.44 "	1 " 2.88
153.5	12.8	½	22.301 "	" 123.01 "	½ " 2.85
0.	0.	0	-----	--------	0 " 2.84
(1)	(2)	(3)	(4)	(5)	(6)

Note:—The cost of incandescent lamp renewals and of arc light operations and maintenance is omitted from the above sliding scale.

—DIRECTIONS FOR USE OF TABULATION.—

307 work days use per year are assumed. The metered K.W. hours per month are divided by the K.W. capacity of the consumers full connected load, as estimated or measured, to obtain his monthly hours of use. The rate per K.W. hour will be found on the same line, or can be interpolated for fractional parts of an hour. Minimum charge for no current—$2.84 per K.W.

the price of a K.W. hour 33 1-3 per cent higher than if I had used the generated power.

Instead of using the commercial rating of the 6.6 ampere magnetite lamps as given at 510 watts, I have taken the measurement made by the company at the sub-station and rated these lamps at 608 watts each, which makes the rating used by me about 20 per cent higher than the trade rating at which they are sold.

In fixing the maintenance and cost of one arc light per year, taken from the books of the company, at $29.07, I have taken the cost and maintenance and the operation of the old-fashioned lamp requiring trimming and new carbons every day. It is stated by the Schenectady General Electric Company to be much in excess of the operating cost and maintenance of the new magnetite arc lights.

In computing the cost of power I have included in it not only all repairs, and the fuel, but also a residual depreciation upon the whole works of 3 per cent as an extra, which is added on the supposition that all that can be has been done in the way of maintenance and repairs to the whole works.

I beg leave to again call your attention to the great liberality of 8 per cent profit, allowed on the investment per magnetite arc light proposed.

In figuring this investment of $264.50, I have accepted the figures reached by the representatives of the Minneapolis General Electric Company in a most exhaustive and elaborate examination of every part of the arc light system, and have only reduced this figure from $284.00 because of an obvious slip in final computation of the present value of each arc light.

I know it is in consonance with the wishes of the committee to have me do as I have done; I have always favored the company in doubtful cases.

I beg leave to recommend to the Public Lighting Committee that the price of a 6.6 ampere magnetite arc light, burning 3,770 hours per year, be fixed at $65.68.

Very respectfully,

WM. D. MARKS,

Consulting Engineer.

To Hon. Wm. Hooker, Ch.

CHAPTER IV.

QUANTITY RATES FOR ELECTRICITY.

In the preceding chapter the natural law of prices has been carefully traced for the conditions obtaining in Minneapolis.

This law has been verified by testing it under the intricate conditions as to diversity of sales and uses, of the *M. G. E. Company's* operations.

The tabulation and diagram of the Even Profit curve of prices give lucid directions for its application to all cases.

The Commonwealth Edison Company of Chicago (one of the largest electric companies in the world) appears to use this natural law in all of its sales, with great satisfaction to its consumers and ever growing prosperity for itself.

Nevertheless objections are often raised to keeping a record of the capacity of the connected load of each consumer, and efforts are made by means of "cut and try guesses" to fix a satisfactory quantity scale of prices, which will sell electricity by monthly quantities regardless of the installed capacity of consumers.

The Minneapolis figures of the preceding chapter will be used for the demonstration of quantity rates.

This quantity method requires a division of the fixed expenses amongst the meters as a monthly minimum charge to each meter, and the assumption that each kilowatt hour shall be loaded with its variable cost, its average depreciation and its average profit.

By use of the natural (and exact) law of prices we have obtained for the 1910 regimen of the Minneapolis G. E. Co. the following figures for a uniform rate (4.073c.) which would protect the M. G. E. Co. in a profit of 8 per cent on its present value of plant, and working capital—($6,500,000.)

The full connected lood operated 2.845 hours per day, 307 days:

Annual sales, K.W. hours				29,177126
Variable operating expense	$54,511.33	or	0.187c.	per K.W.H.
Fixed operating xpense	$463,992.82	"	1.590c.	" "
Profit and depreciation (10.3%)	670,000.00	"	2.296c.	" "
Total price	$1,188,504.15	"	4.073c.	" "
Flat monthly price per K.W. capacity (72.83 hrs.)				$2.97

The number of meters is given as 14,253 but as there are a number of unmetered consumers it will be more equitable to assume 15,000 consumers and charge each a meter per month although the meter is omitted.

The fixed bill per meter per year for service is $30.93 and per month $2.58 for each consumer.

The variable bill is for the commodity:

For variable operating expense	0.187c.	per K.W.H.
For profit and depreciation	2.296c.	" "
Total for commodity	2.483c.	" "

If the public were sufficiently intelligent or thoughtful to be able to recognize the distinction between the service and the commodity purchase necessarily involved in conducting a plant always operating and fully manned for their service, the acceptable method would be to charge separately for each as follows:

For monthly service.................. $2.58
For electricity for power use.......... 2.5c. per K.W.H.

But such does not appear to be the case.

For this reason some public service corporations have established stepped rate methods of charging.

In the previous chapter the rate arises from adding the fixed cost of service to the profit and depreciation on the portion of the plant required by a consumer; plus the vari able cost of the current.

In the present case of quantity rates the rate arises from the cost of service; plus the variable cost of current added to the average profit and depreciation per kilowatt hour deduced from 1910.

The feature of this quantity rate in whch it differs from the natural rate for a given regimen 1910 is that the future profit and depreciation of plant extensions are covered by it.

Dividing 29,177,126 kw-hours by 15,000 consumers and by 12 months we have the sales per meter month of 162.1 kw-hours corresponding to the regimen of 1910, assuming a meter for each consumer.

If, as we must for consistant quantity rates, we assume the average sales per meter month to be proportional to the total annual sales, actual or assumed, we have the following tabulation.

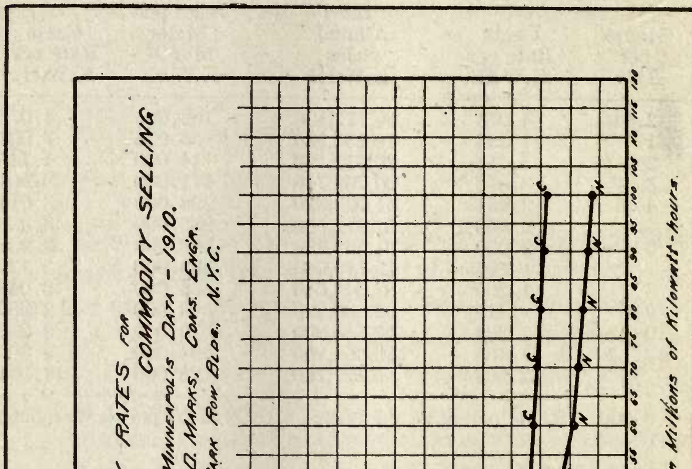
Comparison of Natural and Quantity Rates 1910

Natural Rates			Quantity Rates	
Hours per Day	Cents Rate per K.W.H.	Tot 1 Annual Sales K.W.H.	Sales per Meter Month K.W.H.	Cents Rate per K.W.H.
2.845	4.073	29,177,126	162.095	4.073
1.	11.244	10,255,580	56.975	7.007
2.	5.715	20,511,160	144.000	4.745
3.	3.873	30,766,740	171.000	3.991
4.	2.951	41,022,320	228.000	3.614
5.	2.398	51,277,900	285.000	3.388
6.	2.030	61,533,480	342.000	3.237
7.	1.766	71,789,060	399.000	3.129
8.	1.569	82,044,640	456.000	3.048
9.	1.415	92,300,220	513.000	2.986
10.	1.293	102,555,800	570.000	2.935
12.	1.108	123,066,960	684.000	2.860
½	22.301	5,127,790	28.000	11.531
0.000	$2.84 per K.W. connected		0 to 22	$2.58 per meter month

In the diagram the two rates are drawn as curves to show the relative prices, N. N. depicts the natural and exactly fair rate C. C. depicts the approximate quantity or commodity rate.

At no point will this quantity rate ever allow prices to fall below 2.483c. per kw-hour while the natural and logical rate (8 per cent and 2.3 per cent depreciation included) falls as low as 0.574c. per kw-hour for current furnished without interruption.

We have learned that in 1910 with an average of 162 K. W. H. per meter per month that 4.1c. per K. W. H. is a fair and profitable rate. We also see that this rate cannot fall below 2.483c. per K. W. H. on the quantity scale of prices.


QUANTITY RATES FOR COMMODITY SELLING
FROM MINNEAPOLIS DATA - 1910.
WM. D. MARKS, CONS. ENGR.
PARK ROW BLDG., N.Y.C.
Total Annual Sales in Millions of Kilowatt-hours
Price in Cents per K.W.-hour.

If now we seek a ready means of fixing prices on the commodity scale with rude accuracy, which shall protect the Electric Company in its averages, we have the following step rate per meter per month.

For the first 30 K.W.H. 11½c.
For the excess over 30 K.W.H. 2½c.
Taking the average sale per meter per month 162 K.W.H.

30 K.W.H. at 11½c.	$3.45
132 " " 2½c.	3.30
162 " " 4.1c.	$6.75

For 400 K.W.H. per month:

30 K.W.H. at 11½c.	$3.45
370 " " 2½c.	9.25
400 " " 3.15c.	$12.60

For 684 K.W.H. per month:

30 K.W.H. at 11½c.	$3.45
654 " " 2½c.	16.35
684 " " 2.9c.	$19.80

It is obvious that this Quantity rate cannot be successfully used in large power contracts, or for all night street lighting but it will appeal to small users of electricity because it appears to reduce rates to short hour users at the expense of consumers averaging higher.

A comparison of the commodity curve *C.C.* with the natural curve of even profits *N.N.* will make this clear.

We can verify this rules results by rough estimates as follows (see previous chapter for data):

Classes	Estimated Meters	Annual Sales
Incandescent K.W.H.	12,979	12,104,913
Commercial power K.W.H.	1,509	14,234,213
Street arc K.W.H.	512	2,838,000
Total	15,000	29,177,126

Incandescent sales per estimated meter month K.W.H.	77.7	Rate 5.97
Comm. power sales per estimated meter month K.W.H.	786.0	" 2.84
Street arc sales per estimated meter month K.W.H.	462.0	" 3.08

Proof

12,104,913 at 5.97c	$722,663.31
14,234,213 at 2.84c	404,251.65
2,838,000 at 3.08c	87,410.40
	$1,214,325.36
Check (basis of natural law)	1,188,504.15
Excess 2 per cent	$25,821.21

The tendency of the commodity curve *C.C.* and of the rule based on it is to increase the per cent of profit with each increase of sales that does not require additions to plant, or if the plant must be increased it provides for the fixed per cent of profit and depreciation of plant extensions which in this case is 10.3 per cent.

The natural curve *N.N.* will indicate the lowest limit of profitable operation if separate ventures into power contracts or very long hour lighting contracts are made.

This quantity rule is for current only, and proper additions per K. W. H. or to the cost of the plant must be considered if incandescent lamps or street arc lamps are included in the price.

This discussion of quantity rates is given because of the persistent efforts made by some electric companies to use it blindly and by "cut and try guesses" to reach "all the traffic will bear."

A very good example of this cut and try method is found in New York City's electric service for which the Company has obtained the approval of the New York State Public Service Commission.

The Electricity Rates of New York City

Before proceeding to publicly criticize the technical education and ability of the New York City Public Service Commission, the writer should make the statement that he has called to the attention of members of the Commission and also of the New York Edison Company, the exceeding injustice of its rates to consumers of small quantities, and that he has not had from either party any rational and practical answer to his objections to the existing rates in force in New York City.

As a fact the responsibility for these rates, legally rests entirely upon the Public Service Commission of the First District of New York, and only morally, and as a matter of good business judgment, upon the New York Edison Company.

Perhaps the most extraordinary statistical concoction ever issued by a Public Service Commission as a report, is Volume IV. 1910. Report of the Public Service Commission for the First District of New York State.

Instead of reprinting the financial reports of the few companies under its care as does the Massachusetts Commission, it has dismembered them and recapitulated by boroughs, the different amounts of electrical apparatus in each borough.

Instead of confining its report to the facts and figures of the corporations controlled, we are further given as a preface, a most amazing general essay on "Load Factors and Rates" which is so obscure, as to defy comprehension by the expert, and is misleading to the inexpert.

Naturally at the outset of the service of the Members of this Commission, appointed apparently without regard to technical education or experience, they had to learn, and we all expect errors from learners, but in 1912 the time for deliberate errors should have gone by (The Report for 1910 IV Volume was issued November 1912.)

However it is to this long delayed publication that we must have recourse for our facts.

Perhaps this is not altogether a misfortune since these figures should have formed the basis for the electricity price lists issued by the New York Edison Company, July 1, 1911, and still in force December 21, 1912.

The data required for a general discussion of rates is as follows:

Vol. IV (1910) page		
268	Connected load..................	
	Company's services K.W..........	542
	Arc lights "	17,760
	Street arc lights "	3,571
	Vapor arcs "	511
	Incandescent lights "	201,585
	Forward,	223,969

Vol. IV (1910) page			
	Brought Forward,	223,969	
	Batteries "	6,570	
	Motors "	197,647	
	Total "	428,186	
271	Station capacity K.W	173,100	
276	Total annual sales K.W.H	288,084,122	
599	Total annual gross earnings		$18,051,105.77
599	Total operating expense		10,685,241.38
365	Included in the operating expense are two items requiring consideration, viz.:		
	Materials, supplies and incidentals		$1,395,820.78
	General amortization		2,381,483.22

The total present structural value of a plant of a capacity of 173,100 K.W. located in New York City is estimated at less than $60,000,000 so that the amortization charge of 3.9 per cent of cost may be allowed to remain as fair residual depreciation for one year.

The materials etc., $1,395,820.78 (or 0.484c. per K.W.H.) is proportional to the load.

The remainder of the operating expense, or $9,289,420.60 is fixed and independent of daily variations of the station load.

New Rates Effective July 1, 1911, for Manhattan and the Bronx.

The New York Edison Company, and the United Electric Light and Power Company, the former operating in the Boroughs of Manhattan and the Bronx, and the latter in the Borough of Manhattan, have issued, to take effect July 1, 1911. a schedule of rates which cancels their Retail Light, Retail Power, Intermediate Wholesale, Special Wholesale, Automobile and Storage Battery rates. In addition, the New York Edison Company, has cancelled its Wholesale and

Special Wholesale rates for the Bronx district. The two companies have substituted for the rates cancelled the following rates:

General Rate—Available for all Consumers

The first	250	K.W.H.	of monthly	consumption	at	....	10c.
Next	250	"	"	"	"	....	9c.
"	250	"	"	"	"	....	8c.
"	250	"	"	"	"	....	7c.
"	500	"		"	"	....	6c.
Excess over	1,500	"	"	"	"	for the excess	5c.

These rates include the supply and the renewal of all standard incandescent lamps, and carbons for and trimming of arc lamps, or an equivalent allowance in the price of Tungsten or Tantalum lamps. Where of advantage to the consumer, power may be included under the general or wholesale rate.

Consumers making a yearly contract, who agree to an average monthly use of not less than 1,500 K.W.H., including power if desired, may renew their own incandescent lamps, supply carbons for and trim their arc lamps, and otherwise care for their installations, and for so doing will receive a special discount of ½c. a K.W.H.

Power Rate.

The first	200	K.W.H.	of monthly	consumption	at	....	9.5c.
Next	200	"	"	"	"	....	8c.
"	2,500	"	"	"	"	....	6c.
Excess over	2,900	"	"	"	"	for the excess	5c.

Wholesale Rate.

First 100,000 K.W.H. yearly consumption at		5c.
Next 100,000	" " " "	4c.
Over 200,000	" excess yearly "	3c.
500,000 K.W.H. yearly consumption not to exceed		$17,500.00
625,000	" " " " "	20,000.00
833,333	" " " " "	25,000.00

Yearly guarantee, Manhattan, 100,000 K.W.H; Bronx, 60,000 K.W.H.

Automobile, Storage Battery and Refrigation Rate.

The first	2,500 K.W.H. of monthly consumption at		5c.
Next	2,500	" " " "	4c.
Excess over	5,000	" " " " for the excess	3c.

This rate is dependent upon a minimum monthly bill of $25.00 and includes the agreement that where the use of current does not exceed 50,000 K.W.H. monthly, the cost shall not exceed $1,500.

New York City Rate for Aqueduct, Tunnel or Subway Construction.

Alternating current 6300-6600 volts, 25 cycles, 33-phase, shall be supplied at each or any of the shaft sites of the customer.

The price for this current shall be:

For each K.W.H of maximum demand upon the system of the company twenty ($20.00) dollars annually. The charge of twenty ($20.00) dollars is to be made and paid pro rata at the rate of one dollar, sixty-six and two-thirds cents ($1.66 2-3) monthly for each K.W. of demand.

For each K.W.H. of current actually consumed, as recorded by the company's meters, one (1c.) cent.

Where is it found inadvisable or impracticable to use high tension current, low tension current—120-240 volts—will be supplied at the rate of two and one-half (2½c.) cents per K.W.H. for the current actually consumed, as recorded by the company's meters.

The maximum demand for service rendered under this contract in each yearly period shall be not less than 200 K.W.

To give at a glance a more comprehensive grasp of the variation of each of these price lists they have been put in graphic form.

Diagram 1. General rate available for all consumers.

Diagram 2. Power rate

Diagram 3. Wholesale rate

Diagram 4. Automobile storage battery and refrigeration rate.

It will be noticed that the stepped prices for successive quantities of electricity always results in an average rate considerably higher than the stepped prices save at the origin.

For instance in the "General rate" (Diagram 1.) the lowest stepped price 6c. per K.W.H. corresponds to an average of 7.67c. per K.W.H.

This average result is generally true in all stepped rate price lists. Considering the bulk operating expenses required to produce and sell 288,084,122 K.W.H. we have:

Fixed operating expenses	$9,289,420.60	or 3.225c. per K.W.H.
Proportional operating expenses	$1,395,820.78	or 0.484c. per K.W.H.
Total	$10,685,241.38	and 3.709c.

That is to say with sales of 288,084,122 K.W.H. in 1910.

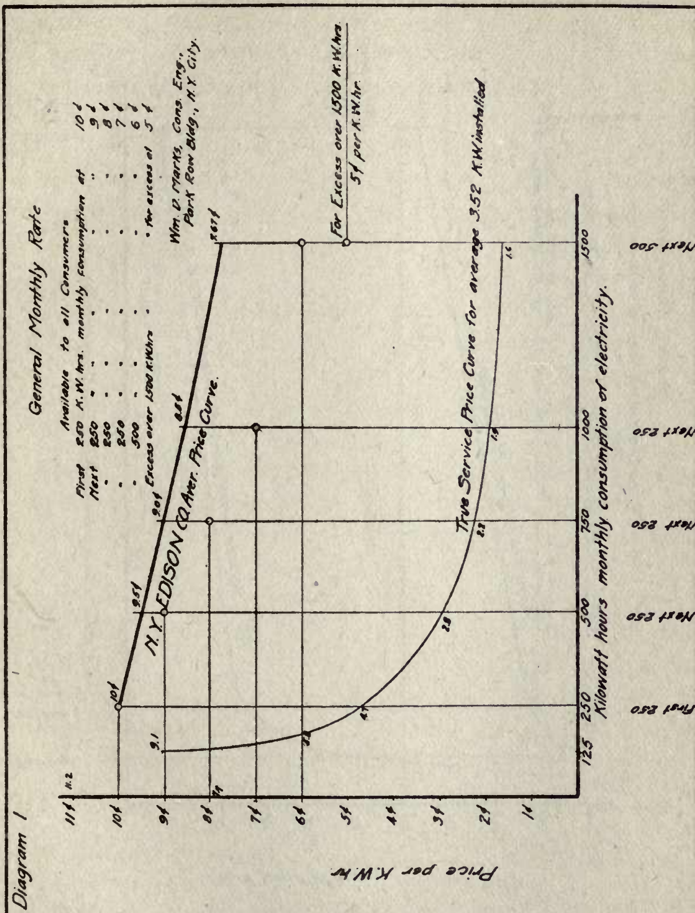


Diagram 1
General Monthly Rate
Available to all Consumers
First 250 K.W. hrs. monthly consumption at 10¢
Next 250 " " " " 9¢
" 250 " " " " 8¢
" 250 " " " " 7¢
" 500 " " " " 6¢
Excess over 1500 K.W.hrs " " for excess at 5¢
Wm. D. Marks, Cons. Eng., Park Row Bldg., N.Y. City.
N.Y. EDISON CO. Aver. Price Curve.
True Service Price Curve for average 3.52 K.W. installed
For Excess over 1500 K.W.hrs. 5¢ per K.W.hr.
Price per K.W.hr.
Kilowatt hours monthly consumption of electricity.
11¢
10¢
9¢
8¢
7¢
6¢
5¢
4¢
3¢
2¢
1¢
125
250
500
750
1000
1500
First 250
Next 250
Next 250
Next 250
Next 500
10¢
9.5¢
9.0¢
8.6¢
7.67¢
11.2
9.1
4.7
2.8
2.2
1.9
1.6

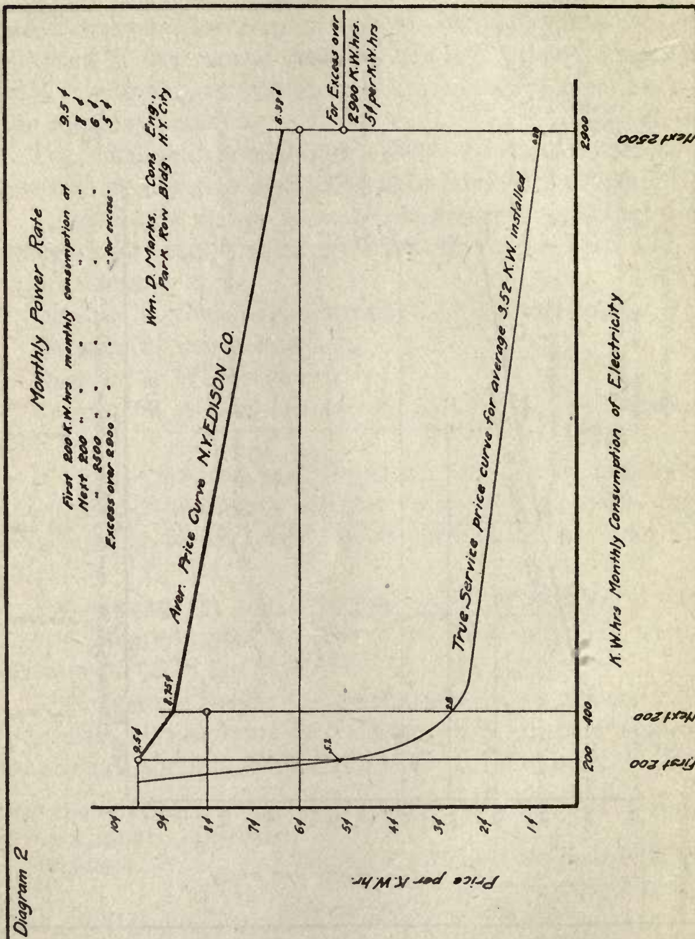


Diagram 2
Monthly Power Rate
First 200 K.W.hrs monthly consumption at 9.5 ¢
Next 200 " " " " " 8 ¢
" 2500 " " " " " 6 ¢
Excess over 2900 " " " " for excess " 5 ¢
Wm. D. Marks, Cons Eng.,
Park Row Bldg. N.Y. City
Aver. Price Curve N.Y. EDISON CO.
True Service price curve for average 3.52 K.W. installed
For Excess over
2900 K.W.hrs.
5¢ per K.W.hrs
9.5¢
8.75¢
5.2
6.39¢
10¢
9¢
8¢
7¢
6¢
5¢
4¢
3¢
2¢
1¢
Price per K.W.hr.
200
400
2900
K.W.hrs Monthly Consumption of Electricity
First 200
Next 200
Next 2500

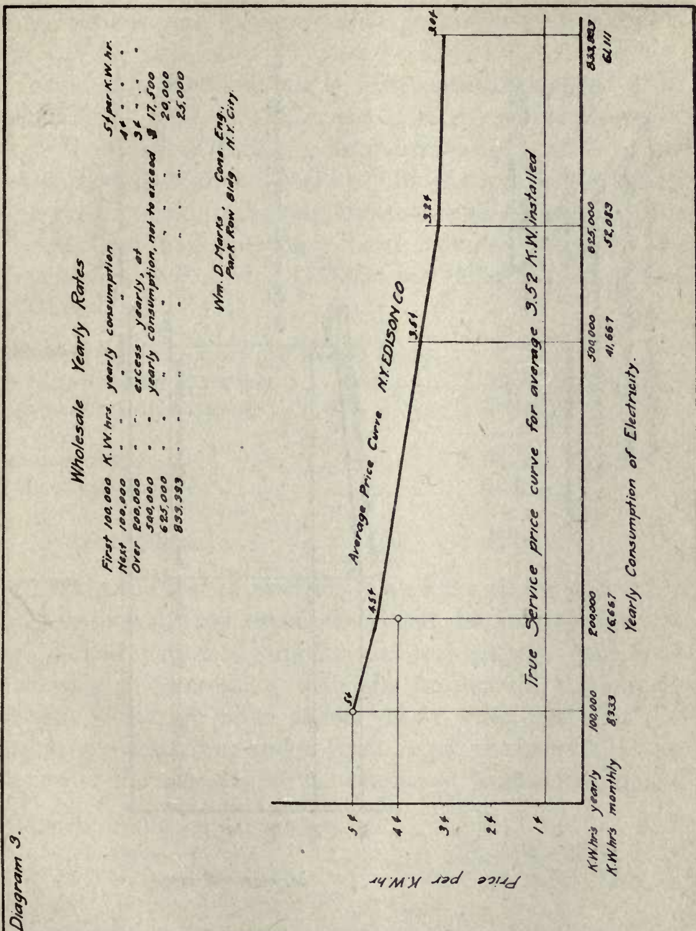

Wholesale Yearly Rates
First 100,000 K.W.hrs. yearly consumption 5¢ per K.W.hr.
Next 100,000 " " " " 4¢ " " "
Over 200,000 " " excess yearly, at 3¢ " " "
500,000 " " yearly consumption, not to exceed $ 17,500
625,000 " " " " " " 20,000
833,333 " " " " " " 25,000
Wm. D. Marks, Cons. Eng.
Park Row Bldg N.Y. City
Average Price Curve N.Y. EDISON CO
True Service price curve for average 3.52 K.W. installed
5¢
4.5¢
3.5¢
3.2¢
3.0¢
Price per K.W.hr
5¢
4¢
3¢
2¢
1¢
K.W.hrs yearly
K.W.hrs monthly
100,000
8333
200,000
16,667
500,000
41,667
625,000
52,083
833,333
Yearly Consumption of Electricity.

Diagram 3.

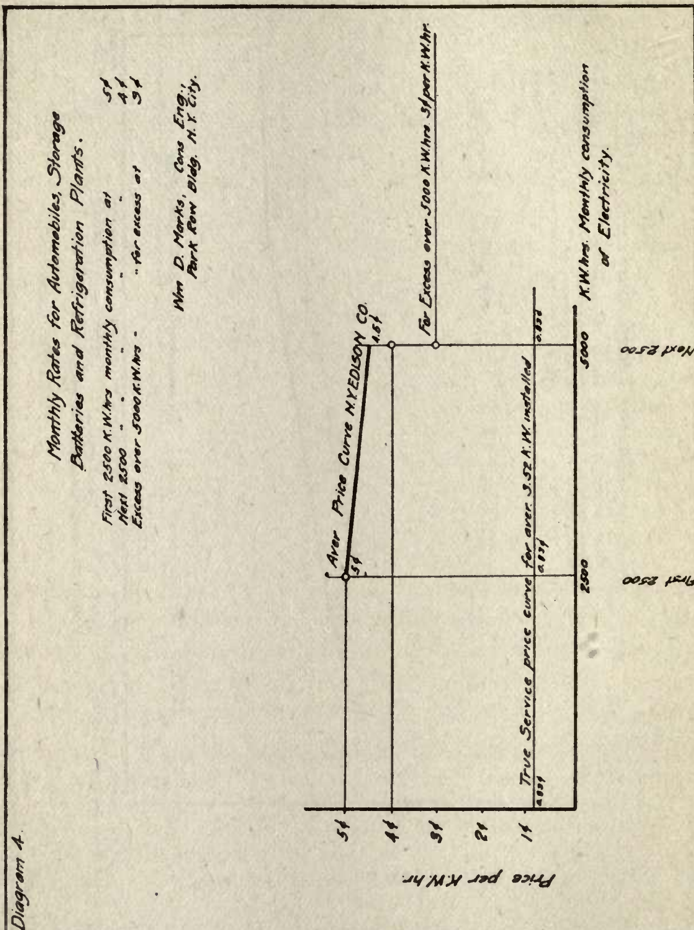


Diagram A.
Monthly Rates for Automobiles, Storage Batteries and Refrigeration Plants.
First 2500 K.W.hrs monthly consumption at 5¢
Next 2500 " " " 4¢
Excess over 5000 K.W.hrs " for excess at 3¢
Wm D. Marks, Cons. Eng.; Park Row Bldg. N.Y. City.
Aver. Price Curve N.Y. EDISON CO.
For Excess over 5000 K.W.hrs 3¢ per K.W.hr.
True Service price curve for aver. 3.52 K.W. installed
K.W.hrs. Monthly consumption of Electricity.
2500
5000
First 2500
Next 2500
5¢
4¢
3¢
2¢
1¢
Price per K.W.hr.

The operating expense due to fixed expenses were 3.225c. and to proportional expense 0.484c. making a total of 3.709c. per K.W.H. cost.

Included in fixed expense is "Utilization Expense" $818, 949.96 (page 362) or 0.283c. per K.W.H. which appears to be for labor and material for an *indeterminate portion* of the station load and for the total load, its changes do not appear to be proportional to the sales but rather as a fixed operating expense, and has, therefore, been included in it for the present purposes—giving 3.709c. per K.W.H. as a final inclusive total.

For power sales only we would have:

Fixed operating expense	3.225c.	per K.W.H.
Less utilization expense	.283c.	" "
Fixed expense	2.942c.	" "
Proportional	.484c.	" "
Total expense	3.426c.	" "

Since in the cost of electricity, we have two factors—first daily or yearly fixed expenses, second, an expense for fuel, etc., (called materials, supplies and incidentals) (page 369), increasing or decreasing with the burden on the electric station, which we have called yearly sales, we must determine for what time and to what extent the capacity of the station or the capacity of the connected load is operated.

The total hours for a year are	8760
" " sales " " " "	288,084,122 K.W.H.
" " connected load is	428, 186K.W.
Average hours of operation of the connected load per year (about)	672.8
Per day (year of 307 work days) hrs.	2.192

(Report page 274). By reason of the diversity of uses of electricity by the connected load, the greatest demand upon the Edison stations in 1910 was—for *A* and *B* 151,800 K.W. The total nominal capacity of this company's stations is given as 173,100 K.W. and this could probably have been, increased 50 per cent for two hours of peak loads without injury to the machinery (page 271). Up to, say 250,000 K.W.

There are large apparent losses between the electric power generated and the electric power sold, but as in this commercial criticism of rates, the amount sold is our basis, it is not necessary to discuss these losses.

The capacity of these stations, being nominally 173,100 K.W., it would be necessary to operate them for 1,681.7 hours per year, to generate 288,084,122 K.W.H. Hours per day (307 work days per year) 5.48.

We can now dismiss the capacity (173,100 K.W.) and the time required per day (5.48 hrs.) of it, as being amply margined in the installation of machines in stations, for if practical requirements could be adapted to a uniform station load, there could be produced each year 173,100 K.W. by 8,760 hours or 1,516,356,000 K.W.H.

Is an electric station *a public servant* entitled to charge for its service a profit on its investment and for its operating expenses, dependent upon its hours and days of service?

Or is it a *vendor of a commodity* (electricity) entitled to charge a profit on the quantity of that commodity sold regardless of other factors?

Since the only correct method of obtaining the cost of electric service is by regarding the time of service and the investment, I am of the opinion that the electric station is a public servant and fairly entitled to render bills for service on that basis.

The general public accustomed to trading in commodities, however, always have a preference for dealings on the basis of quantity, with a discount to wholesale purchasers.

This arises from the fact that most of our merchants, trading in rented stores and having no large investment, have found it practically profitable to give large discounts for large sales, and have permanently acquired and adopted that point of view.

In case of a possibly competitive or wholesale purchaser of electricity the electric station manager may find himself compelled to regard electricity as a commodity.

For this reason I have endeavored elsewhere to add a consistant commodity scale of prices to the service scale of prices properly computed.

In its guarded monopoly, secure from the healthy corrective of competitive commercial warfare, the tendency of most public service corporations is to extort from small consumers to cover losses from large ones who otherwise would be competitors, at least for their own uses.

For the purpose of getting the price of current only in computing even profit rates for electricity, I shall omit "Utilization Expense" and allow to the New York Edison Company, a lump annual profit of $4,800,000 on its plant and working capital (8% on $60,000,000.00).

For the year 1910 we have the following computations:

The full connected load operated daily 2.192 hours for 307 days.

Annual sales K.W.H.			288,084,122
Proportional operating expense	$ 1,395,820.78	per K.W.H.	0.484c.
Fixed " "	8,470,470.64	" "	2.940c.
Profit " "	4,800,000.00	" "	1.666c.
Fair total price	$14,666,291.42	" "	5.090c.
Flat monthly payment per K.W. capacity (56.12 hrs.)			$2.86

The New York Edison Company with a gross earning of $18,051.77 collected 6.266c. per K.W. 1910 which gave an excess of $2,565,864.39 greater than a fair profit of $4,800,000 on its structural value and working capital.

Inclusive of utilization expenses it reported:

Total annual gross earning	$18,051,105.77
Total operating expense	10,685,241.38
Net annual earnings	$7,365,864.39

The full connected load operated daily one hour for 307 days.

Annual sales			131,425,237
Proportional operating expense	$636,779.50		
Fixed " "	8,470,470.64	per K.W.H.	6.929c.
Profit	4,800,000.00		
Fair total price	$13,907,250.14	" "	10.581c.
Flat monthly payment per K.W. capacity (25.6 hrs.)			$2.71

The full connected load operated daily 2 hours for 307 days.

Annual sales K.W.H.			262,850,474
Proportional operating expense	$1,273,559.00		
Fixed " "	8,470,470.64	per K.W.H.	3.707c.
Profit	4,800,000.00		
Fair total priee	$14,544,029.64	per K.W.H.	5.533c.
Flat monthly payment per K.W. capacity (51.2 hrs.)			$2.83

The full connected load operated daily 3 hours for 307 days.

Annual sales K.W.H.			394,275,711
Proportional operating expense	$1,910,338.50		
Fixed " "	8,470,470.64	per K.W.H.	2.632c.
Profit	4,800,000.00		
Fair total price	$15,180,809.14	" "	3.850c.
Flat monthly payment per K.W. capacity (76.8 hrs.)			$2.96

The full connected load operated daily 4 hours for 307 days.

Annual sales K.W.H			525,700,948
Proportional operating expense	$2,547,118.00		
Fixed "	8,470,470.64	per K.W.H.	2.095c.
Profit	4,800,000.00		
Fair total price	$15,817,588.64	" "	3.009c.
Flat monthly payment per K.W. capacity (102.4 hrs.)			$3.08

The full connected load operated daily 5 hours for 307 days.

Annual sales K.W.H.			657,126,185
Proportional operating expense	$3,183,897.50		
Fixed " "	8,470,470.64	per K.W.H.	1.773c.
Profit	4,800,000.00		
Fair total price	$16,454,368.14	" "	2.504c.
Flat monthly payment per K.W. capacity (128 hrs.)			3.21

The full connected load operated daily 6 hours for 307 days.

Annual sales K.W.H.			788,551,422
Proportional operating expense	$3,820,677.00		
Fixed " "	8,470,470.64	per K.W.H.	1.558c.
Profit	4,800,000.00		
Fair total price	$17,091,147.64	" "	2.167c.
Flat monthly payment per K.W. capacity (153.6 hrs.)			$3.33

The full connected load operated daily 7 hours for 307 days.

Annual sales K.W.H.			919,976,659
Proportional operating expense	$4,457,456.50		
Fixed " "	8,470,470.64	per K.W.H.	1.405c.
rofit	4,800,000.00		
Fair total price	$17,727,927.14	" "	1.927c.
Flat monthly payment per K.W. capacity (179.2 hrs.)			$3.45

The full connected load operated daily 8 hours for 307 days.

Annual sales K.W.H.			1,051,401,896
Proportional operating expense	$5,094,236.00		
Fixed " "	8,470,470.64	per K.W.H.	1.290c
Profit	4,800,000.00		
Fair total price	$18,364,706.64	" "	1.746c.
Flat monthly payment per K.W. capacity (204.8 hrs.)			$3.58c.

The full connected load operated daily 9 hours for 307 days.

Annual sales K.W.H.			1,182,827,133
Proportional operating expense	$5,731,015.50		
Fixed " "	8,470,470.64	per K.W.H.	1.200c.
Profit	4,800,000.00		
Fair total price	$19,001,486.14	" "	1.606c.
Flat monthly payment per K.W. capacity (230.4 hrs.)			$3.70

The full connected load operated daily 10 hours for 307 days.

Annual sales K.W.H.			1,314,252,370
Proportional operating expense.	$6,367,795.00		
Fixed " " .	8,470,470.64	per K.W.H.	1.128c.
Profit	$4,800,000.00		
Fair total price	$19,638,265.64	" "	1.494c.
Flat monthly payment per K.W. capacity (256 hrs.)			$3.82

The full connected load operated daily 12 hours for 307 days.

Annual sales K.W.H.			1,577,102,844
Proportional operating expense	$7,641,354.00		
Fixed " "	8,470,470.64	per K.W.H.	1.021c.
Profit	$4,800,000.00		
Fair total price	$20,911,824.64	" "	1.326c.
Flat monthly payment per K.W. capacity (307.2 hrs.)			$4.07c.

The full connected load operated daily 24 hours for 365 days.

Annual sales K.W.H.			3,750,087,713
Proportional operating expense	$18,169,866.25		
Fixed " "	8,470,470.64	per K.W.H.	.710c.
Profit	$4,800,000.00		
Fair total price	$31,440,336.89	" "	.838c.
Flat monthly payment per K.W. capacity (730 hrs.)			$6.12

The full connected load operated daily ½ hour for 307 days.

Annual sales K.W.H.			65,712,618
Proportional operating expense	$318,389.75		
Fixed " "	8,470,470.64	per K.W.H.	13.374c.
Profit	4,800,000.00		
Fair total price	$13,588,860.39	" "	20.679c.
Flat monthly payment per K.W. capacity (12.8 hrs.)			$2.65

The full connected load cut off. No current used.

Total connected load K.W.			428,186
Fixed operating expense	$8,470,470.64		
Profit	4,800,000.00		
Total price	$13,270,470.64	per K.W.H.	$30.99
Flat monthly payment per K.W. connected load			$2.58

Objections have been raised to the above method of computation on the ground that the connected loads, assumed in K.W.H., cannot be operated by the station power installed. To all arithmetical computations the same objection can be raised. If the reader will take the trouble to reverse my operations after segregating the various classes of utilizations and their hours of use, he will find that the method verifies itself when applied to the actual operation of the station. (See Chapter III.)

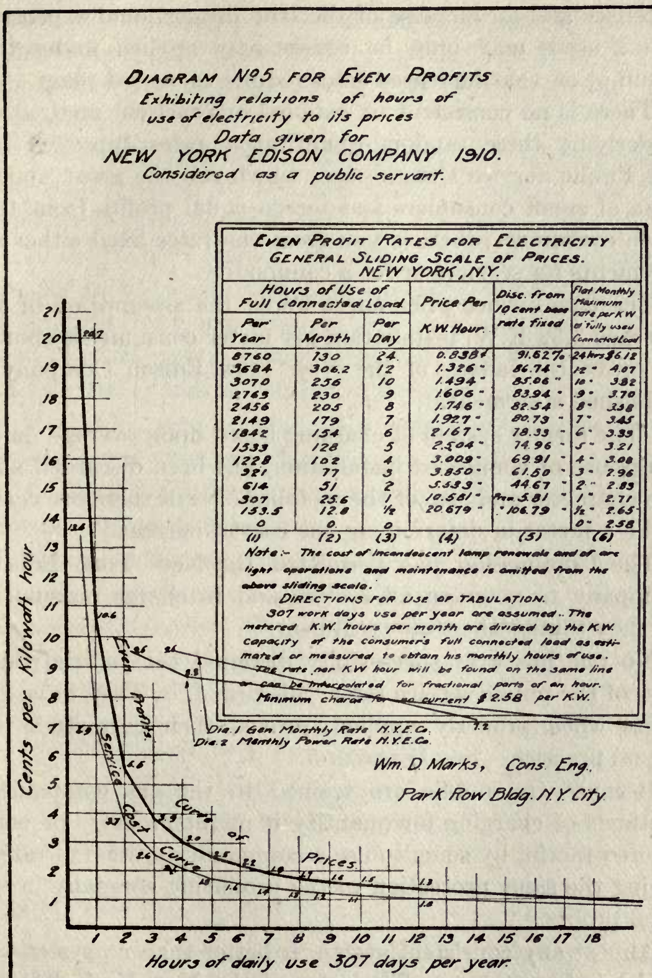
Diagram 5 gives the cost and price curves for electricity, embodying a recapitulation of all of the above computations, in detail, with the rule for the use of the table.

Regarding the New York Edison Company as a public servant only, a public service commission would have reached the following conclusions:—

Each consumer should be charged a minimum rate of $2.58 for each K.W. of capacity installed if using no current. For a daily use of each K.W. installed for one hour, the rate would be about 11c. per K.W.H. with lamps or a monthly payment of $2.71 for current. For a daily use of his K.W. installed for 10 hours, the rate would be about 2c. with lamps per K.W.H. or a monthly payment of $3.82 for current only.

With commercial adequacy the rates for electric power are given on the basis of hours of use for all usual conditions in Diagram 5. The addition of ½c. per K.W.H. of these base rates provides for the free renewal of incandescent lamps and for trimming arc lights, called "Utilization Expense."

The commodity scale of prices is not judicially fair even when figured out carefully—it is a compromise making rates per K.W.H. too low to small consumers, and too high to large consumers—by reason of a reduction of the true fixed



Hours of Use of Full Connected Load			Price Per K.W. Hour.	Disc. from 10 cent base rate fixed	Flat Monthly Maximum rate per K.W. of fully used Connected Load
Per Year	Per Month	Per Day			
8760	730	24.	0.838¢	91.62%	24 hrs $6.12
3684	306.2	12	1.326 "	86.74 "	12 " 4.07
3070	256	10	1.494 "	85.06 "	10 " 3.82
2763	230	9	1.606 "	83.94 "	9 " 3.70
2456	205	8	1.746 "	82.54 "	8 " 3.58
2149	179	7	1.927 "	80.73 "	7 " 3.45
1842	154	6	2.167 "	78.33 "	6 " 3.33
1533	128	5	2.504 "	74.96 "	5 " 3.21
1228	102	4	3.009 "	69.91 "	4 " 3.08
921	77	3	3.850 "	61.50 "	3 " 2.96
614	51	2	5.533 "	44.67 "	2 " 2.83
307	25.6	1	10.581 "	Prem. 5.81 "	1 " 2.71
153.5	12.8	½	20.679 "	" 106.79 "	½ " 2.65
0	0.	0			0 " 2.58
(1)	(2)	(3)	(4)	(5)	(6)

Note:— The cost of incandescent lamp renewals and of arc light operations and maintenance is omitted from the above sliding scale.

DIRECTIONS FOR USE OF TABULATION.

307 work days use per year are assumed. The metered K.W. hours per month are divided by the K.W. capacity of the consumer's full connected load as estimated or measured to obtain his monthly hours of use. The rate per KW hour will be found on the same line or can be interpolated for fractional parts of an hour. Minimum charge for no current $2.58 per K.W.

expenses and an increase of the true proportional expenses, but if used, may only be consistently applied under the assumption that increased sales require increased plant.

There is no consistent or rational or practical method of underlying these random quantitative rates approved by the Public Service Commission, which rob the great multitude of small consumers and forego equal profits from the large consumers whether you treat the rates fixed either as payments for services or for a commodity.

The true service price curve under the assumption of an average 3.52 K.W. installation per meter consumer is shown to prove the fallacy of the New York Edison Company's published statement.

"The former system of charging based upon average daily hours use of connected installation, has been discarded and the character and size of the installation will therefore cease to be a factor in determining the cost of current."

The Commission has permitted the New York Edison Company to abandon all system and to charge consumers all they think "the traffic will bear."

No one has ever successfully disputed the judicial fairness of the public service rates "discarded." They have for years when properly applied, proved their correctness in actual practice. See Diagram 5.

Because the public are trained to the gas companies' methods of charging for quantity it might properly be considered tactful by some to use a commodity system of rates, giving the same protection to the producing company in its total profits.

Almost any consistent system is better than no system at all in making rates. The rates of the New York Edison

Company are utterly irrational and this Company has been turned loose to wander at will over the field of its guarded monopoly, by the New York City Public Service Commission.

What its profits have been since in 1910, is not known to the public, owing to the inexcusable delays of this Commission in printing its reports.

In the writer's opinion, the New York Edison Company's proper profits should not have exceeded $4,800,000 and the Public Service Commission should have established rational and practical rates, giving citizens of New York the benefit of $2,500,000 and preventing future extortion.

It should have adhered to a tested and practically fair system until some equally rational and simpler system than the "discarded" public service rate giving even profits to the producer was presented.

Making a few comparisons, let us see the results.

A consumer has introduced 20 (50 watt) incandescent lights in his installation, it is 1 K.W. with free lamps.

If he burns these four hours a night for one month 25.6 days, he uses 102.4 K.W.H.

New York Edison rate	
102 K.W.H. at 10c..................	$10.20
Diagram 5, Public Service Rate	
102.4 K.W.H. at 3.5c(½c. per K.W.H. for lamps)........................	3.59
Extortion for one month.............	$6.61

A consumer uses a 5 H.P. (3.75 K.W.) motor ten hours per day for one month (25.6 days) requiring 960 K.W.H.

New York Edison rate		
200 K.W.H. at 9½c..................	$19.00	
200 " " 8c..................	16.00	
560 " " 6c..................	33.60	$68.60
Diagram 5, Public Service rate		
960 K.W.H. at 1½c..................		14.20
Extortion for one month..............		$54.40

For service if the 20 light consumer had not used them at all, he would have had to pay $2.58 and if the 5 H.P. motor user had let it remain idle, he would have had to pay a minimum charge of $9.68 to protect the New York Edison Company in a fair profit.

You see the real user of light and power in New York City is subject to grinding extortion to pay excessive profits and for the service of customers, using light and power only at long intervals, as a convenience or a luxury. Even if he were charged reasonable rates, as he is not, if those not really needing light or power, do not pay a minimum charge for readiness to serve on the part of the Company, the real user must be overcharged to pay for idle installations and protect the public service company.

Take as many instances as you please, in nearly every one by the service or commodity rates the small installation is robbed and the large one gets off without paying equal profit or price for electricity under the random rates of the New York Edison Company.

What can this Commission plead as an apology for suffering such injustice to be perpetrated upon the weak for years under its rule?

The vastness of our great monopolistic corporations practically prevents the individual from protecting himself.

The state has appointed this Commission and made it its sole duty to protect the public, and do right by the public service corporations.

The political principle is correct in its aims, but if a Commission is indolent, ignorant, inefficient, timid, or corrupt, it is only a Lord of Misrule (perhaps unwittingly) and the greatest creation to protect organized corrupt practices yet devised in our republic.

For the solution of the problem of electric rates, there is but one right method, yet a thousand or more incorrect ways have been attempted. The only right way is to obtain the details accurately as they present themselves in the operation of an electric plant and then to follow their quantitative combination as they actually occur until *the natural law* controlling the cost and selling price of electric power is evolved. Thus only can all men requiring it, receive judicially fair treatment and an equal opportunity.

CHAPTER V.

METHODS OF APPRAISEMENT.

Very little attention had been given to methods of appraisement of public utilities of any sort in the United States until about 1900.

The water works appear as the first class of utilities to receive the thoughtful and methodical appraisements of engineers; these were followed in turn by gas works and electric works and now railway properties are being appraised

An act of the Senate and House of Representatives approved March 1, 1913 is subjoined as it is supposedly the latest advance in the science of appraisement and appears to be sufficiently broad to cover every form of public utility, prescribing proper conditions for appraisement.

PUBLIC—No. 400.

H. R. 22,593.

An Act To amend an Act entitled, "An Act to regulate commerce," approved February fourth, eighteen hundred and eighty-seven, and all Acts amendatory thereof by providing for a valuation of the several classes of property of carriers subject thereto and securing information concerning their stocks, bonds, and other securities.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act to regulate commerce," approved February fourth, eighteen hundred and eighty-seven, as amended, be further amended by adding thereto a new section, to be known as section nineteen a, and to read as follows:

"Section 19a. That the commission shall, as hereinafter provided, investigate, ascertain, and report the value of all the property owned or used by every common carrier subject to the provisions of this Act. To enable the commission to make such investigation and report, it is authorized to employ such experts and other assistants as may be necessary. The commission may appoint examiners who shall have power to administer oaths, examine witnesses, and take testimony. The commission shall make an inventory which shall list the property of every common carrier subject to the provisions of this Act in detail, and show the value thereof as hereinafter provided, and shall classify the physical property, as nearly as practicable, in conformity with the classification of expenditures for road and equipment, as prescribed by the Interstate Commerce Commission.

"First. In such investigation said commission shall *ascertain and report in detail as to each piece of property owned or used* by said common carrier for its purposes as a common carrier, *the original cost to date, the cost of reproduction new, the cost of reproduction less depreciation*, and an analysis of the methods by which these several costs are obtained, and the reason for their differences, if any. The commission shall in like manner *ascertain and report separately other values, and elements of value*, if any, of the property of such common carrier, and an analysis of the methods of valuation employed, and of the reasons for any differences between any such value, and each of the foregoing cost values.

"SECOND. Such investigation and report shall state in detail and *separately from improvements the original cost of all lands, rights of way, and terminals* owned or used for the purposes of a common carrier, and ascertained *as of the time of dedication to public use, and the present value* of the same, and separately *the original and present cost of condemnation and damages or of purchase* in excess of such original cost or present value.

"THIRD. Such investigation and report shall show separately the *property held for purposes other than those of a common carrier*, and *the original cost and present value of the same*, together wtih an analysis of the methods of valuation employed.

"FOURTH. In ascertaining the original cost to date of the property of such common carrier the commission, in addition to such other elements as it may deem necessary, shall investigate and *report upon the history and organization* of the present and of any previous corporation operating such property; upon any *increases or decreases of stocks, bonds, or other securities*, in any reorganization; upon moneys received by any such corporation by reason of any issues of stocks, bonds, or other securities; upon the syndicating, banking, and other financial arrangements under which such issues were made and the expense thereof and upon *the net and gross earnings of such corporations*, and shall also ascertain and report in such detail as may be determined by the commission upon the *expenditure of all moneys* and the purposes for which the same were expended.

"FIFTH. The commission shall ascertain and report the amount and *value of any aid, gift, grant of right of way, or donation,* made to any such common carrier, or to any previous corporation operating such property, by the Government of the United States or by any State, county, or municipal government, or by individuals, associations, or corporations, and it shall also ascertain and report the grants of land to any such common carrier, or any previous corporation operating such property, by the Government of the United States, or by any State, county, or municipal government, and the amount of *money derived from the sale of any portion of such grants* and the *value of the unsold portion* thereof at the time acquired and at the present time, also, the amount and value of any concession and allowance made by such common carrier to the Government of the United States, or to any State, county, or municipal government in consideration of such aid, gift, grant, or donation.

"Except as herein otherwise provided, the commission shall have power to prescribe the method of procedure to be followed in the conduct of the investigation, the form in which the results of the valuation shall be submitted, and the classification of the elements that constitute the ascertained value, and such investigation shall show the value of the property of every common carrier as a whole and separately the value of its property in each of the several States and Territories and the District of Columbia, classified and in detail as herein required.

"Such investigation shall be commenced within sixty days after the approval of this Act and shall be prosecuted with diligence and thoroughness, and the result thereof reported to Congress at the beginning of each regular session thereafter until completed.

"Every common carrier subject to the provisions of this Act *shall furnish to the Commission or its agents from time to time and as the Commission may require maps, profiles, contracts, reports of engineers, and any other documents, records, and papers, or copies* of any or all of the same, in aid of such investigation and determination of the value of the property of said common carrier, and shall grant to all agents of the commission *free access to its right of way, its property, and its accounts, records, and memoranda whenever and wherever requested* by any such duly authorized agent, and every common carrier is hereby directed and *required to cooperate with and aid the commission in the work of the valuation of its property* in such further particulars and to such extent as the commission may require and direct, and all rules and regulations made by the commission for the purpose of administering the provisions of this section and section twenty of this Act shall have the full force and effect of law. Unless otherwise ordered by the commission, with the reasons therefor, the records and data of the commission shall be open to the inspection and examination of the public.

"Upon the completion of the valuation herein provided for the commission shall thereafter in like manner keep itself informed of all extensions and improvements or other changes in the condition and value of the property of all common carriers, and shall ascertain the value thereof, and shall from time to time, revise and correct its valuations, showing such revision and correction classified and as a whole and separately in each of the several States and Territories and the District of Columbia, which valuations, both original and corrected, shall be tentative valuations and shall be reported to Congress at the beginning of each regular session.

"To enable the commission to make such changes and corrections in its valuations of each class of property, every common carrier subject to the provisions of this Act shall make such reports and furnish such information as the commission may require.

"Whenever the commission shall have completed the tentative valuation of the property of any common carrier, as herein directed, and before such valuation shall become final, the commission shall give notice by registered letter to the said carrier, the Attorney General of the United States, the governor of any State in which the property so valued is located, and to such additional parties as the commission may prescribe, *stating the valuation placed upon the several classes of property* of said carrier, and *shall allow thirty days in which to file a protest* of the same with the commission. If no protest is filed within thirty days, said valuation shall become final as of the date thereof.

"If notice of protest is filed the commission shall fix a time for hearing the same, and shall proceed as promptly as may be to hear and consider any matter relative and material thereto which may be presented in support of any such protest so filed as aforesaid. If after hearing any protest of such tentative valuation under the provisions of this Act the commission shall be of the opinion that its valuation should not become final, it shall make such changes as may be necessary, and shall issue an order making such corrected tentative valuation final as of the date thereof. All final valuations by the commission and the classification thereof shall be published and shall be prima facie evidence of the value of the property in all proceedings under the Act to regulate commerce as of the date of the fixing thereof, and in all judicial proceedings for the enforcement of the Act approved February fourth, eighteen hundred and eighty-seven, commonly known as "the Act to regulate commerce," and the various Acts amendatory thereof, and in all judicial proceedings brought to enjoin, set aside, annul, or suspend, in whole or in part, any order of the Interstate Commerce Commission.

If upon the trial of any action involving a final value fixed by the commission, evidence shall be introduced regarding such value which is found by the court to be different from that offered upon the hearing before the commission, or additional thereto and substantially affecting said value, the court, beore proceeding to render judgment shall transmit a copy of such evidence to the commission, and shall stay further proceedings in said action for such time as the court shall determine from the date of such transmission. Upon the receipt of such evidence the commission shall consider the same and may fix a final value different from the one fixed in the first instance, and may alter, modify, amend or rescind any order which it has made involving said final value, and shall report its action thereon to said court within the time fixed by the court. If the commission shall alter, modify, or amend its order, such altered, modified, or amended order shall take the place of the original order complained of and judgment shall be rendered thereon as though made by the commission in the first instance. If the original order shall not be rescinded or changed by the commission, judgment shall be rendered upon such original order.

"The provisions of this section shall apply to receivers of carriers and operating trustees. In case of failure or refusal on the part of any carrier, receiver, or trustee to comply with all the requirements of this section and in the manner prescribed by the commission such carrier, receiver, or trustee shall forfeit to the United States the sum of five hundred dollars for each such offense and for each and every day of the continuance of such offense, such forfeitures to be recoverable in the same manner as other forfeitures provided for in section sixteen of the Act to regulate commerce.

"That *the District Courts of the United States* shall have jurisdiction, upon the application of the Attorney General of the United States at the request of the commission, alleging a failure to comply with or a violation of any of the provisions of this section by any common carrier, *to issue a writ or writs of mandamus commanding such common carrier to comply with the provisions of this section.*" Approved, March 1, 1913.

If the Interstate Commerce Commission conscientiously obeys this mandate of the people of the United States they will uncover such a record of colossal thievery and extortion as will make the investors in and the patrons of our railways stand aghast.

On December 11, 1905, the author wrote an open letter upon the "Overcapitalization of Railroads" afterwards printed as Senate Document 168 of the 59th Congress and reprinted in The Finances of Gas and Electric Light and Power Enterprises, page 510.

This letter showed that of the nearly $12,600,000,000 railway securities in existence in 1903 about $7,000,000,000 were fictitious, having at the time of issue no more real value back of them than a counterfeit bank note.

Claims are now made that as many of our railways have utilized a portion of their profits to improve and extend their roads, their capitalizations and their present values are not so widely separated as at first.

In some cases this is true but it is the result either of the extortion of excessive profits from patrons or of the denial of dividends and interest to stock or bondholders.

These robberies are the inseparable evils resulting from the morally, if not legally, criminal act of making fictitious issues of securities.

Counterfeiting differs only from it in being a quicker and more direct method of swindling the public.

CHAPTER VI.

PRESENT VALUE. STRUCTURAL COST OF REPRODUCTION.

When the present value of the bare land without improvements is under consideration, the appraiser should obtain from the records the tax assessment of each parcel.

This present tax value is usually as high (pro rata if a percentage) as the tax assessors can venture to fix it without dispute.

If the appraiser is not personally and for some time, familiar with the values of real estate in the locality being considered, he must be cautious enough to obtain the assistance of a committee of real estate experts and having obtained their valuation should check it from recent sales of adjacent properties. The effect upon its value of any adjacent railways, navigable water fronts and other transportation facilities must also be taken into consideration.

The questions as to whether the real estate owned is required for the particular utility under consideration and whether it is used and useful, should be answered for each parcel and if not required in the near future its present value must be omitted.

Unless for the most cogent reasons, the use of multipliers of the value of adjacent lands to fix the value of the various parcels of land used, must be avoided, for it has led to absurd results in some cases.

If the utility works supplies a number of municipalities, each municipality should be allotted its pro rata of the present value of the real estate. Somer's System of Valuation of R. E. appears to the writer to be the only logical and fair system of appraisement of land published.

The courts are inclined to let a public utility share the advantage of the usual appreciation of land with the growth of a community, but cases do occur where land has become so much more valuable for other pruposes, that it would be unfair to value land above its worth for the purpose of supplying the utility for which it is used.

This is a debatable principle and each case must be settled on its local merits, and the possibilities of relocation of the works.

The writer has always been in doubt as to whether or not the present value of land should be increased by the addition of an overhead percentage charge, as properly are the buildings and apparatus, but has usually added the average overhead charges to land as favoring the utility company on a doubtful point.

Fixing the present value of the buildings and apparatus of a public utility is an exceedingly laborious and intricate task, but owing to the fact, that obtaining from its books the actual cost of a public utility is, in many (I might say in most) cases an impossibility, owing to its neglect and sophistication of its accounts and also to the fact that its books are frequently lost or destroyed, courts now invariably require the present value as a basis for their decisions.

The present value of the buildings and apparatus is obtained by subtracting their depreciations from their structural cost of reproduction at the prices of the date of an appraisement.

This structural cost is obtained by computing the individual cost (or contract price) of each building or parcel of apparatus separately and then adding them together as classified further surcharging them with the proper overhead charges of their class.

For the discovery of this structural cost in as complete detail as justice to the utility demands, requires

FIRSTLY. An exhaustive list of all of the used and useful property of the public utility as of the date of appraisement fixed.

SECONDLY. Accurate drawings and descriptions of every building, structure, or piece of apparatus now in existence as of the date of appraisement fixed.

THIRDLY. A list and descriptions of all of the public utility's property not in use directly for the purpose of supplying its special utility together with a statement as to the reasons for its ownership, whether for working stock, for future use or as abandoned property.

If the utility company is not able or willing to furnish such a list and the documents and records supplementing it, it will be necessary for the appraiser to construct this list himself.

In the case of works of considerable magnitude the author sends his assistant engineers in pairs to sketch and measure each building and piece of apparatus, after which they make dimensioned working drawings and compute the bills of material for each building or apparatus, each assistant doing his work separately and checking his associate's drawings and figures.

The chief engineer should so arrange as to be free to supervise and direct this work and will find himself the busiest individual of all.

When these lists of property and drawings of buildings are completed they must be verified and corrected by a most careful personal inspection before being collated and classified for the attaching of their present prices and the computations of the totals of each class.

When this is done the overhead charges of each class are added to it and the final total is the *structural cost of reproduction* at present prices.

From this structural cost subtract the *depreciation* (See Chapter VIII) and the result is the *present value.*

To reach a proper present value is no easy task, even after the enormous and intricate detail of the structural cost and of the depreciations are completed.

In obtaining the structural cost one must fix upon such times and order of construction in the future as are rationally and practically possible in which to construct the works.

If the investment in works amounts as it frequently does to millions, the time required is an important item affecting as it does the interest on the construction fund.

Some engineers make the statement that it is rarely possible to spend more than $1,000,000 a year but really such is not the case for the time required is principally a question of delivery of raw material.

If that can be obtained in sufficient quantity it is rarely impossible to build an ordinary public utility in two summers or 18 months.

As a matter of fact most public utilities have been extended piece-meal as their service requirements increased, and the overhead charges have been mostly covered into operating cost as salaries and appear on its books as the cost of the utility sold to be added to the price of the utility to consumers rather than as charges to plant construction.

Nevertheless it is always advisable within reason to err in favor of a public utility in the matter of liberal speculative allowances. It must be realized that as present value is based on the assumption the plant is going, it is in a physical sense its going value, otherwise the plant would have only a scrap value.

In considering the overhead charges we are obliged by an effort of the imagination to reach forward into the future construction of a plant but in considering depreciation we must by a similar effort of the mind reach backward into the past of a public utility.

Long experience and an intimate knowledge of the practical construction and operation of the kind of public utility considered are required to prevent irrational and impracticable assumptions as to the past or the future conditions controlling it.

As the truth should be known I may be pardoned for calling attention to a famous example of the general ignorance of the practical facts of a public utility's construction and operation, which occurred in the case of Willcox vs. the Consolidated Gas Company of New York, Supreme Court, United States.

The master's report, though voluminous, blundered at every practical point to which he referred in a most pitiable manner, and the Supreme Court of the U. S. ludicrously assumed in its decision that gas in the street mains was at all points at very high and dangerous pressures, although its decision as to price was fair, and as practical results afterward proved, entirely correct and satisfactory to the company.

Other values besides the controlling present value should be obtained as follows:

If the records of a utility are complete and reliable the *original cost to date* should be obtained to throw further light on its present value.

If the whole or a part of the works are obsolete, the structural cost of reduplication of an equivalent capacity of the present works may be of value to the court in finally fixing the present value although in so doing the methods of construction and processes of the present works may be entirely abandoned, for newer and better types, and the locations of the works may also be changed.

Franchise value (Chapter IX) Market value (Chapter X) Comparative Appraising (Chapter XI) and Going Value (Chapter XII) should each be considered in the case of a public utility as possibly modifying its present value obtained or as presenting it from a new point of view.

Sometimes a public utility company combines water and electricity or gas and electricity or water gas, electricity and transportation or all four under one management.

In such a case, the items of the plant must be carefully segregated in their structural costs and present values, and treated separately.

CHAPTER VII.

OVERHEAD CHARGES.

The overhead charges present another difficult matter for decision to the appraising engineer. Fixing overhead charges requires a fair minded effort to prophesy the percentages of various unavoidable time and technical expenses occurring in the reproduction of an existing plant.

Of one factor only is the mind relieved; omissions of structural details need not be considered, for if the list or inventory of a going property is complete, the omissions required by a preliminary estimate no longer exist.

The losses incurred in the sale of securities too should not be regarded as they are dependent more upon the solidity of the promoters means and abilities than anything else, and need not occur at all in the case of financially strong and experienced syndicates.

If the members of a promoting syndicate do not have the necessary financial standing and experience to sell their securities at their real values or furnish the cash, the public should not bear their burdens for them, unless very cogent reasons for it are given.

By common consent the interest on the cost of the plant during its time of construction forms part of the structural cost of reproduction of an existing plant, therefore the experienced appraiser should carefully estimate the period required under the present conditions to reproduce the plant being appraised.

Very few plants in the cities of the United States appear to require more than two summers or 18 months for reproduction and so at 6 per cent interest the manufacturing plant starting with no investment may usually be said to have lost about 4½ per cent of its estimated cost new during construction.

In a similar manner the interest lost during a longer or shorter period may be computed.

In the matters of engineering design and supervision from practical experience the writer is inclined to assume about 2 per cent of the whole manufacturing plant investment as fair. Usually architects and engineers appear to charge 3 to 5 per cent of the cost of the structures required for manufacturing for their designs and supervision but many of the details of a plant, more particularly of its equipment and land do not require the special services of an engineer or architect and so as a fact the percentage of the total cost of a manufacturing plant is greatly reduced. Practically the omission of most careful studies of the smallest details of a works is false economy both from a structural and an operating point of view. Nevertheless it is a fact that such omissions occur in the case in the construction of the works of most of our public utilities.

In the matter of taxes, after the appraiser has fixed upon the time of reproduction required the amount of the taxes for a similar period can be found from the company's records and its per cent of the estimated cost computed, assuming in that period as in the case of interest that the plant begins with no investment and completes the period of construction with its present estimated value.

For the usual public utility, with a construction period of

18 months, taxes on the plant do not exceed an average of 2 per cent in most places.

Royalties and occupation taxes on the gross sales or the net profits are really a part of the operating expense of a public utility and as such are not included in the taxes during construction.

Organization expenses 4 per cent is a leap in the dark and a most uncertain quantity.

We do know that franchises have to be obtained, that employes have to be paid to conduct a campaign of education of the public, that men controlling means of access to investors have to be paid commissions on their sales of stocks and bonds, that legal services are required, and much money spent in office organization, literature, account books, rent, etc., etc., during a preliminary period to the active construction period and also during such period.

No serious exception appears to have been taken to an allowance of $40,000 for each $1,000,000 estimated cost of the manufacturing plant.

This makes the usual aggregate of overhead charges appear to be:

Interest during construction	4½%
Engineering drawing and supervision	2%
Taxes during construction	2%
Organization expenses	4%
Total per cent of estimated cost	12½%

If access can be had to reliable records of the original cost of a public utility these overhead charges should be found to be less in the case of conservatively managed works.

In other instances it would appear as if more than 12½ per cent had been spent.

Nevertheless some appraisers laying great stress on the present structural cost of reproduction insist as a matter of consistency on a probable estimated overhead charge (for instance 12½ per cent) as of the present day even though, the facts being known to them from past records, the actual overhead expenses are much less than the estimated overhead charges.

When a works is sufficiently complete to operate with a portion of its distribution system only, then the piece-meal work of its extension begins under the supervision of its regular staff of employes. The overhead charges are usually small and sufficient margin to provide a contractors' profit of about 15 per cent should be substituted for the overhead charge of say 12½ per cent, on contract prices.

This 15% contractors' profit forms part of the cost of each structure whether surcharged or not.

CHAPTER VIII.

DEPRECIATION.

The remedy for depreciation is repairs but it is not its complete cure, for although repairs may be as thorough as possible there always remains a residual depreciation of both buildings and apparatus. Finally the works come to an end leaving only the land. The end of depreciation is scrap value.

Usually depreciation is reckoned on the basis of the useful life of the buildings and apparatus, that is to say in a physical way on their going value because they are going, although this term is also sometimes used in a financial sense to mean the computed "present value of a prospective income" to be added to the present physical value of an operating plant (see Going Value, Chapter XII), to obtain its total value.

Depreciation takes three forms:

(1) Physical decay or "wear and tear" requiring renewals.

(2) Inadequacy requiring enlargements.

(3) Obsolescence requiring abandonment.

Careful appraisers besides finding the age and life of a structure necessary to determine its physical decay also modify their percentages of depreciation by a personal inspection and the determining of its condition as either good, fair or bad.

In any structure its "wear and tear" is so largely dependent upon its quality of material and workmanship and the care given to it, that it is obvious, that its useful life is greatly prolonged by good materials and good care, and that its depreciation per year grows less as its life grows longer.

Renewals or repairs less scrap value are undisputedly an operating expense and pass from this account directly to the operating cost of the utility supplied.

Enlargements involve charging plant account with their cost, and then crediting this same account with the original cost of the inadequate building or apparatus displaced, and charging depreciation account, with the amount of the credit to plant account less value of the scrap if any.

Sometimes this latter amount is charged directly to profit and loss account, but this appears to be a mistake for then the true cost of supplying the utility is apparently reduced.

The cost of abandoned land, buildings or apparatus, if obsolete, less their scrap value, should be charged to depreciation account, unless these abandoned items arise from some other cause than obsolescence.

Very little heed appears to be paid to the scrap value of buildings and apparatus by experienced appraisers because they know that the cost to the plant of removal of materials and restoration of their vacated locality, usually exceeds scrap value, save in the case of land and of valuable metals, such as copper, lead, etc., in exceptional cases.

It is generally the case that the present value of vacated land is greater than its original cost and then depreciation becomes appreciation reducing the operating expenses when sold.

When abandoned land is sold at an advance cash or other accounts must be charged with its price, the land account credited with its original cost and depreciation account credited with the difference between the sale price and the lands original cost; as the reverse operation adopted with comparatively worthless scrap is considered proper and consistent.

In some cases courts have refused to allow the appreciation of land in use to be deducted from the depreciation of the buildings and apparatus in use, because they prefer to allow the utility company an equal advantage with the holders of unimproved land. This inconsistency is very human although irrational.

When a depreciation fund is established it should be in an immediately convertible form unless re-invested in the works in extensions.

Residual depreciation (remaining after thorough repairs) should be charged directly to operating expense account and credited to depreciation account and not as is often done—charged to profit and loss and credited to plant only. The result of this latter cross entry is that no cash is shown to be moved into depreciation account, but it still remains in bank in the common fund, and is frequently used for other purposes than extensions of plant to cure the residual depreciation and uphold the present value of the plant to the amount of its original cost.

For the purpose of a clear record the depreciation account must be credited with the amount of residual depreciation each year and operating expense charged with it.

Usually for gas works and electric plants this should be about 3 per cent and for water works 1½ per cent of the present value.

Of course each case requires study before final decision.

Whenever new extensions or new enlargements are made the depreciation account should be charged with them and the cash account credited with the same amount, then depreciation account credited and plant account charged.

Practically it is particularly important to have a full and clear depreciation record.

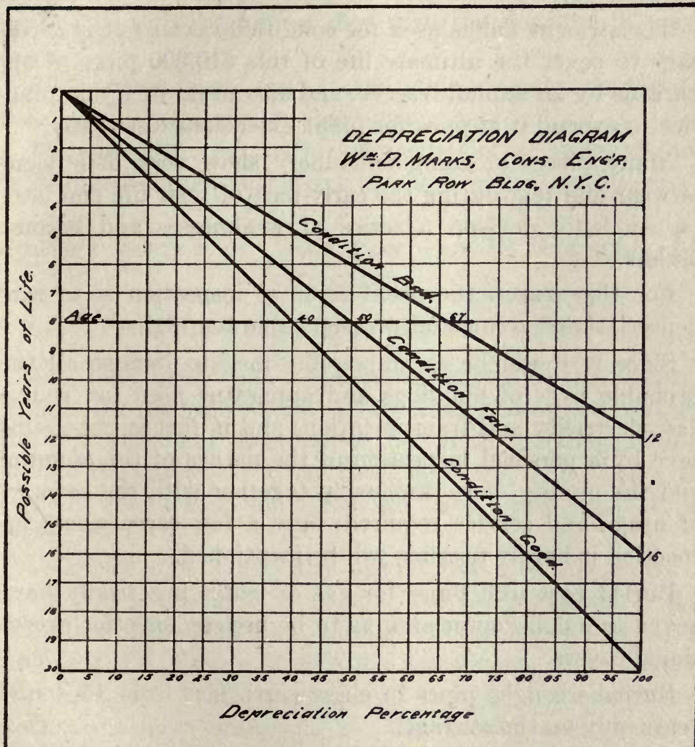
In the case of some companies charging a depreciation of large percentage each year to profit and loss and crediting it to plant account, the result often has been to find the book value of the plant very much less than its appraised present value because the repairs have been very thorough and minor extensions were included in them.

In some cases the cash was divided up as dividends.

The establishment of an inaccessible depreciation fund has been found to be impracticable since the result would after a few years, be a very much depreciated plant, and a fund at interest which could not be used, to extend the works as required by a growing business. Similarly annual allowances for depreciation on the basis of annuities producing an ultimate sum are impracticable because the residual depreciation should be charged to operating expense each year credit being given to it.

A diagram will elucidate the meaning of depreciation or rather residual depreciation best.

A piece of apparatus eight years old worth $10,000 original cost has a scrap value of $500, a possible life of twenty years if of the best material and given the best of care.


DEPRECIATION DIAGRAM
Wm. D. MARKS, CONS. ENG'R.
PARK ROW BLDG. N.Y.C.
Condition Bad.
Condition Fair.
Condition Good.
Age
40
50
67
12
16
Possible Years of Life.
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Depreciation Percentage

Nothing can impress the necessity of careful personal examination and test more strongly than this graphic presentation. If the condition is good we have a residual value of $6,500, fair condition $5,500, bad condition $3,800.

The straight line is used for condition because it is necessary to cover the ultimate life of this $10,000 piece of apparatus by an annual reserve, and also usual in actual practice to expend it at once for plant extensions elsewhere.

Many pieces of going machinery show very little signs of wear and tear during the early part of their life and later on suddenly develop a series of weaknesses and become useless.

For this reason the usual error of inspection is to rate depreciation too low and present value too high.

Since it would be an impossible task to itemize all the probable lives of buildings and apparatus used for water, gas, electricity and transportation; and in fact is impossible save by a personal inspection of the nature of the material and the quality of workmanship together with the severity of usage and service required; only a few cases where inspection is hardly possible will be mentioned.

Buried cast iron pipes for gas or water practically have never so much depreciated as to be useless, save for exceptional causes.

Buried wrought pipes in clean earth last from 15 to 25 years only on the average.

The steel pipes which latterly have supplanted the true wrought iron pipes are much more likely to pit.

Various pipe coverings for wrought iron have largely increased its life.

Electrolysis of buried pipes can be prevented. Concrete or terra cotta underground ducts are imperishable.

Foundations for machinery may be depreciated with the machinery. Although the concrete and cement are imperishable their usefulness dies with the machine in most cases.

Buried cast iron, terra cotta and concrete depreciate because of inadequacy or obsolescence only.

The subjoined figures for depreciation of buildings are probably the most authoritative and practical published.

SOMER'S SYSTEM OF VALUATION AND DEPRECIATION OF BUILDINGS.

From Report to City of Minneapolis, 1913.

As I have used what is commonly known as the Somers' System for the valuation of all dwelling houses and also for the depreciation of them and of the various buildings in and around the gas works where possible, it will be necessary to explain the method and give the basis upon which it is based.

I first became practically acquainted with the Somer's System in the year 1910 while it was being applied to the valuation of the land and buildings of the City of Cleveland, Ohio, for the purpose of taxation assessment. I was much impressed by the thoroughness of the preparation for this work on a large scale and by the rational and practical methods adopted in carrying it out.

It appeared to be an honest attempt to scientifically place a correct valuation upon all of the property of this city of more than 500,000 inhabitants.

The method and results attained in Cleveland will be found in a pamphlet published by the Board of Assessors of Real Property for the City of Cleveland, Ohio, 1910. This Board had five members and Mr. W. A. Somers as chief clerk. It employed 396 men of whom 125 were men of high attainments and technical education. Over 145,000 parcels of land were appraised and over 100,000 buildings were valued and depreciated during that year. Notwithstanding the appalling size of this task, I was impressed by the superabundance of precaution and consideration shown in the attempt to make perfectly fair valuations which valuations were each in their districts submitted to a large number of local committees and real estate experts for their criticism and met with their approval.

It is the first city of the United States which has been fully and thoroughly valued on the Somers plan. This plan is a fair and honest appraisal at one hundred per cent of the value of each piece of property with a uniform and regular distribution of these values in adjacent localities. The Somers method of appraising the values of land is not required for our present purposes, and therefore, is not touched upon.

The building values, however, should have the method of fixing them given consideration since upon it are based the values of such dwelling houses as the Minneapolis Gas Light Company possesses. Very properly as anyone will discover who attempts to use a cubic foot as a basis, the valuation of the dwelling houses was based on *the square foot area occupied by them and on the number of stories in height.* The schedules used in Cleveland were carefully prepared for each type of house or building and then were submitted for discussion to engineers, architects, contractors and real estate operators and the figures given in each schedule represent as near a fair average price as the combined experience of these referees could produce.

For dwelling houses the following schedule was used:

Schedule No. 1. Single House, One Side of Double House, One of Row, Duplex House.

Class 1.—Cheap construction, set on posts, only small cellar, no plumbing except kitchen sink and W. C., plain pine finish.

	1-story	1½-story	2-story	2½-story	3-story
Frame......	1.00	1.50	1.80	2.10	2.60
Brick.......	1.20	1.70	2.00	2.30	2.80

Class 2.—Brick or stone foundation with full cellar, with bath and furnace.

	1-story	1½-story	2-story	2½-story	3-story
Frame......	1.60	2.10	2.40	2.70	3.20
Brick.......	2.30	2.30	2.60	2.90	3.40

Class 3.—Same as above except medium porches (150 sq. ft.), laundry trays, two one-story bay windows. Plain pine finish and plain fixtures, open or closed plumbing.

	1-story	1½-story	2-story	3-story
Frame................	2.20	2.70	3.00	3.90
Brick.................	2.40	2.90	3.20	4.20

Class 4.—Same as above except plain hardwood finish. Plain electric or gas fixtures; more than two one-story bay windows; large porches; open plumbing; two baths.

	1-story	1½-story	2-story	3-story
Frame................	3.00	3.80	4.50	5.60
Brick................	3.20	4.00	4.80	6.00

Class 5.—Same as above except two or more baths; ornamental trimming and cornices; ornamental inside finish and fixtures; hot water or steam heat.

	1½-story	2-story	3-story
Frame...........................	5.30	6.30	8.00
Brick or stone..................	6.00	7.00	10.00

Schedule No. 2. Flats for Families. Tenements and Apartments.

Class 1.—Cheap construction, foundation piers or wall in trenches; small cellar; no plumbing except for kitchen and W. C.

	2-story	3-story	4-story
Frame........................	1.90	2.80	3.70
Brick........................	2.10	3.00	3.90

Class 2.—Brick or stone foundation with full basement, with furnace, bath in common.

	2-story	3-story	4-story
Frame........................	2.40	3.20	4.00
Brick........................	2.80	3.40	4.20

Class 3.—Same as above with addition of bay windows. Porches or balconies, laundry trays and private baths. Plain pine finish; four one story bay windows.

	2-story	3-story	4-story
Frame........................	3.00	3.90	4.80
Brick........................	3.20	4.20	5.30

Class 4.—Same as above except hardwood finish, electric lights, steam or hot water heat.

	2-story	3-story	4-story
Frame	4.50	5.60	6.60
Brick	4.80	6.00	7.00

Class 5.—Same as above except ornamental outside and inside finish and ornamental fixtures. Elevators; reinforced floors and other high class features.

	2-story	3-story	4-story	5-story
Frame	5.50	6.60	....	....
Brick	5.80	7.00	9.00	12.00

Schedule No. 4. Warehouse, Factory, Mills, Foundry, Garage Stable Shed.

Class 1.—Cheap construction; pier foundation or walls in trenches; small basement; main floor near grade; composed of dirt. flat roof; plain trimmings and cornice; joist floor construction without trusses.

	1-story	2-story	3-story	4-story	5-story
Frame	0.60	1.20	2.00	2.80	3.50
Brick	0.90	1.50	2.20	3.10	3.80

Class 2.—Ordinary construction; brick or stone foundation; full basement; main floor several feet above grade; wood floors; flat roof; joist floor construction without trusses; plain trimmings and cornice:

	1-story	2-story	3-story	4-story	5-story
Frame	1.00	1.80	2.60	3.40	4.20
Brick	1.40	2.20	3.00	3.80	4.60

Class 3.—Same as above except mill construction; wood trusses:

	1-story	2-story	3-story	4-story	5-story
Frame	2.00	2.90	3.80	4.70	5.60
Brick	2.40	3.30	4.20	5.10	6.00

Class 4.—Modern fireproof manufacturing building; steel frame; one elevator; flat roof. Rate per sq. ft.

1-story	2-story	3-story	4-story	5-story
2.70	3.80	4.90	6.00	7.60
6-story	7-story	8-story	9-story	10-story
9.00	10.40	11.80	13.20	14.60

There are altogether five schedules of different types of building each with four different classes, dependent upon the quality of material and workmanship used in their construction, making altogether about nineteen classes more or less which appeared sufficient to cover the average types of structures in Cleveland. As these various buildings were of different ages and according to the thoroughness and completeness of their repairs as judged by an inspection in different conditions, it was necessary to depreciate them according to the subjoined table.

Somer's System, Cleveland, Ohio, 1910.

Table for the Depreciation of Buildings.

Store Buildings and Dwellings.

Brick				Frame			
Per Cent Depreciation				Per Cent Depreciation			
Years	Good	Fair	Bad	Years	Good	Fair	Bad
1	2	3	6	1	3	4	10
2	4	5	11	2	6	7	17
3	6	8	15	3	8	10	23
4	8	10	18	4	10	12	27
5	10	12	21	5	13	15	31
6	12	13	24	6	15	17	34
7	13	15	27	7	17	19	37
8	14	17	29	8	18	21	40
9	16	18	32	9	20	23	42
10	17	20	34	10	22	25	45
11	18	21	36	11	23	26	47
12	19	22	38	12	25	28	49
13	20	23	40	13	26	30	51

Brick				Frame			
Per Cent Depreciation				Per Cent Depreciation			
Years	Good	Fair	Bad	Years	Good	Fair	Bad
14	21	24	41	14	28	31	53
15	22	25	43	15	29	32	55
16	23	26	45	16	30	34	57
17	24	27	46	17	31	35	58
18	25	28	47	18	32	36	60
19	25	29	49	19	33	37	61
20	26	30	50	20	34	38	63
21	26	30	51	21	34	39	65
22	27	31	53	22	35	40	66
23	27	32	54	23	36	41	68
24	28	32	55	24	37	42	69
25	28	33	56	25	37	43	71
26	29	34	57	26	38	44	72
27	29	34	57	27	39	45	74
28	30	35	58	28	39	46	75
29	30	35	59	29	40	47	77
30	31	36	60	30	40	47	79
31	31	36	61	31	41	48	80
32	32	37	61	32	42	49	82
33	32	37	62	33	42	50	83
34	33	38	63	34	43	51	85
35	33	38	64	35	43	52	86
36	33	39	65	36	44	53	88
37	34	40	65	37	45	53	90
38	34	40	66	38	45	54	91
39	34	41	67	39	46	55	93
40	35	41	68	40	46	56	95
41	36	42	68	41	47	57	
42	36	42	69	42	47	58	
43	37	43	70	43	48	59	
44	37	43	71	44	48	59	
45	38	44	72	45	49	60	
46	38	44	72	46	50	61	
47	39	45	73	47	50	61	
48	39	46	74	48	51	63	
49	40	46	75	49	51	64	
50	40	47	75	50	52	64	

In the above table it is obvious that *depreciation is, after all, largely a matter of personal judgment.* Thus, for a brick building fifty years old, the depreciation ranges all the way from forty to seventy-five per cent of it structural cost.

On the continent of Europe, houses and factories and other buildings hundreds of years old are very common, but on this side of the Atlantic fifty years appears to be considered the maximum life of dwellings and of factory buildings in almost all cases.

Regarding Somer's System, I would say that it has proved a great success in Cleveland, Ohio, and subjoin a letter from his Honor, Mayor Newton D. Baker, regarding the great satisfaction with which it is used.

Office of the Mayor
CLEVELAND, June 7, 1912.

PROF. WM. D. MARKS,
Omaha, Nebraska.
My dear Prof. Marks:

I received your letter of June 5th, and since what you ask is rather a resumé of the state of public sentiment on the subject of the Somer's system than any detailed comment upon the rate of taxes here last year, I can perhaps myself answer your letter as well as through another. In short it is quite within bounds to say that the Somer's system of real estate valuation in Cleveland has worked admirably, and I do not think I have heard a single suggestion against the system. It is universally accepted here as an enormous advance over the previous method which was haphazard, unscientific and extremely unequal. It may well be that some other system might be devised which would either be as scientific or more so, but up to this moment I know of no other system comparable to the one we used.

Cordially yours,
(Signed) NEWTON D. BAKER.

It should be understood in advance that in appraisement it is as impossible as it would be insincere, to claim any excessive degree of accuracy.

Although long experience as a specialist will enable an appraiser to obtian the substantial truth in the aggregate of large gas works or other works in which the appraiser has used experienced judgment in their depreciation and has laboriously gone into all details, still the above table of depreciation shows the wide margin of personal difference of opinion which may exist between perfectly sincere engineers trying to impartially state the truth.

Somer's System is particularly valuable as presenting these wide margins of valuation and of depreciation as the well considered and clearly and publicly stated opinion of a large body of specially qualified appraisers of property.

The average depreciation of the Minneapolis Gas Light Company's works of 20.7 per cent covers buildings and machinery and does not appear excessive but rather too small if in error.

CHAPTER IX.

COMPARATIVE APPRAISING.

Comparative methods may be used for rough sketchy approximations by an experienced appraiser with close results to accuracy.

The engineer in charge of a score or more assistants in a large appraisement will find it humanly impossible to repeat and check the work of all in detail still he must let no final results pass unchecked.

The characteristics of the various buildings required by a public utility are marked. They are mostly mere shells with one or more floors lighted by windows and doors and generally devoid of ornament, but roofed in an expensive manner.

For this reason after a prolonged experience in the detailed cost computations of their elements, it is easy for an engineer to construct a table of their approximate costs per square foot per story for comparative estimates and for roughly checking the future detailed computations of other works which should always be made for each works appraised, regardless of precedents.

If the result of the paired assistants' detailed computations of the value of each building does not agree closely with the average per square foot of similar buildings, there should be a careful review of these computations in detail and if found correct the cause of the variations noted.

So too with the apparatus. There is a generally correct average cost per H.P. for boilers of each type.

Each K.W. capacity of each type electrical machinery has an average price.

Each type of steam engine has an average cost per H.P.

Each cu. ft. of capacity of a gas holder of a certain capacity has its average cost.

Each lineal foot of buried cast iron street main has its average price for each diameter and weight.

So too with wrought iron and terra cotta piping buried in the streets.

Patented machinery or machinery monopolized by a single factory, cannot be so closely figured and prices must be obtained from the makers.

Finally each size of gas works has its average cost per 1,000 cu. ft. capacity or of annual sales.

Each electric works has its average cost per K.W. of capacity, installed.

Each electric or steam railway has an average cost per mile of single track.

When these costs are finally deduced they must be compared with similar works serving like populations under similar conditions, and if a marked difference is observed the cause of it be found. *Nothing is more misleading than improperly chosen precedents.*

Water works do not so readily yield consistent rough averages for comparison of type with type, on the basis of capacity.

Many of these capacity values or costs of public utilities are given in The Finances of Gas and Electric Light and Power Enterprises and also in this work in Chapter XVIII, Capitalization Assets and Profits of Massachusetts Gas Companies.

In Chapter VIII, from Somer's System of Valuation is quoted the costs per square foot so far as they refer to buildings required by public utilities.

CHAPTER X.

MARKET VALUE. ENGLISH GOING VALUE.

The market value of the securities of a public utility is affected (as an investment) by many and often obscure factors.

The controlling factor always is the population and its commercial and manufacturing activity together with the future prospects of the community served.

Next to this in the enhancement of value comes such a management of a utility as gives confidence in its profitable operation.

A loosely drawn franchise giving exclusive occupation, and sometimes making no provision for the fixing of fair and reasonable rates, is reckoned of very great value to enterprising promoters.

For each locality and utility there are usually individual factors affecting the market prices of its utilities, and these may be peculiar to each locality and occur nowhere else.

In fixing the market value of a utility's stocks the utmost caution and most thorough investigation is required.

If, however, we have the present value of a utility plant from reliable appraisement, and from the operating expenses record have obtained the utility's net annual earnings, the rate of interest or dividend ruling as acceptable in this proposition will fix the market value of it.

If for instance 6 per cent is satisfactory to an intending purchaser of a plant appraised at $1,000,000 present value whose net earnings are $90,000 per year with a prospect of remaining the same or increasing; its market value results from the capitalization of $90,000 at 6 per cent which is $1,500,000.

The premium of $500,000 which a willing purchaser pays beyond the present value of the plant is sometimes in England called a part of its "going value" and it is the present value of a prospective income of $30,000 at 6 per cent from a plant earning 9 per cent of $1,000,000 present value.

In England the market value of the stocks of utilities about to be municipalized has been determined as follows in an endeavor to reflect and embody public opinion as to the present market value of the investment.

The average sale price of the shares of the utility is computed from a series of yearly market records.

The average dividend is likewise computed.

Dividing the average dividend by the average price of shares gives the interest on the investment found satisfactory to investors.

The net earnings of this utility are likewise averaged for a series of years, and shown to be maintainable.

These net earnings are then capitalized at the per cent profit on its stock found acceptable to the investing public, and this results in the market value of the utility to be paid by the municipality. It is the English going value.

This method of attempting to learn and to execute the common opinion of the investing public as to values of stock and rates of interest pre-supposes that the rates for the utility are and will continue to be satisfactory to the public, and further that the stock sales were bona-fide sales to investors for income.

No appraisement is required for market values under this method so where rates for the utility are often subject to change and securities are issued without checks of any kind as has so frequently been the case here, market value may not be safely used to fix values of plants. It may, however, reflect the public opinion of investors.

Bonds, preferred stocks, debentures, all are frequently issued by and take precedence of the common stock of public utilities.

In such cases the interest on the preference securities must be subtracted from the net earnings before the value of the common stock can be computed from its dividend, if one should desire to compute market value as a check upon other values.

CHAPTER XI.

FRANCHISE VALUE.

Franchise value really belongs to the community which grants it.

A franchise conveys to a public utility an easement or a right of way for its apparatus without trespass.

It also is a permit to do business in a community, and as most public utilities are natural monopolies, a franchise usually is a virtual monopoly.

These privileges are often very valuable, but as it is usual for a community to grant a franchise without direct payment for it, it is also usual and consistent not to reckon franchise value in appraising works for rate making purposes.

Certain relatively small expenses for obtaining the right of way and for placing apparatus in streets and commons are incurred and are included in the physical present value of the plant without reference to the franchise.

It might be proper to issue to a community granting a franchise a certain proportion (say one-half) of the public utility's securities whenever issued in return for this intangible franchise value and then in the form of dividends and interest, the whole people would receive pay for the privilege granted and have an active part in its management.

Some cities demand a royalty or occupation tax of public utilities based on its gross earnings or its sales measured in quantity, but as the utility at once adds this to the cost of operation (and the price) it becomes a special tax on its consumers, it does not appear as just as the previous suggestion, of a share in the capitalization.

In the writer's opinion as affecting rates a legislative body granting a franchise should provide a time limit, a purchase clause by which the municipality can at any time purchase the utility for a relatively inconsiderable cash payment, together with bonds secured by the property of the utility only, running for specified terms and allowing amortization from its profits.

The franchise should specially provide that the price of the utility should be its present value of the time of transfer free from any additions for cost of development of income, good will, franchise value, going value, or any form of intangible value.

Likewise in the matter of rates there should be a provision for their review and re-determination by the municipality itself at regular and short intervals during the term of the franchise on the basis of present physical value since its citizens are best informed as to local conditions and local costs and directly feel the burden of its utility prices, and this rate determination should be a municipal matter exclusively. Public Service Commissions in some notable instances have recently failed to protect consumers from extortion for reasons which they alone know, and do not give.

In the matter of the issues of new securities by a public utility, it should not be allowed until after a public hearing and a thorough and exact estimate itemizing the cost of proposed extensions or enlargements. These securities should be publicly auctioned.

It is money well spent to require the annual publication by a utility in one or more daily papers of all of its operating expenses in the most minute detail as carefully prescribed in the franchise ordinance, for there always are able and public spirited citizens ready to point out possible improvements and economies of management, if the management is not good.

Publicity to all is the best safeguard possible.

If a legislative body granting a franchise will feel it to be its duty to guard its citizens from extortion and its public utility from loss or mismanagement by these precautionary clauses in its franchise ordinance, there should be little difficulty in cities purchasing public utilities at a fair price under easy conditions, or in lieu thereof establishing fair and reasonable rates upon a judicially fair appraisement.

The two gas ordinances of Minneapolis 1910 containing most of the provisions stated above which were carefully drafted as to technical and commercial details by the writer, thoroughly criticized and amended on local points by the Gas Committee of the City Councils, and finally put into legal form by their counsel, have greatly benefitted that city and are often quoted as model ordinances, fair alike to the utility and its consumers.

These ordinances are an excellent example of home rule in municipalities and of its practical good results.

As a matter of equity a franchise which is a gift of the people is not usually valued, but as a matter of fact its protection of extortion in an exclusive business or of the profits of a well conducted utility has frequently proved it of an immense value which it would be hard to overestimate.

CHAPTER XII.

PRESENT VALUE OF PROSPECTIVE PROFITS; "GOOD WILL"; "DEVELOPMENT EXPENSE"; "GOING VALUE"; "INTANGIBLE VALUES"; OPTIONS.

In England from which country we can obtain both fair and rational and practical precedents, it is often the custom in appraising the good will of a competitive works to value it at three years net profits as near as they can be figured from its past and the future growth, for the very simple reason that it is estimated that it will require that time under like conditions to reach an equal annual profit, if a new concern is started like it.

In the case of natural monopolies such as public utilities it is customary to add 10 per cent to the present value of reproduction less depreciation or to the market value, to cover all intangible values, when they are valued for purchase by a municipality.

The writer does not know that either of these customs are defined in the written laws of that country, but in Canada we find the latter crystallized out in the following law.

Municipal Acts of Ontario 3 Ed. VII Chapter 19 Section 566 Sub. Sec. 4 Clause (a 2).

"In any arbitration under clause (a) hereof to determine the price to be paid for the works and property of a gas or water company, the arbitrators shall determine the actual value of such works and property having regard to what the same would cost if the works should be then constructed or the property then bought, making a due allowance for deterioration and wear and tear and making all other proper allowances, *but not allowing anything for prospective profits or franchise* and shall increase the amount so ascertained by 10 per cent thereof, and such increased amount shall be the amount which the arbitrator or arbitrators shall award as the price to be allowed for the said works and property."

This is a decided reduction of the proportion of prospective profits for a natural monopoly as compared with a competitive going concern.

Of course good will cannot be said to exist as a valued feature of a virtual monopoly.

That part of the development expense of the business of a public utility, which has exceeded a fair return upon the investment, and has not been recouped or more than recouped by profits in later years, justly should be included in an appraisement of it.

The practical difficulty in awarding development expense is the fact that in most public utility's books there is no intelligible record, or segregation of it, even though the records do exist, which is rarely the case.

The Wisconsin Railroad Commission, (Payne *vs.* Wisconsin Telephone Company) with characteristic thoughtlessness says, "Every effort honestly put forth, every dollar properly expended, and every obligation legitimately incurred, in the establishment of a public utility business, must be taken into consideration in the making of rates for such business. Collectively the elements just referred to may be designated by the term going value."

But this is precisely what the gentlemen who originated the term going value and developed the method of computing it say it is not.

What the Wisconsin Railroad Commission statement really means is development expense, incurred in the past, and what "going value" means, as a matter of common consent among its originators, is the present value of a prospective income.

This theory of going value, in the face of the ever growing rate regulation of public utilities, appears to be a speculative risk in futures and a computation of a prospective income based on many arbitrary assumptions, which must be made by a very fallible computer whose point of view often prevents him from seeing but one side of a case, and whose chain of logic has many missing links.

No amount of skill and ingenuity displayed in computing going values, could persuade a seasoned capitalist to invest in public utilities unless their market values confirmed the computers results and a continuance of rates upon which it was based was apparently assured.

As defined by its advocates "going value" is "the value of a created income or to put it in the language of the theory of reproduction, it is the cost of reproducing a given income."

In its final analysis they compute it as the present value of a difference of prospective profits, or losses.

The basis of "going value" upon which they rear their elaborate structure of arbitrary assumption and plausible prophesy is the competitive disadvantages under which a municipality labors, *if it has no option of purchase*, and decides not to purchase the utility but to build another works of equal capacity and value.

If the municipality builds it will be obliged to:

First.—Invest the money required and lose the profits of the construction time required by the plant.

Second.—When the structure is complete and business begins it will pay the money and spend the time required to reach an equal gross income to that of the going concern.

(An option for the purpose of avoiding these disadvantages obviates them and "going value" need not be considered for only the past development expense is required.)

Of options Mr. J. W. Alvord says, "The city has by contractual relations acquired the right to become possessed of the particular plant in question. Under these circumstances it must be conceded that it does not have to face the possibility of building a duplicate or rival plant, that by its contractual relations it has acquired the right at once to step into the possession of the plant and its revenues." (See Proc. American Water Works Assn., June, 1909.)

The value of the option appears to equal the "going value" in its entirety if his method of reasoning is carried to its logical conclusion.

The question of the fairness of the existing rates and whether the going concern is profitable or not, does not concern some of the advocates of "going value" for they say getting business and income costs money in all cases.

Graphic methods and the use of diagrams appear to be the favored method of its advocates of showing going value, but for the purpose of showing "going value" to be the present value of prospective annual differences in profits or losses we will take the case of the Dubuque Water Works as an example.

From Report of Benezette Williams

Dubuque Appraisement, April, 1899.

"In making this estimate additional factors are used as follows:

The total time from the date of purchase September 1, 1899 to March 1, 1908 is 8½ years, two years of which are used in construction. Money is considered to be worth 5 per cent on water works investments. Hydrant rental for 1899 of $17,000 is assumed to continue through the years of construction 1900 and 1901. The operating expenses for old works during those two years is taken at $22,000 for each year. It is considered that on September 1, 1901 new works would start with no earnings and that in 6½ years ending with March 1, 1908 they would have earnings at the rate of $54,000 per annum from domestic service.

It is also considered that during this period the expense of maintenance which includes operating expense and interest would be equal for reasons herein before stated. It is also considered that during the period of construction there would be a gain of one year's interest by the new works or say 5 per cent on $500,000. A tabulation of the estimate which follows shows a total going value of $147,218 and is assumed to be correct in the determination made by us in this case."

WILLIAMS' ESTIMATE OF GOING VALUE OF DUBUQUE WATER WORKS.

	Credits			Debits						
Year Ending Sept. 1 (1)	Domestic Earnings Old Works (2)	Hydrant Rental Old Works (3)	Total Credits (4)	Domestic Earnings New Works (5)	Operating Expenses Old Works (6)	Interest on Investment One Year (7)	Total Debits (8)	Annual Going Value (9)	Divisor (10)	Present Worth Going Value (11)
1900	$38,000	$17,000	$55,000	....	$22,000	$25,000	$47,000	$ 8,000	1.05	$ 7,620
1901	40,000	17,000	57,000	....	22,000	....	22,000	35,000	1.10	31,818
1902	42,000	....	42,000	$ 4,154	....	....	4,154	37,846	1.15	32,904
1903	44,000	....	44,000	12,463	....	....	12,463	31,537	1.20	26,275
1904	46,000	....	46,000	20,770	....	....	20,000	25,230	1.25	20,184
1905	48,000	....	48,000	29,078	....	....	29,078	18,922	1.30	14,555
1906	50,000	....	50,000	37,386	....	....	37,386	12,614	1.35	9,342
1907	52,000	....	52,000	45,694	....	....	45,694	6,326	1.40	4,520
								Total going value,		$147,218

MARKS' ELABORATED ESTIMATE OF GOING VALUE.

Year Ending Sept. 1 (1)	Domestic Earnings Old Works (2)	Hydrant Rental Old Works (3)	Total Earnings Old Works (4)	Operating Expense Old Works (5)	Profits Old Works (6)	Domestic Earnings New Works (7)	Operating Expense New Works (8)	Interest Gained by New Works (9)	Losses New Works (10)	Profit New Works (11)	Difference in Profits Old and New Works (12)
1900	$38,000	$17,000	$55,000	$22,000	$33,000	....	....	$25,000	......	$25,000	$ 8,000
1901	40,000	17,000	57,000	22,000	35,000	....	....	....	....	....	35,000
1902	42,000	......	42,000	22,000	20,000	$ 4,154	$22,000	....	$17,846	......	37,846
1903	44,000	......	44,000	22,000	22,000	12,463	22,000	....	9,537	......	31,537
1904	46,000	......	46,000	22,000	24,000	20,770	22,000	....	1,230	......	25,230
1905	48,000	......	48,000	22,000	26,000	29,078	22,000	....	....	7,078	18,922
1906	50,000	......	50,000	22,000	28,000	37,386	22,000	....	....	15,386	12,614
1907	52,000	......	52,000	22,000	30,000	45,694	22,000	....	....	23,694	6,306

This elaborated estimate gives in Column (12) the same results as in the previous estimate Column (9) and calls attention to the fact that "annual going value" is only a new name for the difference in annual prospective profits or losses as estimated under the assumptions of the computer. The correctness of these assumptions or amounts is of no present importance as the only object in the present case is to lucidly show the meaning of "going value" as computed and accepted in Dubuque *"going value" is the present total of a prospective estimated difference in annual profits, or losses* of two works as estimated under the conditions assumed.

Assuming that there is no option doing away with the possibility of a construction period and its required fixed investment besides another period required for the development of business with its required expense and that a public utility is to be appraised and purchased by negotiation or under condemnation proceedings what weight should a conscientious appraiser give to "going value?"

In fact is not the "going value" of the future the present value of prospective differences in future profits or losses obtainable only (if the premises are correct) under the protection of a virtually exclusive franchise? Is it not franchise value? Would not its intangible prospective excess of profits as well as its equally intangible franchise value vanish together leaving the present physical part of a utility plant open to ruinous competition? Such appears to have regularly been the case when competing plants have been built.

Is not an option to purchase a plant intended to be a means of terminating its franchise without interfering with its physical operation?

The protection of the prospective profits of a public utility (its going value) appears to be wholly dependent upon the virtual exclusiveness of a continued franchise.

It is a well established principle of equity that franchise value is not to be charged against its donors, the people. Should going value be?

No concern is of any ultimate value to a community unless it makes a profit. Substantial justice and substantial profit are due a utility for the risk they have assumed in furnishing what the community should have itself furnished.

Nor should this profit be based on the safety rates of an investment in government securities or sound mortgages.

Like the values of land, the per cent of net profit allowed to a public utility should be locally fixed by experienced local business men. If money can be shown to have been expended in development expense; without question, if wisely spent and not recouped in extra profits, it should be included in a valuation and recognized as fixed capital or otherwise provided for in the rates for the utility furnished.

If there are no intelligible records of development expense as is too frequently the case, the use of the method developed so ably and ingeniously and called "going value" on the basis of rational and practical assumptions with fair and reasonable rates may prove of great assistance in suggesting a sum fairly allowable to prosperous companies for present development expenses, just as present value serves us in the absence of complete records enabling us to fix the original cost of a utility.

Possibly the English law makers in adding 10 per cent to the present value of a utility plant, for all intangible values intended to cut a Gordian knot which they assumed could not be untied, by any one.

CHAPTER XIII.

BOOKS AND ACCOUNTS; OPERATING EXPENSES AND INCOME.

Many admirable systems of keeping the account books of public utilities have been devised and printed by professional accountants, but the utilities most likely to require investigation rarely use any of them, and so the rate maker may find himself obliged to rewrite the books from vouchers and check stubs and bank deposit books in order to properly apportion the various items of expense and income.

The classification of these items too, requires a practical familiarity with the manufacturing or operating methods and costs of the utility under consideration, so that an accurately correct set of account books may require careful segregation of accounts in a form differing from the existing form used.

Thus, for rates, the income must not be from other sources than operation and if in its operation the concern supplies different classes of users the income from each class must be segregated.

In cases of importance this examination is usually for a period of five years preceding the action.

The segregation of the operating expenses is a more difficult problem.

In cases requiring great accuracy a period of five years is usually taken as covering the cycle of greater and lesser repairs and depreciations occurring in most public utilities and giving a fairer average than one year.

Incidentally one can learn the custom of the corporation as to charging expenditures to capital or plant accounts or to operating accounts.

The operating items after being verified by vouchers and classified for each year should be segregated, as necessary operating expenses and deductions from income, the latter being such expenditures as are not imperatively required for the manufacture and delivery of the particular utility considered.

For instance, bad debts are deductions from income not varying operating cost. Voluntary contributions, advertising campaigns of education and extraordinary expenditures of all sorts may be justifiable as good business policy, but are not necessary operating cost. Deductions from income are not indisputably necessary costs and may not have the approval of the arbitrators or courts as displaying good business judgment, and may be rejected by them in whole or in part. Personally the writer favors a liberal allowance for deductions for income. (See Chapter II.)

When this segregation is completed it is then necessary to divide the selected necessary operating expenses into two classes:

(1) Time expenses which like rent, office salaries and expenses, insurance, taxes, etc., grow regularly with the passage of time, and are often called service costs.

(2) Proportional expenses which increase and decrease with the commodity sales, such as the raw material and productive labor required in proportion to the commodity sold.

These are often called commodity costs. The reason for this last classification is that water, gas, and electricity are often sold by a meter which measures the commodity only, and not the service rendered.

In Chapters II and III are given careful practical examples of rate making, in which by natural laws of prices and stepped rates, the service rendered is approximately included in the bill to consumers.

Complete balance sheets of each year should be obtained and be carefully compared and dissected by tabulations and perhaps graphic methods.

The original structural cost of the plant if recorded should be carefully compiled and compared with the present value of the existing plant if possible.

The records of issues of securities should be arranged chronologically and compared with the assets of even dates.

Unfortunately the records of many utilities are out of existence and so the means of an exhaustive analysis are not procurable, but so far as possible the entire financial and physical history of a public utility should be related.

A chronological chart or charts showing capital, assets, income, expenditures and profits in dollars for each year, will enable a good grasp of the history of a utility.

The methods of making use of these results require much thought and ingenuity to disentangle the real facts from a mass of inconsistent and careless expenditures, occasioned by other motives than a desire for the welfare of the concern.

Chapter II has been introduced as an example of about everything that is bad in business and Chapter III as of a very good business management, barring excessive capitalization which was not considered or an opinion asked for in my report to the City of Minneapolis.

From a comparison of the appraisements and accounts of differently situated utilities many enlightening inferences can be drawn, as will subsequently be shown in this book.

To the appraiser I would say, that however great his confidence may be in his accountants, he cannot safely forego a detailed personal study of the accounts of the utility considered if he desires to learn the salient features and controlling factors of its business for valuation or for rate making purposes.

CHAPTER XIV.

THE LAW OF DEMAND FOR ELECTRICITY; REDUCTION OF PRICE INCREASES PROFITS.

This chapter is part of a series of reports made at the request of Hon. James Logan, Mayor of Worcester, Massachusetts, who, believing that owing to the high average price and restricted sales of the Worcester Electric Light Company, 1909, the City under his protection was not being given an equal opportunity with other Massachusetts cities to develop its minor manufactures, and was also being overcharged for street lighting; employed the writer to seek out the roots and foundations of electric rates, and to compare the sales of electricity in Worcester with the sales of like cities.

Mayor Logan was successful and obtained a reduction of about $10,000 per year in Worcester's street lighting and the Worcester Electric Light Company is now building a new power station having about four times the capacity of its station of 1909 because the company finally agreed with Mayor Logan's views.

Fair and Reasonable Rates for Electric Light and Power in Worcester, Mass., 1910.

To reach practical, profitable and judicially fair prices for the various applications made in the use of electricity, requires difficult and intricate computations even when an accurate appraisement of the structural cost of an electric plant together with depreciations made by experienced and fair experts, are furnished as a basis; together with carefully segregated operating expenses and income accounts and a complete balance sheet.

In the case of Worcester, the only appraisement available is derived from the company's book assets and its tax returns. The latter is not of great authority as tax assessors usually place as high a value upon property, as they think will not provoke dispute.

As for book assets, the Interstate Commerce Commission makes the following statement as to the deceptiveness of these records, in its report of December 24, 1908. "Every balance sheet begins with cost of property against which is set a figure which purports to stand for investment. It is sufficient to refer to the well known fact, that no court or commission or accountant or financial writer, would for a moment consider that the present balance sheet statement, purporting to give the cost of property, suggests even in a remote degree a reliable measure of money invested or of present value."

In the discussion of the case, no appraisement is available and so its result will be valuable only in proportion to the nearness of the book assets and tax valuation to the truth.

For 1910 the following values were found.

Book assets	$1,547,041.08
Taxable value	1,283,900.00
Company's valuation of plant	1,459,483.01
Amount of capital stock	800,000.00
Cost of plant more than capital	$659,483.01

Assuming for the sake of argument that the true value and the true operating expenses are known for any given period, it is not an impossible although an intricate task to fix rates yielding an assumed even rate of profit on the investment for the particular period and under the existing physical conditions.

To attempt to fix an invariable basis for further prices without being able to also fix the cost of raw materials and productive labor would surely lead to injustice to the company or its consumers. To attempt to fix prices for a short term of years is better in the case of a natural monopoly such as an electric company, but has not always produced good results, for the courts and commissions usually intrusted with this responsibility often lack an intimate knowledge of details required to prevent them from falling into pit falls and thus reaching unjust decisions.

There is another factor which enters into rate making. It is a most important one and takes into consideration the human elements of the law of demand. There has been an increasing struggle on the part of the public for lower prices for electricity, and as will be presently shown, such a struggle has not been unreasonable nor inconsiderate. On the contrary, lowered prices for electricity have resulted in increased sales per capita, thus proving an advantage and material profit to the electric generating company, when the lowered rates have been fixed wisely and judicially.

There is one important point to be recollected, for it is one not generally grasped in the discussion of prices and that is: it is not always necessary to reduce the commodity cost per unit of supplying electricity to increase the sales and profit of the company.

The reason is this: If increased sales at a lower profit per unit results from lowered prices, this increased sale also reduces the investment or capital per unit sold, and so the same or greater profits or dividends may result from lowered prices, if the plant and time or service costs do not have to be appreciably enlarged for the greater sales.

Of course, the possibilities of development of the sales of electricity by a company are controlled by the characteristics of its field. A manufacturing city is better than a commercial centre and it in turn is better than a residential city.

The population of cities appears to largely affect its sales per capita, for it is obvious that a metropolis containing large office buildings, merchandise stores, theatres and other places brilliantly lighted at night will have a larger sales per capita than towns which have not reached a metropolitan stature. This change from a mere town to a metropolis appears to occur at about 75,000 population and the scale of expenditure to increase with it. Worcester with its 132,000 population is well forward in its metropolitan development and being a manufacturing city offers an almost unlimited field for the future sale of electricity at fair rates.

For the purpose of discovering the practical relation between the average price and the sales per capita of electricity, the report of the Board of Gas and Electric Light Commissioners of Massachusetts, June 30, 1908, may be employed.

The published scale of prices (subject to discounts) of 15 electric companies serving the largest cities in Massachusetts will only mislead. The average sales and prices are obtained as follows, and while not closely accurate in a technical sense, they are near enough for our commercial purposes (Report Table 7, page CCXXXV). From the total K.W.H. generated are subtracted K.W.H. generated for street lighting. The remainder, divided into K.W.H. sold to consumers, gives the per cent efficiency of distribution for consumers, and is approximately the efficiency of the whole system with sufficient accuracy for commercial comparisons. The total K.W.H. generated, multiplied by per cent efficiency of distribution, gives total K.W.H. sold. This is rudely approximated in the abstract given.

As each city differs from the other in population (census 1905) the K.W.H. sold per capita is found by dividing the total K.W.H. sold by the population.

The average price per K.W.H. sold is found by dividing the total income by the total K.W.H. sold.

The revenue per capita is found by dividing the total income by the population, and this is checked by multiplying the K.W.H. sold per capita by the average price per K.W.H.

The small variations found are of no consequence in the present research.

The profit per capita is found similarly, and is given to assure against the use of unprofitable precedents.

The sales per capita in K.W.H. is the index of the working of the law of supply and demand at a given average price.

It answers the question, "What will the people buy at a given average price?"

The profits per capita tell what the electric company can realize at a given price.

It tells how good an electric company's management is, just as the profit per acre tells how good a farmer is, or, at least, how his farm is cared for when compared with others of equal fertility.

For this reason the results in Boston cannot be compared with those of the other cities in Massachusetts.

In so large a metropolis, the teeming multitudes and the irresistible tide of business activity would make it difficult to escape a sale of 100 K.W.H. per capita, and Boston must be used only in comparison with other large metropolitan cities.

By sheer good management Boston has been surpassed in K.W.H. sales per capita both by Springfield and Salem.

By reason of the relatively high price per K.W.H. maintained and borne by metropolitan necessities, Boston's profits per capita $3.08 are larger than the revenue per capita of any of the 17 cities, except Lynn, $4.16; Springfield, $5.39; Brocton, $3.59; Haverhill, $4.10; Salem, $4.99; and Fitchburg, $3.97.

Boston's revenue per capita is $6.40, and its average price 6.2c. per K.W.H.

Brockton, like Boston, because of its relative seniority and retention of high prices for electricity, must be excluded from comparison with the remaining 15 Massachusetts cities selected.

This leaves 15 cities, ranging from 33,000 to 132,000 population, for use in tracing the relation between price per K.W.H. and sales per capita in K.W.H. as graphically shown in the figure.

The profit per capita is of interest, but, as the cost of the various managements per K.W.H. enters in, is of no value save to prove the vagaries of managers, as against the rela-

ABSTRACT FROM REPORTS OF 1908 TO THE COMMISSIONERS OF GAS AND ELECTRIC LIGHTING OF MASSACHUSETTS.

Name	K.W.H. Generated	Per Cent	K.W.H. Sold	Population	K.W.H. per Capita	Income Light and Power	Average Price per K.W.H.	Revenue per Capita		Profit per Capita
						Dollars	Cents	Total Figures	Check	
Boston—Edison Ill.	88,535,490	79.1	70,031,572	......	....	4,229,239.02	....	....	....	....
Block Plant	621,660	....	433,879	703,597	103.3	24,007.89	6.20	$6.39	$6.40	$3.08
Consoli. Gas	3,071,478	71.5	2,196,007	......	....	255,257.24	....	....	....	....
Worcester	5,400,192	79.0	4,262,151	131,549	32.0	332,375.16	7.86	2.51	2.51	1.23
Lowell	9,426,511	67.0	5,315,762	110,786	57.0	328,032.59	5.19	2.96	2.94	0.97
Fall River	4,061,284	73.0	2,964,737	105,762	28.0	237,054.54	8.00	2.24	2.24	0.64
Malden	4,647,545	64.0	2,974,370	101,129	29.0	260,236.62	8.89	2.57	2.57	0.83
Cambridge	6,043,204	85.0	5,136,723	97,434	52.7	297,238.51	5.79	3.05	3.05	1.34
Lawrence	4,363,416	70.9	3,093,662	89,972	34.4	221,554.08	7.16	2.46	2.46	1.07
Lynn	8,776,166	78.0	6,845,409	89,358	77.0	370,577.32	5.41	4.14	4.16	1.65
Springfield	16,230,797	59.0	9,576,170	86,486	111.0	465,682.35	4.86	5.38	5.39	2.45
New Bedford	1,747,178	81.6	1,425,697	79,777	18.0	151,238.07	10.60	1.89	1.90	0.95
Brockton	3,803,885	65.0	2,472,425	57,484	43.0	206,664.67	8.36	3.59	3.59	1.43
Newton and Watertown	2,062,724	68.0	1,402,652	48,085	29.0	146,316.29	10.40	3.04	3.01	0.32
Charlestown	1,138,599	65.0	740,089	39,983	19.0	72,557.82	9.80	1.81	1.86	0.55
Haverhill	4,408,965	78.0	3,438,993	37,830	91.0	155,206.94	4.51	4.10	4.10	1.18
Salem	4,462,550	88.0	3,927,004	37,627	104.0	188,316.43	4.80	5.00	4.99	1.75
Chelsea	1,453,200	70.0	1,004,640	37,289	27.0	84,129.72	8.37	2.22	2.25	0.88
Fitchburg	3,288,623	87.0	2,861,102	33,021	87.0	130,607.83	4.57	3.95	3.97	1.42

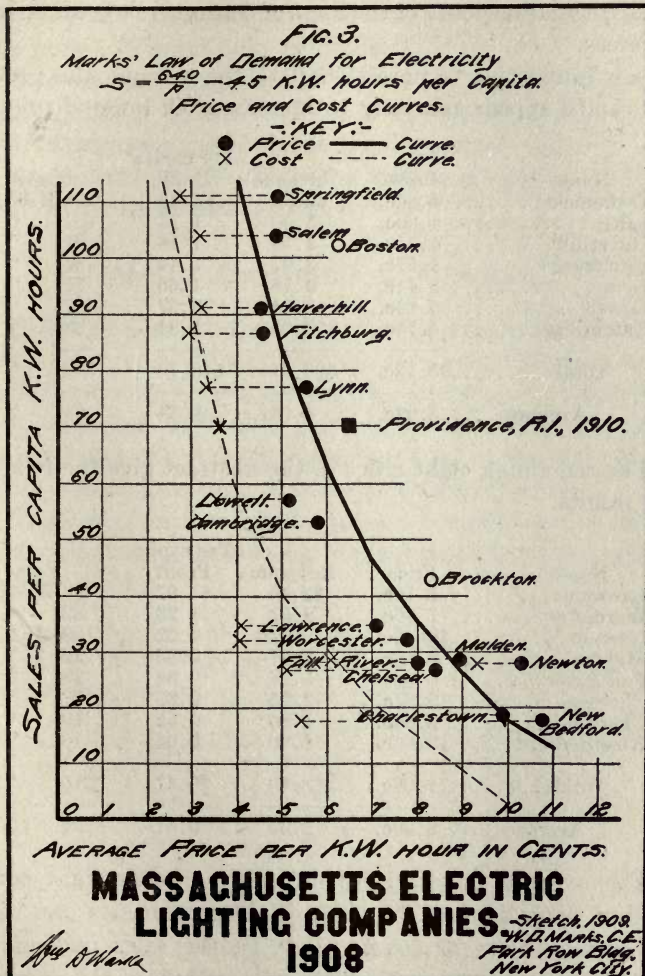


FIG. 3.
Marks' Law of Demand for Electricity
S = 640/P − 45 K.W. hours per Capita.
Price and Cost Curves.
KEY:
● Price ——— Curve.
× Cost - - - - Curve.
Springfield.
Salem
Boston.
Haverhill.
Fitchburg.
Lynn.
Providence, R.I., 1910.
Lowell.
Cambridge.
Brockton.
Lawrence.
Worcester.
Fall River.
Chelsea.
Malden.
Newton.
Charlestown.
New Bedford.
SALES PER CAPITA K.W. HOURS.
110
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
AVERAGE PRICE PER K.W. HOUR IN CENTS.
MASSACHUSETTS ELECTRIC LIGHTING COMPANIES 1908
Sketch, 1909.
W. D. Marks, C.E.
Park Row Bldg.
New York City.

tively regular response of the mass of consumers to reductions in prices.

It is interesting to note that both the revenue and profit per capita appear generally to increase with lowered prices.

Name	Price	Per capita Revenue	Per capita Profit	Sales
1. Springfield	4.86c.	$5.39	$2.45	111 K.W.H.
2. Salem	4.80c.	5.00	1.75	104 "
3. Haverhill	4.51c.	4.10	1.18	91 "
4. Fitchburg	4.57c.	3.97	1.42	87 "
5. Lynn	5.41c.	4.16	1.65	77 "
6. Lowell	5.19c.	2.94	0.97	57 "
7. Cambridge	5.79c.	3.05	1.34	33 "
Totals	35.13c.	$28.61	$10.76	580 "
Averages	5.02c.	4.13	1.54	83 "

The remaining eight cities in the abstract give the following results.

Name	Price	Per capita Revenue	Per capita Profit	Sales
1. Lawrence	7.16c.	$2.46	$1.07	34 K.W.H.
2. Worcester	7.86c.	2.51	1.23	32 "
3. Newton	10.40c.	3.01	0.32	29 "
4. Malden	8.89c.	2.57	0.83	29 "
5. Fall River	8.00c.	2.24	0.64	28 "
6. Chelsea	8.37c.	2.25	0.88	27 "
7. Charlestown	9.80c.	1.86	0.55	19 "
8. New Bedford	10.60c.	1.90	0.95	18 "
Totals	71.08c.	$18.80	$6.47	216 "
Averages	8.89c.	2.35	0.81	27 "

The average practical results of the electric light companies' operations of 15 cities in Massachusetts are: At an average price of 5c. per K.W.H. the sales per capita (83 K.W.H.) are three times the sales (27 K.W.H.) at 8.9c.

per K.W.H. The profits per capita ($1.54) are nearly twice the profits (81c.) at 8.9c. per K.W.H.

It does not necessarily follow because sales are increased four fold that the investment in machinery and plant required be even doubled, as the structural capacity of a plant is fixed by the coincident demands upon it in K.W. and not by its annual sales in K.W.H.

Marks' Empirical Law of Demand.

Referring again to the figure, the hyperbolic curve, drawn to scale, threads its way through the dots representing the various cities and it will be noted in the cases of cities having low prices and high sales per capita, that these dots more nearly touch the average curve line than in the cases of the cities adhering to high prices and restricted sales.

The law of increase of the sales per capita can be rudely approximated by the curve of an equilateral hyperbola giving average results.

Let s = the sales per capita in K.W.H.
Let p = the average price per K.W.H. in cents.
The equation is

$$s = (640 \div p) - 45$$

		Difference for 1c.
If p = 4c.	s = 115 K.W.H.	
If p = 5c.	s = 83 K.W.H.	32 K.W.H.
If p = 6c.	s = 62 K.W.H.	21 K.W.H.
If p = 7c.	s = 46 K.W.H.	16 K.W.H.
If p = 8c.	s = 35 K.W.H.	11 K.W.H.
If p = 9c.	s = 26 K.W.H.	9 K.W.H.
If p = 10c.	s = 19 K.W.H.	7 K.W.H.

Laying down this equilateral hyperbola on the figure it appears to average the practical results of 1908 very closely, giving a general empirical law of supply and demand for electricity in cities.

The interesting facts appear that while a reduction of from 10 to 9c. produces an increase of 7 K.W.H. per capita, an equal reduction of the average price from 5 to 4c. produces an increase of 32 K.W.H. per capita, or about 4½ times as much.

At 10c. per K.W.H. the sales per capita are 19 K.W.H., and at 5c. 83 K.W.H., or over four times as great. *Present experience does not appear to have fixed any point of satiation for consumers or minimum price for electricity.*

It is particularly of value to learn that the lowered average price of the first group of seven cities results in revenue and profits per capita increasing in a geometric ratio far more rapidly than the reduction of price per K.W.H. made from the average of the second group of eight cities, and that this appears to be irrespective of the population of the cities between the limits selected.

This is an entirely new law of demand and it should be distinctly understood that it resulted from an absolutely practical derivation and is not scientifically accurate but only empiric.

Per Cent Profits Actually Realized.

The preceding discussion has only served to show the increased sales per capita for lowered prices for electricity. Using the same statistics for 12 of these cities in Massachusetts it will be shown that lowered rates bring increased profit to the electric generating company. These profits are based on tax valuation, that being the only valuation available from the report of the Board of Gas and Electric Light Commissioners of Massachusetts. The tax value may be less than the real value of the plant and therefore, in the following discussion, an apparently smaller investment per K.W.H. sold may result; but since all these plants were taxed under the same state law, these reductions of apparent value will be proportionate and still leave the figures available for comparison.

In the case of these 12 companies the cost of a K.W.H. is obtained by dividing the total operating expenses by the total number of K.W.H. sold. Depreciation for the current year is temporarily omitted from expenses and will be considered later. The tax investment per K.W.H. is obtained by dividing each company's tax valuation by the total sales in K.W.H.

The subjoined table gives the results.

Table Based on K.W.H. Sold.

First Group:

Cities	Average Price	Cents Cost per K.W.H.	Tax Value Investment
1. Springfield	4.86c.	2.64c.	15.3c.
2. Salem	4.80c.	3.13c.	10.8c.
3. Haverhill	4.31c.	3.21c.	11.9c.
4. Fitchburg	4.57c.	2.99c.	13.4c.
5. Lynn	5.41c.	3.27c.	8.5c.
6. Lowell	5.19c.	3.50c.	19.3c.
7. Cambridge	5.79c.	3.24c.	20.2c.
Averages	5.02c.	3.14c.	14.2c.
Investment profit per K.W.H.	......	1.88c. or 13.2% of 14.2c.	

Second Group:			
1. Lawrence	7.16c.	4.06c.	18.9c.
2. Worcester	7.86c.	4.03c.	28.6c.
3. Newton	10.40c.	9.33c.	14.4c.
4. Malden	8.89c.	6.05c.	22.0c.
5. Fall River	8.00c.	5.70c.	26.9c.
Averages	8.46c.	5.83c.	22.2c.
Investment profit per K.W.H	......	2.63c. or 11.0% of 22.2c.	

As a practical fact, it may be observed from the above tabulation that the lower price (5.02c.) produces an average profit of 13.2 per cent as against a lower profit of 11.9 per cent for the price of 8.46c. per K.W.H. on the basis of tax valuation of the investments in these companies.

With the exception of Springfield favored by water power, it would be impossible to find a group of 12 companies operating under more nearly the same conditions save as to population.

It is, therefore, safe to infer that an average reduction of 3.44c. in the price by the first group has not reduced the percentage of profit on the investments made by this group's companies. On the contrary, the profit is increased 1.3 per cent by the lowering of the prices, and the sales per capita computed by the law of demand, previously stated, would increase from about 30.6 K.W.H. per capita annually to 82.5 K.W.H., an increase of nearly threefold in sales.

It is also evident from the last figures, that lowered prices per K.W.H. result in lowered costs per K.W.H. sold by reason of the increased sales per capita. This is illustrated in the figure by the broken line average cost curve, laid down by a similar method to the price curve. This curve also appears to have a rude approximation to the hyperbolic law (due to the preponderance of time or service costs) and to be a function of the sales per capita. The fact may be observed that the price and the cost of supplying electricity move down together as the sales per capita increase and there always is an average profit shown on each K.W.H. sold, which varies from 2½ to 1½ c.while going from 10c. to 4c. average price per K.W.H. sold.

Depreciation.

Each year, in order to compute the total cost per K.W.H. sold of electricity, it is necessary to include the depreciation per K.W.H.; and yet the depreciation cannot be considered as proportional to K.W.H. sales. It is customary in many electrical works to allow a certain average percentage of the value of the works, fixed plant or as above figured of its taxable value. This percentage is a much disputed quantity, but in fairly equipped works it is hardly ever claimed to be less than 3 per cent or over 7 per cent. In fact, any percentage is a guess and a careful inventory and appraisement furnishes the only means of fixing depreciations accurately. In this appraisement care must be taken to discriminate between physical decay, obsolescence and inadequacy of plant. The current repairs are usually charged to operating expenses as they occur, and physical decay becomes less in proportion to the thoroughness of repairs.

In the 12 Massachusetts companies cited, the depreciation is not charged to operating expenses, but is charged directly to profit and loss, if at all, and credited to various accounts. If one assumes the extremely liberal average of 7 per cent depreciation, the first group of seven low priced companies earning 13.2 per cent is able to divide 6.2 per cent of the tax value and to put aside 7 per cent reserve depreciation fund; and the second group of five higher-priced companies earning 11.9 per cent is able only to divide 4.9 per cent and put aside 7 per cent.

For the first group the following obtains:

Price		5.02c.	per K.W.H.
Operating expense	3.14c.		" "
Depreciation	0.99c.	4.13c.	" "
Net earning		0.89c.	" "

For the second group the following obtains:

Price		8.46c.	per K.W.H.
Operating expense	5.83c.		" "
Depreciation	1.55c.	7.48c.	" "
Net earning		0.98c.	" "

The second group shows the larger profit per K.W.H., but it gives a smaller per cent profit on the investment made.

The explanation of this stubborn series of facts appears to be the following: With a rational method of lowering prices, the response of the public to it is a sure increase of sales per capita according to the law of demand previously exhibited. The increased sale of energy results in a decreased operating service cost per K.W.H. sold and also usually results in a decreased investment and depreciation per K.W.H. sold, since depreciation depends principally upon time and the cost of investment.

CHAPTER XV.

GAS SALES PER CAPITA.

The contents of this chapter were first published in 1909. They cannot pretend to be given with scientific accuracy nor do I think in any commercial matter such as this, that the personal vagaries of men, and communities of men, can be sufficiently eliminated to be reduced to scientific accuracy.

But the law of increasing demand with reduction of price is as clearly indicated for gas as it was for electricity in the previous chapter. Gas can be stored for one day, electricity cannot.

The service costs growing with time do not form so large a proportion of the total cost of gas as they do with electricity, and so there cannot be so rapid a reduction of price in stepped rates for it, to large consumers of gas; as there can be for electricity. Nevertheless there is a great profit both to the producer and to the business community in properly reduced rates to large gas consumers.

To the constructing engineer and to the gas manager the most important quantity to be determined is the attainable sales of gas per capita for any population served. Without it the constructing engineer has no basis from which to compute the required capacity of the works installed to serve any community and the gas manager no definite idea of his aim or limitations in the operation of his gas plant. With it, it is possible to fix the capacity of a gas plant intelligently in advance of construction and to allow for future enlargements. For the gas manager it is possible to fix the lowest price for gas which will yield the greatest attainable profitable sales for his stockholders and thus to wisely serve both stockholders and gas consumers.

In an attempt to find the factors controlling the sales of gas per capita it is first necessary to disembarrass the problem of all factors of little influence upon it.

For instance the illuminating power of ordinary artificial gas exceeding 14 to 16 candle power does not appear to largely affect the volume of its sales per capita. This will presently be shown by means of data from the reports of the Massachusetts Gas and Electric Light Commission and Brown's Directory of American Gas Companies.

The cost of making gas need not be considered in the discussion of the laws connecting the population served, and its price per 1,000, with its average annual sales per capita. For the present at least the cost of gas and its profits can be neglected until the natural laws controlling annual sales per capita are deduced.

It must not be forgotten that there are exceptional communities to which no generally deduced rule will apply and that average results are somewhat affected by the management of individuals.

Nevertheless there appears to be a general law or perhaps two laws, enabling sufficiently accurate predictions (to serve for commercial purposes) to be made for average communities.

The sales per capita is the index of the need of disposition of the individual consumer to buy gas. This is varied somewhat by many local conditions.

The competition of electric lighting does not in busy communities appear to reduce the sales of gas; for by reason of the great brilliancy of electric lighting a rivalry in illumination is created that usually increases the sales of gas.

The introduction of economical methods of gas lighting appears only to cause a temporary slackening of the sales of gas and ultimately increases it.

The gas wars which occasionally occur between gas companies increase the sales of gas per capita and it appears as if any gain made during them remains although the price of gas is again raised at the close of the war.

High prices for, or temporary dearth of fuel, appears to force an increase of sales of gas for cooking and heating purposes.

Aberrations in sales per capita resulting from the above causes are, however, of a temporary nature and relatively inconsiderable, when compared with the populations served or the prices fixed, which are two factors which appear to have a controlling influence upon the annual sales of gas per capita.

The history of the gas sales upon the island of Manhattan illustrates in a most vivid manner the concrete results of an exploration of this new field.

In 1888 the competition of electric lighting became commercially noticeable. The price of gas was $1.26 per 1,000 cu. ft. and the sales per capita 5,626 cu. ft. to a population of 1,386,000. In 1892 the Welsbach mantle light was coming into use as a competitor of electric lighting. The price of gas was $1.25 per 1,000 cu. ft. and the sales per capita 6,357 cu. ft. to a population of 1,523,000. In 1895 the sales per capita had fallen to 6,321 cu. ft.

In the years of 1899–1900 a gas war arose on the island of Manhattan. The New Amsterdam Gas Co. sold gas for 50c. and the Consolidated Gas Co., the New York Mutual Gas Co. and the Standard Gas Co. sold gas for 65c. per 1,000 cu. ft. during parts of these years.

In 1900 the average price of gas was 82c. per 1,000 cu. ft. and the sales per capita 8,128 cu. ft. to a population of 1,850,000. In the year 1900 the price of gas was put back to $1 per 1,000 cu. ft. and the sales per capita remained without increase. The average price of gas was 98c. per 1,000 cu. ft. and the sales per capita, 8,135 cu. ft. to a population of 1,903,000.

The anthracite coal strike and famine occurred in the winter of 1902–3.

In 1903 the price of gas was 99c. per 1,000 cu. ft. and the sales per capita 9,328 cu. ft. to a population of 2,007,000. In 1904 the price of gas was 99c. per 1,000 and the sales per capita 9,426 cu. ft. to a population of 2,060,000. In 1905 the price of gas was $1 per 1,000 cu. ft. and the sales per capita fell to 9,250 cu. ft. to a population of 2,112,000.

During all of the period 1888 to 1906 the gross sales of gas on Manhattan increased yearly but in 1904 the sales per capita increased little and in 1905 decreased showing an indisposition on the part of consumers to increase their use of gas without a reduction in its price per 1,000 below $1.

Without a reduction in price it appears as if its future increase in gross sales must be due to an increase in population only, of Manhattan.

The above figures for Manhattan are taken from an exhibit in the well known "80c. gas case" of the City of New

York and are used because its great and compressed population eliminates minor causes of variation from average results in New York.

From graphical studies made in this search for an empirical formula for either the price or sales per capita it appears that the towns in Massachusetts under consideration divide themselves into two groups.

The Metropolitan group for cities above 75,000 population and the town group for towns and villages under 75,000 population.

From a population of 2,000 to 75,000 the sales per capita appear in most instances to depend almost entirely upon the price of gas regardless of population.

Above 75,000 the sales per capita appear to be decidedly dependent upon the population, increasing from an amount fixed by the density of population as the price of gas is lowered.

A moment's reflection on the altered conditions of night life in a metropolis as compared with that of a village will assure one of the reasonableness of this separation into two groups.

About 75,000 population appears to be the dividing line. Tabulating the results

Price of gas per 1,000 cu. ft. 1901	Annual sales per capita, cu. ft.	Gross revenue per capita
$2.25	383	$0.86
2.00	584	1.17
1.75	843	1.48
1.50	1,187	1.78
1.25	1,669	2.09
1.00	2,393	2.39

It will be noted that a reduction of price from $2 to $1 quadruples the sales per capita and doubles the gross revenue per capita.

The above empirical table was deduced from the results of about 60 gas companies in the town group taken from the report, for 1901, of the Massachusetts gas and electric light commission and has again been checked by the average results of the same companies for 1907, as will presently be shown.

Grouping according to prices and deducing averages as they actually are after 6 years we have

Price of gas per 1,000 cu. ft. 1907	Annual sales per capita, cu. ft.	Gross revenue per capita
$2.25 (non-existent)		
2.00	722	$1.44
1.75	898	1.57
1.50	1,395	2.09
1.25	2,539	3.17
1.00	3,824	3.82

The above tabulation is computed by dividing the gross revenue of each group of gas companies averaging prices within 12½c. each way of the standard price, by the standard price, and then by the population served, to obtain the annual sales per capita, in an approximate manner. Comparing with the previous 1901 table we see that for $2 and $1.75 the gain is relatively small and for $1.50, $1.25 and $1.00 the gains are respectively about 308, 870 and 1,431 cu. ft. in 6 years; *240 cu. ft. per capita annually is this increase for $1 gas.* These gains are not due to any reduction in the price of gas, but principally to the multifarious advances in methods of lighting, to cooking apparatus, and to the temporary economical use of gas for heating and power.

It can be expected to continue at the rate of 4 to 6 per cent annually for the same reasons, in most cases.

Referring now to the increases shown for each reduction of 25c. per 1,000 cu. ft. in price, we have

Price of gas per 1,000 cu. ft. 1907	Annual sales per capita, cu. ft.	Increased sales per capita, cu. ft.
$2.00	722	....
1.75	898	176
1.50	1,395	497
1.25	2,535	1,140
1.00	3,824	1,289

The reduction in price from $1.25 to $1 appears to produce an increase of about 50 cu. ft. per capita for each one cent.

Since increased sales are apt in the case of most gas works to produce a reduction in the invested capital per annual 1,000 and therefore to require a smaller manufacturing profit per 1,000 cu. ft. sold to pay as great or greater dividends on the capital stock this average increase of sales becomes a pivotal factor in the expansion of gas sales, and of gas works.

I have omitted the laborious computations of the above tabulations as requiring too much space, but as the method is stated they can be verified by anyone. Boston, Cottage City, Worcester County and a few other gas companies selling gas in bulk have been omitted for obvious reasons.

In making use of the empirical results derived, the first table will probably give the best results in entirely new enterprises, and the second tabulation will be better for the consideration of the probable results of gas works which have been in operation for a number of years in the town groups.

Considering and Tabulating the Larger Cities of Massachusetts.

The metropolitan groups of the gas works serving more than a population of 75,000 appear to distinctly show the effect of crowded populations upon the habits of the community, in a larger use of gas per capita regardless of small differences in prices.

Massachusetts Towns, 1907	Population	Price per 1,000	Sales per capita	Gross Revenue per capita	Remarks
Boston	504,063	$0.80	7,447	$5.95	Sliding Scale
Lynn	88,436	0.84	5,404	4.54	$0.99 in 1903
Lowell	106,295	0.94	5,043	4.74	1.00 " 1901
Cambridge	97,434	0.91	5,465	4.97	1.01 " 1905
Springfield	89,281	0.95	4,209	4.00	1.00 " 1905
Fall River	105,762	0.91	3,957	3.60	1.01 " 1905
Worcester	128,135	0.90	3,853	3.46	1.01 " 1905
Lawrence	89,972	0.97	3,619	3.61	1.01 " 1906
New Bedford	74,362	0.98	3,088	3.02	1.19 " 1905

Lawrence, 3,619, and New Bedford, 3,088, fall below the average sales per capita (3,824 cu. ft.) of towns below 75,000 population selling gas at $1 per 1,000; they are on the border land between metropolitan cities and towns.

It has already been shown that the natural annual growth of sales per capita averages 240 cu. ft. at a constant price of $1, and that it is considerably less for higher prices.

If we eliminate this natural annual increment not due to price we can isolate the effect of a reduction of prices in the above tabulated group of metropolitan cities selling gas at prices ranging from 98c. to 84c. per 1,000 cu. ft. at the consumer's meter.

While the increase of sales per capita appears to be about 50 cu. ft. for each cent reduction of price in towns selling at from $1.25 to $1 it will be seen that the average increase in cities is about 40 cu. ft., although their average sales per capita is greater than in towns.

Massachusetts towns	1907 Sales per capita cu. ft.	Sales per capita and date year cu. ft.	Difference cu. ft.	Gain due to time yrs. cu. ft.	Gain due to reduction cts. cu. ft.	For 1c. cu. ft.
Lynn..........	5,404	1903..3,616	1,788	4.. 960	15..828	55
Lowell.........	5,043	1901..3,352	1,691	6..1,440	6..251	43
Cambridge.....	5,465	1905..4,504	961	2.. 480	10..481	48
Springfield.....	4,209	1905..3,491	718	2.. 480	5..238	47
Fall River.....	3,957	1905..3,036	921	2.. 480	10..441	44
Worcester.....	3,853	1905..3,205	648	2.. 480	11..168	15
Lawrence......	3,619	1906..3,229	390	1.. 240	4..150	38
New Bedford...	3,088	1905..2,233	855	2.. 480	11..375	34
Average.......	4,330			Average		40

It would be insincere to claim that this average of 40 cu. ft. increase of sales per capita for each 1c. reduction is anything more than a rudely approximate commercial quantity indicating that while the increase of sales per capita always appears for each reduction in price it is still a quantity affected by obscure causes and limitations which must be found, and allowed for in each individual case under consideration.

Boston, with its brilliant example of an increase of 2,000 cu. ft. per capita in a few years, is not used, since until its present management was installed its affairs were in a chaotic state.

The earlier dates for computation of the above table were selected from consideration of the changes in average prices, without regard to possible results.

The important questions to be answered are:

1. Does an increase per capita always follow a reduction in the price of gas?

The answer is yes under usual conditions.

2. How much average increase of annual sales per capita can be expected to follow each reduction in price?

The answer is: For gas at $1 to $1.25 per 1,000 cu. ft. about 50 cu. ft. for each cent reduction and for gas below $1 about 40 cu. ft. for each cent reduction, on an average under usual conditions.

In its enlightened methods of dealing with public service utilities Massachusetts is a quarter of a century ahead of the rest of the United States.

In no other state and particularly not in the statistical publications issued at great cost by the nation from Washington can be found data clearly stated, enabling a rational and practical discussion of the gas business in complete detail.

A few cases of the larger cities will serve to give an idea of the sales per capita in 1907.

City	Price	Year	Sales per capita
New York, Manhattan	$1.00	1907	9,375 cu. ft.
	1.00	1905	9,250 "
	1.00	1904	9,426 "
Population, 2,217,293.			
New York, Brooklyn	0.80	1907	6,421 "
Population, 1,358,891.			
Pennsylvania, Philadelphia	1.00	1907	7,139 "
Population, 1,300,000. Public buildings and streets free.			
Missouri, St. Louis	0.80 & 0.60	1907	6,000 "
Population, 750,000.			

Ohio, Cincinnati.......... Population, 325,000.	0.75 " 0.50	1907	9,231	cu. ft.
Maryland, Baltimore...... Population, 600,000.	1.00 " 0.85	1907	4,541	"
California, San Francisco... Population, 360,000.	0.85	1907	7,024	"
Louisiana, New Orleans.... Population, 350,000.	1.15	1907	1,714	"
Michigan, Detroit......... Population, 305,000.	0.90 to 0.50	1907	7,000	"
Wisconsin, Milwaukee..... Population, 350,000.	0.80 " 0.60	1907	6,371	"
District of Columbia, Wash. Population, 307,457.	1.00	1907	6,020	"

These variations in sales suggest at once an investigation of the local causes of the disparity in sales per capita.

For each case the reason at once suggests itself and can be traced to the needs of the population or to the characteristic management of the various gas companies.

Of metropolitan cities Buffalo, Cleveland and Pittsburgh have natural gas and cannot be compared with others without it.

Manhattan, New York, has oscillated up and down for three years awaiting a further reduction in price when it will further surpass Cincinnati in rank.

Detroit, Milwaukee, St. Louis and San Francisco show good results of low prices and detailed classification of consumers.

Philadelphia and Brooklyn have not larger sales because the former is not permitted to charge less than $1 and the latter claims the right to collect $1, although it accepts 80c. on account.

New Orleans reveals the effect of a large population that does not purchase gas.

The increase per capita of Boston under the sliding scale has been marvellous in the last three years.

The annual sales per mile of main, per meter and per ton of coal, usually so carefully stated in the analyses of gas-works statistics, are artificial details useful and necessary to the engineers of gas works only.

The annual sales of gas per capita is the gage of the natural law of supply and demand. It is necessary to a just comparison of the gas manager's ability in different cities and towns. It is necessary to a conservative consideration of the expansion of existing gas works. It is necessary to fix the capacity of new gas works in advance of their construction.

Finally no variations in the price of gas can be wisely and safely made without using the sales per capita for the basis of computation.

Fixing exact prices is a common error of inexpert legislators. Since the prices of raw materials and productive labor cannot be fixed it is obviously unjust to unalterably fix the price of gas.

In England for many years and recently in Boston a just method of fixing the relative price of gas and the per cent of dividends appears to have been found in the use of The London Sliding Scale.

Its fairness to both producer and consumers of gas should recommend its use in all cases of legislative enactments fixing the price of gas, and tend to relieve the tension o the present bitter antagonism of the public and he public utility corporations.

CHAPTER XVI.

THE LONDON SLIDING SCALE.

This chapter was written in 1909 and used to elucidate the probable results of Boston's Sliding Scale just then enacted into a law.

The Boston Consolidated Gas Company, still (1912) has the capitalization of $15,124,600 with which it started and is paying 9 per cent dividends with the price of gas fixed at 80c. per thousand with total gas sales of 4,990,691,000 cu. ft. for the year ending June 30, 1912. There is also a scaled reduction in price for fuel gas made by the Boston Consolidated Gas Company.

In England this fuel gas rate is called a differential rate and here a stepped rate.

It is interesting to discover how accurately Boston's gas prices have followed the tabulation deduced for them in 1909, in this paper.

It is important to clearly understand what the London Sliding Scale means, and that it is based upon a uniform price to all consumers, and that the sliding scale concerns only the relation between the uniform price of gas to consumers, and the rate of dividends to stockholders.

The Boston Consolidated Gas Company has added a differential rate to large fuel gas users which reduces the price of gas to them below 80c. per 1,000 cu. ft., but does not affect the Boston Sliding Scale dividends.

Before taking up the mathematical discussion of the London sliding scale, it should be understood that the English method of issuing corporate stock differs widely from the American method. In England, gas corporations make separate successive issues of stocks, each issue bearing a separately fixed dividend, and it is the practice to closely and immediately divide up all profits as dividends, and to make and sell by public auction, new issues of stock for extensions, or additions to, the working plant, when and as they may be needed.

From a usually small initial issue of capital stock at 10 per cent the subsequent issues of the going company are reduced to dividends of 7, 5, 4 or 3½ per cent as capital is required for expansions of business. The auction sales of these stocks usually result in cash premiums and these premiums are used to increase the capacity of the works, thus increasing the value of the works beyond the total face value of the securities issued without increasing the requirement for dividends.

The 10 per cent issues of stock by the London suburban companies are about one-tenth of their total issues at present. By reason of the conversions acts the three Metropolitan companies have only 5, 4 and 3½ per cent stocks at present. In none of these companies does the price of gas exceed $1, and its price averages from 60 to 70c. per 1,000 cu. ft.

No established general theory of the sliding scale is stated by the English, and oddly enough, the only explanation is that it means an indefinite division of extra profits between the company and its consumers; each time the price of gas is lowered by means of an increased dividend on stock for each penny of reduction in the price of gas.

For 10 per cent stock this is usually 1/4 or 1/3 of 1per cent. and for issues carrying lower dividend rates 1/8 to 1/16 per cent. This results in giving the greater share of any reduction in price to the consumer.

A strong argument in favor of the sliding scale is the fact that companies using it in England are so satisfactory to the public, that they have not been municipalized, although municipal ownership has become exceedingly popular in that country.

In obtaining the cash value of public utilities the usual method followed is:

First. To obtain an average of the net divisible income, which also must be shown to be maintainable.

Second. To compute the rate of interest yielded by the capital stock by comparing its average market price with its average dividend.

Third. To estimate the total value of the public utility corporation's property by capitalizing the net divisible income at the rate of interest computed.

This gives what might be called the present going valuation of the corporation's property used for the purpose of purchasing it outright and converting it into a municipal enterprise.

The original structural cost of works is another matter as also is the present structural value.

Owing to premiums received from auction sales of stocks and their investment in plant, the capital stock of most English companies is less than their actual assets, and there is comparatively little fluctuation in the market prices in public utility stocks, owing to the complete publicity of every detail of operation required by law and custom. In exceptional cases other methods of valuation have been used, but under ordinary conditions the above methods appear to be generally satisfactory.

This publicity seems to prove a practical and effectual check upon criminally-minded managers by preventing any action, or failure to act, which would prevent any man from having an equal opportunity, to use his own judgment as to values and prices, and it further acts to steady them.

Capitalization of franchises beyond actual cost is never claimed or practiced in England, although the security arising from a protected monopoly undoubtedly increases the market value of public service corporations stock and thereby usually increases greatly the present going valuation above the original structural cost or the present structural value.

The objection of Englishmen to over-capitalization is very strong, and enforced, too.

In 1903 The Gas Light and Coke Co. of London, was compelled to retire $5,000,000 of its converted capital stock, paying for it out of profits divisible under the sliding scale.

In England, competition between public service corporations is no longer permitted and consequently each public utility corporation is a monopoly, regulated in details by law, and policed by publicity.

The annoyance to the public resulting from competing systems in the streets was the principal cause of the suppression of competition, although the unnecessary duplication of cost of operating plant in the streets is an equally good reason to prevent investments.

As a concession to English preference for low dividend stocks, Parliament since 1887 has permitted companies having high dividend stocks to convert them into a pro-rata amount of lower dividend stocks. A share of the 10 per cent stock being thus replaced by two shares of 5 per cent stock with proportional increases under the sliding scale, and similarly with other rates. Care is always taken to exclude this converted stock from any influence upon future possible computation of the present going valuation.

The entire good faith of all the dealings of Parliament with the gas companies, and its refusal to disturb them in the enjoyment of franchises and contracts unless these companies themselves apply for additional legislation, has, when combined with a publicity forcing all companies to sell a copy of their printed annual accounts for one shilling to any applicant, made English gas stocks one of the safest and most popular investments conceivable.

Two funds are usually permitted to be accumulated by these companies:

The insurance fund usually is 5 per cent of the unconverted capitalization and obtained by withdrawing from the annual profits an amount equalling 1 per cent of capital each year until 5 per cent is reached.

This fund is carefully guarded and is used by permission of court officials to meet any extraordinary claim, demand, or charge, arising from accident, strike or other circumstance, which due care and management could not have prevented.

The reserve or dividend fund is drawn from undivided profits under the sliding scale and is not usually limited in amount.

It is intended to equalize dividends by furnishing sufficient in lean years to bring dividends up to their usual amounts and therefore in its accumulation has reduced the possible dividends of good years.

From 4 to 7 per cent of the unconverted capital are the amounts carried by some of the English companies. In some of the earlier legislation 10 per cent was fixed as a maximum; this was when there was no insurance fund. It is the intention of these companies to cover in their repairs accounts all forms of depreciation such as physical decay, inadequacy and obsolescence.

The universal English custom of covering the cost of all extensions and large improvements by new issues of capital, naturally goes with the immediate division of each year's profits among stockholders.

Since 1898 Parliament has in some few cases allowed from 1 to 1½ per cent of a company's capitalization to be taken from annual earnings, to create a renewal (depreciation) fund not exceeding a total of 10 per cent of the capitalization.

Some of the very old gas companies were allowed to make fixed dividends on cumulative stock issues, and as these are usually large, they were allowed to raise the price of gas, if necessary, to earn them; these companies have refrained, if possible, from soliciting further legislation from Parliament, as that would open the door to the sliding scale for them.

The maximum price of gas for fixed dividends or the standard price for the sliding scale, appear always to have been fixed by the committees charged with revision of a company's affairs, and new legislation for it, slightly in excess of the price required to obtain the fixed or the standard dividends.

Parliament in 1899 definitely ignored a suggestion of revision of the affairs of gas companies and the fixation of a new standard price for gas periodically. The sliding scale appeared to it to have operated so successfully as not to require a readjustment of prices by an outside commission.

However able and conscientious such a commission may be, it is necessarily lacking in practical knowledge of the gas business, and may in dictating fixed prices, which do not allow the necessary elasticity to come and go upon with the fluctuations of cost of raw material and labor, do very great injustice to either the gas producers or the gas consumers of a company.

This appears to be the opinion of all parties in England after more than half a century of practical experience in legislating for gas companies.

Official revision and fixing of prices for gas by a commission at stated periods; public ownership for gas companies; or competition in the sale of gas; all have been abandoned, so far as possible, for the use of the sliding scale. The sliding scale with its elasticity, and its comprehensive advantages to both producer and consumer of gas appears to have proved itself by 34 years of use to be the final solution of the problem of just dealing in England.

Doubtless the universal satisfaction felt with its results arises also in part from the care with which the insurance funds, the reserve (or dividend) funds, and the later depreciation funds, have been hedged about with limitations as to the manner of their creation and expenditure, and limited as to their maximum amounts, and further checked by the publishing to all the world of the annual accounts of the operations of these gas companies.

The auction clause forcing the open sale of all new issues of stocks subsequent to the first (or 10 per cent) issue, reduces the company's capitalization required for expansions of works, since the very large premiums usually paid are used in adding to the plant, but do not require to be covered by profits in the form of dividends. Since 1877, unless valid objections are adduced, the auction clause has been mandatory in all English gas legislation.

The Utopian miracle of the universal prosperity of gas companies in England; of companies paying 10 to 15 per cent dividends on first issues of stock, or proportional dividends on these stocks after conversion into lower dividend stocks; of the contented consumers of these companies receiving and paying for gas at prices ranging from 48c. (South Metropolitan) upwards, and in some cases below this, appears to have been wrought by the sliding scale. The companies not having the sliding scale appear to have been forced to the greater economies resulting from their use in the sliding scale companies.

Factors of the London Standard Sliding Scale.

For new companies, the standard price per 1,000 cu. ft. of gas of a given candle power appears to be fixed at from 2c. to 6c. above the cost of the gas delivered at the consumer's meter plus a dividend of 10 per cent on the investment required per 1,000 cu. ft. of annual sales.

This cost consists, as a matter of common consent, of the various factors given in Field's Analysis, and is carefully presented by gas experts to the Parliamentary committee.

The standard dividend on first issues of stock is 10 per cent cumulative. Of late years this standard dividend of 10 per cent has been changed in some instances to other issues of 7 and 5 per cent stock.

By the conversions act already explained, many companies have substituted larger amounts of lower dividend bearing issues for their original 10 per cent issue.

The standard ratio between the variations in the price of gas per 1,000 cu. ft. and the variations in dividends paid, was formerly, for each penny change in price of gas, one-quarter of one per cent change in dividend on 10 per cent, and afterwards on 7 and 5 per cent stocks; thus the dividend increased as the price of gas decreased, or vice versa. This one-quarter of one per cent, in 1900 and subsequently, has at times been changed to one-third of one per cent and the standard price of gas has been somewhat reduced with it.

These ratios were, and are now, empirical relations fixed arbitrarily, and so long as the price collected by the company was close to the standard price, they appeared to content the companies, but the companies' constant successes in reducing capital expenditures and in increasing sales, has operated to give almost all of any reduction in cost to the consumer, so that in some extreme cases the company has received for dividends one-eighth and the consumer has saved seven-eighths of the reduction in the cost of gas (cost is not price).

The representatives of the gas companies naturally have complained, that as a fact there was no incentive left to reduce prices, and have desired so to modify the existing sliding scale as to divide more nearly equal sums between producers and consumers of gas.

As will hereafter be shown, this could have easily been accomplished by computing the fraction of one per cent to be added for each reduction of price (or one-half the reduction in cost), but no one appears to have mentioned this fact, or to have solved this problem generally and exactly.

The neutral zone in the sliding scale is an excess or reduction usually not exceeding 6c. variation from the standard price within which a change of price, up or down, does not require a change of the standard dividend. Its use appears to have arisen from an overabundance of precaution which has not proved necessary.

All comparisons between the maximum dividend (10 per cent) and sliding scale gas companies, show greater reductions of price of gas, and greater increase of dividends, to have resulted from the sliding scale.

The opinion of English gas engineers appears to be, that most of the exceptional trouble with the Gas Light and Coke Co., London, has arisen from its indiscretion in too hastily reducing prices, in order to obtain increased dividends.

The sliding scale is not a substitute for good management, it only adequately rewards it.

Meter rents, discounts on price to large consumers of fuel gas for heat or power, etc., are not allowed to affect the nominal price of gas to the ordinary consumer, which is used in the sliding scale.

Profit sharing with employes based on the sliding scale, sales of the company's stock to them and to consumers, and beneficial funds of all sorts have followed this prosperity due to the sliding scale. These are separate problems, whose consideration is not necessary to a review of the sliding scale's principles.

General Theory of the Sliding Scale.

For conciseness sake algebraic formulas will have to be used to a small extent in this (hitherto avoided) attempt to give a comprehensive and rational and practical theory of this scale. American data will be used in applying it practically. The following theses appear to be commercially correct:

Cities of over 75,000 population have larger annual sales of gas per capita (regardless of minor variations in price) than towns and villages below 75,000 population. In all cases a reduction of the price of gas is followed by increase in the sales and revenue per capita.

In all cases, at a fixed price for gas, there is an annual increase of sales per capita due to the development of new methods of using gas, until a point is reached where further increase of sales per capita stops until a reduction of this fixed price is made.

Using the data obtainable from the annual reports of the Massachusetts Gas and Electric Light Commission, we obtain the following averages:

Relation of Gas Price to Per Capita Sales.

See Chapter XV

For towns less than 75,000 population.

Price of gas per 1,000 cu. ft.	Annual sales per capita cu. ft.	Gross revenue per capita
For the year 1901	cu. ft.	
$2.25	283	$0.86
2.00	584	1.17
1.75	843	1.48
1.50	1,187	1.78
1.25	1,669	2.09
1.00	2,393	2.39
For the year 1907	cu. ft.	
$2.00	722	$1.44
1.75	898	1.57
1.50	1,395	2.09
1.25	2,535	3.17
1.00	3,824	3.82

One dollar gas has increased its sales per capita by 1,431 cu. ft. in six years, or about 240 cu. ft. per year.

In 1907 the reduction of price from $1.25 to $1 increased annual sales per capita 1,289 cu. ft. or about 50 cu. ft. for each cent reduction of price. These averages from about 60 gas companies prove conclusively the invariable increase of the revenue per capita following each reduction in price in a period of about one year.

For cities over 75,000 population, excluding Boston but including eight cities with prices ranging from 98c. to 84c., the average annual sales per capita is 4,330 cu. ft. and the average increase of this for one cent reduction in price appears to be about 40 cu. ft.

In obtaining this latter quantity periods ranging from one to six years and reductions of price ranging from 4c. to 15c. have been used, no tentative selection of data having been made. The range of gain per capita appears to be from 15 to 55 cu. ft. for 1c. reduction in the price of gas.

Some of the cities used, having been but slightly in excess of 75,000 population, the annual sales per capita (4,330 cu. ft.) is rather too low.

From these results we can state the following formula for the average total gain in sales resulting from a reduction in the price of gas and the lapse of time, in similarly situated cities. Let

r = reduction per 1,000 cu. ft. in cents of price of gas.
P = population served.
y = number of years considered.
Z = total increase of sales in thousands. Then

$$Z = \frac{(240 + 40r)\, yP}{1,000}$$

That is, add 240 to 40 times the reduction of price in cents, multiply it successively by the years and population and divide by 1,000. The result will be the probable average increase of total sales in thousands.

Before formulating the first or starting equation of condition of the sliding scale, it is necessary to decide upon the valuation of the gas works to be used as a basis of computation. This may be determined to be

1. The capitalization of the company in stock.

2. The present going valuation as stated above (market value).

3. The present structural value (actual or reproduction depreciated).

4. The original structural cost to date less depreciation (excluding appreciation of land).

Judge Hough of the United States Circuit Court decided upon the third valuation.

Precedents in England appear to sustain honest capitalization as to this basis for dividends under the sliding scale.

The second valuation has been principally used in the outright purchase of public utilities by English municipalities. Acceptance of these English views will finally be found to be most beneficial to the companies themselves when under the sliding scale.

The average cost of gas per 1,000 cu. ft. delivered should be determined from that series of years of operations most nearly fulfilling future conditions of gas making as to cost of productive labor and raw materials at a given candle power.

To the bare cost of gas thus found is usually added from 2c. to 6c. per 1,000 cu. ft. to allow room to come and go upon in the operation of works.

The standard price of gas per 1,000 cu. ft. delivered at the consumer's meter is reached by adding to these two quantities a sufficient amount to provide a standard dividend upon the valuation of the investment required for each 1,000 cu. ft. of annual sales.

The First or Starting Equation of Condition.

C = the total valuation of works or plant in cents.
p = the standard (or initial) price of gas per 1,000 cu. ft. in cents.

c = the agreed cost of gas per 1,000 cu. ft. delivered in cents.
a = the agreed standard dividend (per cent).
S = the total annual sales in thousands.

$$\frac{a}{100} \times \frac{C}{S} = p—c$$

That is, the standard dividend upon the valuation required by 1,000 cu. ft. of sales equals the difference between the price and cost of gas delivered.

Note above that it is usual to permit a small excess for the latter quantity (p—c).

At the time of the acceptance of the sliding scale by the Boston Consolidated Gas Co. its data were as follows:

C = \$15,000,000; S = 3,000,000 thousands; c = 56c., and p = 90c.; a = 7 per cent and one-fifth of one per cent increased dividend was allowed to it for each cent reduction in the price of gas per 1,000 cu. ft. From this data we have

$$\frac{a}{100} \times \frac{C}{S} = \frac{7}{100} \times 500 = 35 \text{ cents.}$$

$$p—c = 90—56 = 34c.$$

This company has since reduced the price of gas to 85c. and then 80c., greatly increasing its sales without increasing its capitalization, and has been able to pay an 8 per cent dividend without reducing the cost of gas appreciably, as will presently be shown.

Second or General Equation of the Dividing Scale.

r = the reduction in price of gas per 1,000 cu. ft. in cents.
x = the per cent increase of dividend for a reduction of 1c. in price to divide equally the saving in cost of gas, or in the reduction of investment, per 1,000 cu. ft. sold.

B = total cost in cents of extensions or additions to capital required to meet increase of total sales, Z.

We must write this equation as follows:

$$\frac{(C+B)}{(S+Z)} \times \frac{(a+rx)}{100} = p - c - r.$$

That is, the increased dividend upon the new valuation of investment required by 1,000 cu. ft. of sales must equal the reduced price of gas (p—r) less the cost of gas (c) delivered to the consumer's meter.

If in this equation we place the condition that the reduction of price (r) to the consumer shall equal the increase of dividend

$$\frac{(C+B)}{(S+Z)} \times \frac{rx}{100}$$

we share the saving in cost of gas equally and have

$$r = \frac{(C+B)}{(S+Z)} \times \frac{rx}{100}$$

$$x = \frac{100}{\frac{(C+B)}{(S+Z)}} = \frac{100\ (S+Z)}{(C+B)}$$

That is, the fraction of one per cent (x) by which the dividend must be increased, for each 1c. reduction in the price of gas is the reciprocal of the investment required by one annual 1,000 cu. ft. of sales.

Thus, in Boston, when gas was at 85c., we had

$$\frac{C+B}{S+Z} = \$3.57$$

and x = 0.28 of one per cent increase dividend for each cent.

By legislation it was fixed at one-fifth (or 0.20) of one per cent, although the natural conditions produced 0.28 of one per cent for an equal division.

But this fixing the value of x also fixed the corresponding value of r (the reduction in price) and substituting x in the general equation we obtain

$$r = \frac{(p-c) - \frac{(C+B)}{(S+Z)} \times \frac{a}{100}}{2}$$

That is, the reduction in price (r) giving equal shares of reduction in cost to consumer and producer is one-half the standard manufacturing profit (p—c), less one-half the standard dividend on the investment required by one annual 1,000 cu. ft. sales.

For Boston this would correctly be

$r = 17 - 12.5 = 4\frac{1}{2}$c. reduction and
$p - r = 85\frac{1}{2}$ cents price of gas.

The dividend should have been

$(a + rx) = 7 + 1.26 = 8.26$ per cent dividend.

So far the Boston sliding scale gives close results for total annual sales of 4,233,256 thousands. About 5,600,000 thousands appear to be the practical limit of Boston's annual sales in the near future. It is further assumable that this demand can be met without increasing the present capitalization of $15,000,000 fixed by the legislature.

Further it is to be reasonably expected that the manufacturing cost of gas, at present 56c., will be reduced in successive steps to 51, 46 and 41c., and that the price at present, 80c., will be reduced to 75c. With the cost of gas at 56c. we have

$$\frac{C+B}{S+Z}=\$2.67 \text{ investment per annual 1,000 cu. ft. sales.}$$

$$x=\frac{100}{267}=0.375 \text{ of 1 per cent for each cent.}$$

$$r=\frac{34-18.7}{2}=7.6c, \text{ reduction in price.}$$

$(a+rx)=7+2.85=9.85$ per cent dividend.
$(p-r)=82.4c.=$the price of gas.

With the cost of gas 51c. and no other change
$x=0.375$ of one per cent increase of dividend for each cent.

$$r=\frac{39-18.7}{2}=10.1 \text{ reduction in price.}$$

$(a+rx)=7+3\frac{3}{4}=10\frac{3}{4}$ per cent dividend.
$(p-r)=79.9c.$ price of gas.
With the cost of gas 46c. and no other change

$$r=\frac{44-18.7}{2}=12.6c. \text{ reduction of price.}$$

$(a+rx)=7+4.7=11.7$ per cent dividend.
$(p-r)=77.4c.$ price of gas.
With the cost of gas 41c. and no other change

$$r=\frac{49-18.7}{2}=15.1c. \text{ reduction of price.}$$

$(a+rx)=7+5.6=12.6$ per cent dividend.
$(p-r)=74.9c.$ price of gas.

It will be instructive to follow the division of the proceeds of the sale of one 1,000 cu. ft. of gas according to each scale.

RELATION OF PRICE TO DIVIDENDS.

Boston's Sliding Scale.

Unequal division of proceeds of sale of 1,000 cu. ft. of gas.

Price of gas, c.	Consumer saves, c.	M'f'g cost, c.	Dividends to stockholders c.	Dividends to stockholders Per cent	Surplus c.	Approximate sales in 1,000 cu. ft.
90	0	56	35	7% of $5.00	— 1	3,000,000
85	5	56	29.5	8% " 3.57	—½	4,233,256
80	10	56	24	9% " 2.67	0	5,600,000
80	10	51	24	9% " 2.67	+ 5	5,600,000
80	10	46	24	9% " 2.67	+10	5,600,000
80	10	41	24	9% " 2.67	+15	5,600,000
75	15	46	27	10% " 2.67	+ 2	5,600,000
75	15	41	27	10% " 2.67	+ 7	5,600,000

Marks' Dividing Scale.

Equal division of proceeds of sale of 1,000 cu. ft. of gas (same data).

Price of gas c.	Consumer saves, c.	M'f'g cost c.	Dividends to stockholders c.	Dividends to stockholders Per cent	Surplus c.	Approximate sales in 1,000 cu. ft.
90	0	56	35	7% of $5.00	—1	3,000,000
85.5	4.5	56	29.5	8.25% " 3.57	0	4,233,256
82.4	7.6	56	26.3	9.85% " 2.67	0	5,600,000
79.9	10.1	51	28.7	10.75% " 2.67	0	5,600,000
77.4	12.6	46	31.2	11.7% " 2.67	0	5,600,000
74.9	15.1	41	33.6	12.6% " 2.67	0	5,600,000

Consideration of these two tables reveals at once the grave defects due to the superficiality and rigidity of the London and Boston sliding scale for gas, when the reduced price of gas departs a little way from the standard price.

If the various funds, such as the "insurance," "reserve" and "depreciation," are full, there is no other honest method of disposing of the surplus than to reduce the price of gas without causing the company to receive an equal share of this reduction to the consumer, which latter individual gets nearly all the benefit of the reduction.

These defects are cured in the Marks' dividing scale, which can be applied to every conceivable case because it embodies all the factors naturally operating upon the finances of gas works.

In it the computed fraction of one per cent added to dividend for each reduction of 1c. in the price of gas must be the reciprocal of the capital stock invested for the sale of 1,000 cu. ft. of gas during the current year.

In it the computed reduction in the price of gas must be one-half the difference between the standard price profit on 1,000 cu. ft. of gas and the amount of the standard percentage of the capital stock invested for the sale of 1,000 cu. ft. of gas during the current year.

The equitable dividend giving equal shares to stockholders and consumer, is the total sum of the standard dividend and of the product of the reduction in price by the computed fraction of one per cent allowed for each 1c. reduction in price per 1,000 cu. ft.

It would be hard to overestimate the colossal sums of money invested and disbursed since 1875 under the benignant guidance of the London sliding scale; they are amazing, overwhelming.

The division of the vast profits from gas at the extreme of this scale is so unfair to the companies as to have caused much dissatisfaction to and complaint by the gas engineers whose skill and honest efforts have enabled the present exceedingly low cost and price of gas, and great profits, in England.

Since 1875 committees of Parliament, the London board of trade, gas engineers and accountants, and lawyers and experts, have all sought to amend this defect involving millions of pounds sterling, but the complete answer to this stupendous problem in equity appears to have ever eluded their grasp.

My own efforts have been to completely state, explain and exemplify this problem, and I hope I have cleared up this tangled situation, reaching an equitable and universal dividing scale.

There is but one right way to do this thing, and there are countless wrong ways, many of which are even now being tried without complete satisfaction to either party.

In adapting the London sliding scale for gas to local conditions Boston has made a long step in the right direction, following a conservative and tested lead, but instead of using the fixed fraction one-fifth of one per cent for the increment of dividend for each 1c. reduction in the price of gas, it should have made this increment the reciprocal of the capitalization required for each 1,000 cu. ft. of annual sales, and if great precision is required, also fixed the allowable reduction in price at one-half the standard price, less one-half the sum resulting from adding the cost of gas to the amount of the standard dividend on the capitalization required for each 1,000 cu. ft. of annual sales.

Thus the first American example of the use of the sliding scale for gas would have established comprehensively and universally for all cases, the equitable adjustment of its factors.

The triumphant progress of the sliding scale in England will be repeated in America, and the future interests controlled by it will be far greater, therefore the dividing scale should be without flaws in theory and judicially fair in its practical operation.

Marks' Dividing Scale.

As the object of this research of mine was to discover a mathematically correct and universally applicable relation between all the factors affected in a division of surplus savings or surplus profits, I would suggest the use of the term "Marks' dividing scale" as indicating a method by which equal shares can be allotted to producer and consumer in every known form of selling.

It is interesting to note the ease with which it can be applied to all businesses.

For instance, the recent thorough overhauling of the Cleveland electric railways gives us the following data very nearly:

Actual cost of one passenger, 3c.

Passengers (1907), 135,000,000.

Final valuation of all Cleveland's electric railways, $23,909,731, or about 18c. per passenger.

It has been suggested that the railway company be limited to 6 per cent dividends and the fares scaled down as economies permit, so as to never make more profit.

Would it not have been better to have agreed upon a standard 4c. fare and a standard 5 per cent profit and used "Marks' dividing scale" of profits.

We would have then 5 per cent of 18c. =0.9c., and 4—3 =1c., which is very nearly equality.

The increment for 1c. reduction would have been $\frac{100}{18}$

=6 per cent very nearly, and the result attained by the company as soon as it could possibly and safely reach it would have been 11 per cent dividends and 3c. fares.

It is quite sure that by means of tickets it would not be long before this railway company would have reduced its 4c. fare somewhat and increased its 5 per cent dividend as far as it could.

Of course, these figures are only roughly illustrative of the adaptability of this formula for "Marks' dividing scale."

The most careful and exhaustive investigation must precede every application of this scale.

Whenever a specialty is sold; as passenger miles, ton miles, car miles, cubic feet of water, telephone messages, telegrams, K.W.H., arc lights, etc.; this "dividing scale" will work as beneficently as has the London scale, already operated for 34 years on gas in England.

The division of surplus savings with the employes of the gas company can be arranged in almost any proportions desired.

For instance, for any selected year, let

S = total annual sales of gas.

p = standard price of gas per 1,000 cu. ft.

O = total operating cost for one year.

F = total preferred interest or dividend charges.

E = total standard dividend on stock.

D = divisible surplus saving. Then

$D = Sp - (O + F + E)$

If we decide that the divisible surplus savings should be shared equally by the consumers, the stockholders and the employes, the amounts would be $D \div 3$ to each.

This amount, if divided by the total annual sales, would give the drop from the standard price per 1,000 cu. ft. of gas. $D \div 3\,S$.

If this amount is divided by the total stock, we obtain the total increment of the dividing scale stock to be added to the standard dividend fixed.

The remaining one-third of the total divisible surplus saving can be apportioned to the employes, or for their benefit in the form of life or accident insurance, pensions, or extra pay, as may be deemed suitable to their needs.

Dividing the divisible surplus savings into 3 equal parts appears to me to be fair dealing with the parties to the tripartite relation, but others may think differently and agree on a different divisor.

Changing the divisor from 2 affects the fundamental or general equation stated in the case of the London sliding scale, in which an equal division of the divisible surplus saving per 1,000 cu. ft. is assumed as between stockholders and consumers.

Rewriting this equation for 3 equal shares, we have

for $m = \dfrac{C+B}{S+Z}$

$$m\left(\frac{a+r\,x}{100}\right) = p - c - 2\,r$$

in which the divisible surplus savings is represented by 3r and from the standard price (p), in addition to the cost of gas (e), is taken 2r, covering one allotment to reduce the price of gas, besides an equal one for distribution among employes.

We have $x = 100 \div m$ on the condition of equality of surplus dividends and of reduction in price of gas, and by transformation after substitution

$$r = \frac{p - c - 0.01\,a\,m}{3}$$

That is the reduction in price per 1,000 cu. ft., giving three equal shares, as apportioned above, is one-third of the standard price, less the cost and also less the standard dividend for 1,000 cu. ft.

A liberal interest in savings for all trustworthy employes appears to be just and should not diminish the results shared by others.

CHAPTER XVII.

CAPITALIZATION, ASSETS AND PROFITS OF MASSACHUSETTS GAS COMPANIES.

In previous considerations of the "Sales Per Capita" and of the "London Sliding Scale" for gas companies in the search for a universal and equitable dividing scale, it has been necessary to divide the Massachusetts gas companies into two groups.

The first group includes all companies in towns less than 75,000 population.

The second group includes companies in cities over 75,000 population.

The first group has further been sub-divided into five groups approximating the prices of $2, $1.75, $1.50, $1.25 and $1 per 1,000 cu. ft. of sales.

Unless this segregation of precedents is made, the averages deduced will surely mislead when used for the general purpose of estimating the cost of gas works.

Heretofore it has been shown that there is a law rudely connecting the selling price of gas with its sales per capita and it will also be found that there is a general relation existing between the selling price and the investment per 1,000 cu. ft. of annual sales of gas works.

For the proper use of an equitable and universal dividing scale, it is imperative that the true average structural cost of gas works per 1,000 cu. ft. of annual sales should be learned from honest practical precedents.

The malign results of unregulated competition, over-capitalization, and inexpert legislation, is nowhere better shown than in Boston, whose gas works will necessarily be excluded as a precedent of value in estimating, capitalization, assets and profits.

In 1907 the Boston Consolidated Gas Co. purchased 2,261,945 1,000 cu. ft. of gas of the New England Gas & Coke Co.; it sold 4,215,472 1,000 cu. ft., manufacturing the difference with a gas works rated by its own officials at 9,725 1,000 cu. ft. daily, multiplied by 200, or 1,945,000 1,000 cu. ft., annual capacity.

The State Legislature fixed the capital of this company at $15,126,000 or $7.77 per annual 1,000 cu. ft. of capacity —1907 (capacity is not sales).

The total annual sales of gas when this legislation was enacted was about 3,000,000 1,000 cu. ft., and the basis of Boston's present sliding scale was 7 per cent of $5, or 35c., standard profit on each 1,000 cu. ft. of gas sold; a sum nearly twice as large as should have been permitted, resulting from excessive capitalization, granted by the legislature.

Segregating the various groups according to price in towns of less than 75,000 population, we have the following series:

APPROXIMATE PRICE $2 GROUP—1907.

Names	Price	Rated annual capacity; cu. ft.	Annual sales; cu. ft.	Capitalization: Ordinary Stock	Capitalization: Bonds and Notes	Assets	Tax value
Gardner........	$2.07	10,000,000	8,020,900	$26,200	$52,100	$90,368.53	$24,500.00
Marblehead....	1.88	6,000,000	5,328,100	20,000	17,450	43,357.75	11,000.00
Totals.....		16,000,000	13,349,000	$115,750		$133,726.28	$35,500.00

AVERAGE VALUATIONS PER 1,000 CU. FT.

Names	Annual capacity: Capital	Annual capacity: Assets	Annual sales: Capital	Annual sales: Assets	Cost of gas per 1,000 cu.ft.	Dividend
Gardner.........	7.83	$9.04	$9.76	$11.26	$1.55	None
Marblehead.....	$6.24	7.22	7.03	8.14	1.96	None
Averages of totals	$7.23	$8.36	$8.64	$10.02	$1.75	

APPROXIMATE PRICE $1.75 GROUP—1907.

Names	Price	Rated annual capacity cu. ft.	Annual sales; cu. ft.	Capitalization: Ordinary Stock	Capitalization: Bonds and Notes	Assets	Tax value
Greenfield.......	$1.64	12,000,000	8,401,400	$50,000	$53,000	$107,647.71	$32,000.00
Ipswich.........	1.78	20,000,000	4,144,900	16,000	14,000	29,703.79	19,100.00
Leominster......	1.71	60,000,000	16,885,000	50,000	72,500	152,187.65	85,300.00
Milford.........	1.66	18,000,000	14,974,100	72,300	6,500	118,913.84	73,400.00
Plymouth.......	1.78	18,000,000	8,834,500	40,000		48,170.88	24,000.00
Totals......		128,000,000	53,239,900	$374,300		$456,623.89	

AVERAGE VALUATIONS PER 1,000 CU. FT.

Names	Annual capacity Capital	Annual capacity Assets	Annual sales Capital	Annual sales Assets	Cost gas per 1,000 cu.ft.	Dividends
Greenfield	$8.58	$8.97	$12.26	$12.81	$1.55	Preferred, 2%
Ipswich	1.50	1.48	7.24	7.16	1.43	27c. per 1,000 cu. ft.; 7%
Leominster	2.04	2.54	7.25	9.01	1.31	None.
Milford	4.38	6.60	5.26	7.94	1.08	48c. per 1,000 cu. ft.; 10%
Plymouth	2.22	2.50	4.53	5.45	1.19	23c. per 1,000 cu. ft.; 5%
Averages of totals	$2.93	$3.57	$7.03	$8.55	$1.31	

APPROXIMATE PRICE $1.50 GROUP—1907.

Names	Price	Rated annual capacity; cu. ft.	Annual sales; cu. ft.	Capitalization Ordinary Stock	Capitalization Bonds and Notes	Assets	Tax value
Amesbury	$1.50	48,000,000	12,830,800	$60,000.00	$91,800.00	$182,578.16	$53,800.00
Arlington	1.54	20,000,000	19,994,200	100,000.00	59,800.00	176,647.99	60,129.00
Framingham	1.59	20,000,000	15,871,000	75,000.00	110,000.00	170,919.49	36,900.00
Marlboro	1.46	40,000,000	30,060,300	130,000.00	75,000.00	252,870.39	146,280.00
Natick	1.61	12,000,000	11,706,300	50,000.00	9,500.00	84,079.08	34,600.00
Norwood	1.56	30,000,000	13,568,200	12,000.00	52,186.15	90,343.40	36,600.00
Woburn	1.40	16,000,000	15,307,900	45,100.00		88,460.72	57,500.00
Totals		186,000,000	119,338,700	$870,386.15		$1,045,908.23	

Average Valuations per 1,000 Cu. Ft.

Names	Annual capacity		Annual sales		Cost of gas per 1,000	Dividends
	Capital	Assets	Capital	Assets	cu.ft.	
Amesbury	$3.16	$3.80	$11.83	$14.23	$0.95	None.
Arlington	7.99	8.83	8.00	8.80	1.21	None.
Framingham	9.25	8.55	11.65	10.77	1.28	None.
Marlboro	5.12	6.32	6.82	8.41	0.94	26c. per 1,000 cu. ft.; 6%
Natick	4.96	7.01	5.08	7.18	1.27	26c. per 1,000 cu. ft.; 6%
Norwood	2.14	3.01	4.73	6.66	1.30	None.
Woburn	2.82	5.53	2.95	5.78	1.07	53c. per 1,000 cu. ft.; 18%
Averages of totals	$4.68	$5.62	$7.29	$8.76	$1.14	

Approximate Price $1.25 Group—1907.

Name	Price	Rated annual capacity; cu. ft	Annual sales; cu. ft.	Capitalization: Ordinary Stock	Capitalization: Bonds and Notes	Assets	Tax value
Brockton	$1.26	200,000,000	129,732,800	$390,000	$301,000	$758,444.08	$352,300
Chicopee	1.27	48,000,000	31,109,700	166,500	86,130	297,569.53	104,000
Gloucester	1.20	70,000,000	53,933,600	150,000	12,000	228,067.81	155,000
Northampton	1.34	100,000,000	44,221,200	100,000	20,000	172,449.06	122,600
North Attleboro	1.37	33,000,000	28,781,300	68,100		94,847.65	62,250
Pittsfield	1.21	96,000,000	75,139,700	300,000	17,000	335,455.75	228,200
Salem	1.20	100,000,000	111,327,800	349,600	75,000	620,147.91	511,200
Totals		647,000,000	474,246,100	$2,035,330		$2,506,981.79	

AVERAGE VALUATIONS PER 1,000 CU. FT.

Names	Annual capacity		Annual sales		Cost of gas per 1,000 cu. ft.	Dividends
	Capital	Assets	Capital	Assets		
Brockton	$3.45	$3.79	$5.33	$5.85	$0.87	15c. per 1,000 cu. ft.; 5%
Chicopee	5.68	6.20	8.12	9.57	0.96	17c. per 1,000 cu. ft.; 4%
Gloucester	2.31	3.26	3.00	4.23	0.86	28c. per 1,000 cu. ft.; 8%
Northampton	1.20	1.72	2.71	3.90	1.00	8%
North Attleboro	2.06	2.87	2.36	3.30	0.70	24c. per 1,000 cu. ft.; 10%
Pittsfield	3.30	3.49	4.22	4.46	0.88	24c. per 1,000 cu. ft.; 7%
Salem	4.24	6.20	3.81	5.57	0.87	25c. per 1,000 cu. ft.; 8%
Averages of totals	$3.14	$3.87	$4.29	$5.28		

APPROXIMATE PRICE $1.00 GROUP—1907.

Names	Price	Rated annual capacity; cu. ft.	Annual sales; cu. ft.	Capitalization: Ordinary Stock	Capitalization: Bonds	Assets	Tax value
Taunton	$1.09	140,000,000	81,397,000	160,000	$80,000	$311,601.37	$142,000

AVERAGE VALUATION PER 1,000 CU. FT.

Names	Annual capacity		Annual sales		Cost of gas per 1,000 cu. ft.	Dividends
	Capital	Assets	Capital	Assets		
Taunton	$1.71	$2.22	$2.95	$3.83	$0.70	20c. per 1,000 cu. ft.; 10%

METROPOLITAN GROUP—1907.

Names	Price	Rated annual capacity; cu. ft.	Annual sales; cu. ft.	Capitalization: Ordinary Stock	Capitalization: Bonds or Notes	Assets	Tax value
Lowell	$0.94	800,000,000	536,029,600	$1,000,000		$1,790,829.99	$1,708,120
Cambridge	0.91	800,000,000	533,033,100	1,000,000	$266,000	2,083,186.53	2,071,000
Springfield	0.95	600,000,000	375,844,400	800,000	294,880	1,658,330.04	1,213,800
Fall River	0.91	500,000,000	418,519,900	690,000	50,000	1,335,038.38	944,850
Worcester	0.90	840,000,000	493,625,800	800,000	70,000	1,492,703.87	1,485,900
Totals		3,620,000,000	2,357,072,800	$4,970,880		$8,360,088.81	

AVERAGE VALUATIONS PER 1,000 CU. FT.

Names	Annual capacity: Capital	Annual capacity: Assets	Annual sales: Capital	Annual sales: Assets	Cost of gas per 1,000 cu.ft.	Dividends
Lowell	$1.14	$2.03	$1.87	$3.34	$0.60	19c. per 1,000 cu. ft.; 10%
Cambridge	1.58	2.60	2.38	3.91	0.62	23c. per 1,000 cu. ft.; 12%
Springfield	1.82	2.76	2.91	4.41	0.69	21c. per 1,000 cu. ft.; 10%
Fall River	1.48	2.67	1.76	3.19	0.55	16c. per 1,000 cu. ft.; 10%
Worcester	1.04	1.78	1.76	3.02	0.61	18c. per 1,000 cu. ft.; 11%
Averages of totals	$1.38	$2.31	$2.11	$3.55		

Great care has been taken to eliminate from the Massachusetts companies used obviously abnormal instances and to select such as have apparently found themselves and settled themselves down under normal conditions undisturbed by too serious financial vagaries, or the introduction of electric lighting adventures.

Companies purchasing their gas are omitted, because gas would not be bought except at lower cost than it could be made.

The tax value of these companies affords a valuable check upon the capitalization and (bookkeeping) assets.

It might appear from these tax values that the assets (capital) had often been very greatly impaired unless (as a fact) this impression be corrected by the market value of the stock.

The rated annual capacity of these works is compared with the annual sales in each case and frequently serves to show how closely these two approach in the more profitable works which are not overbuilt.

The grouping of the selected gas companies according to prices of gas, was on the assumption that having naturally reached a given price the fundamental units will be found to be close to each other and yield reliable averages, for practical use.

The inclusion of common stock, mortgage bonds and short term notes in the units of capitalization of these gas companies, has arisen from the custom of the companies, which are said to issue these short term notes for permanent improvements and then apply to the Massachusetts Gas and Electric Light Commission for permission to convert the notes into stock or bonds.

The cost of gas per 1,000 cu. ft. is derived from the total operating expenses less the income from residuals, divided by the total annual sales.

The dividends declared are noted; they are usually very much less than the manufacturing profit per 1,000 cu. ft. of gas.

The fairer English custom is to rely on the "insurance" and "reserve" funds and divide up the manufacturing profit very closely among the stockholders providing for expansion of works by new issues of stock sold at public auction.

A closer comparison of the results of the various groups will give a better grasp, although the groups covering two or less cities cannot have the weight of the larger groups as to averages.

The prices, costs and profits on gas are averages of averages and not of totals giving each town of each group equal weights in results.

In the Metropolitan group the $2.31 of assets per 1,000 cu. ft. of annual capacity and the $3.55 of assets per 1,000 cu. ft. of annual sales are noteworthy, as the averages of Massachusetts cities not exceeding 150,000 or less than 75,000 population.

Manhattan Island, New York City, has sales of more than double the sales of all Massachusetts. Its towering office buildings, hotels, apartment houses, and tenement districts and its theatres and restaurants with its densely congested population of over 2,000,000 appears to make it the only spot where less than $2 of assets per 1,000 cu. ft. of annual sales is probable with its works driven to their utmost capacity.

AVERAGE VALUATIONS PER 1,000 CU. FT.

Name	Approximate price per 1,000 cu. ft.	Approximate cost per 1,000 cu. ft.	Approximate profit per 1,000 cu. ft.	Dividends cents per 1,000 cu. ft.	Dividends per cent	Annual capacity Capital	Annual capacity Assets	Annual sales Capital	Annual sales Assets	Remarks
$2.00 group.	$1.88 2.07	$1.96 1.55	$0.08 0.52	0 0	0 0	$7.23	$8.36	$8.64	$10.02	Averages no value.
1.75 "	1.71	1.31	0.40	0 48	0 10	2.93	3.57	7.03	8.55	
1.50 "	1.52	1.14	0.38	0 53	0 18	4.68	5.62	7.29	8.76	
1.25 "	1.26	0.88	0.38	15 28	4 10	3.14	3.87	4.29	5.28	
1.00 "	1.09	0.70	0.39	20	10	1.71	2.22	2.95	3.83	Taunton only
Metropolitan	0.92	0.61	0.31	16 23	10 12	1.38	2.31	2.11	3.55	

Up to this point the collective capitalization of these Massachusetts companies has been dealt with as if, like ordinary stock, all securities were dividend bearing.

If there are preferential charges on preferred stock, bonds, notes, etc., these charges must be added to the operating cost of gas and a special cost of gas per 1,000 cu. ft. obtained to use with the special dividing scale stock capitalization per 1,000 cu. ft. of sales.

Conservatism would suggest that the dividing scale stock issued should not be less than $2 per annual 1,000 cu. ft. of sales, for an increment of dividend of over one-half of one per cent on a low capitalization per 1,000 cu. ft. sales, might produce dividing scale dividends so large as to cause public objection.

Recognizing the risk and delays in all new ventures the custom in England is to allow 10 per cent dividends (if earned) on the first issue for a new gas company and this would naturally suggest a cumulative 10 per cent preferred sliding scale stock for all new company's first installment of stock, with lower rates for subsequent installments, as required for extensions.

But there appears to be no idea of exaggerating the capital per 1,000 cu. ft. of annual sales of gas in England, by capitalizing franchises; allowing for appreciation in the value of real estate used, or adding to the gas company's cost for its distributing system, the cost of pavements (laid at the municipality's cost) over mains and services.

In the recent decision of the United States Circuit Court in "the 80-cent gas case," its action was contrary to all English precedents and law. Its valuations were approximately as follows, when separated:

For franchises (a gift)	$12,000,000
For increased value real estate	7,500,000
For pavements over mains and services paid for by city, etc	6,000,000
	$25,500,000
Present value plant (approx.)	33,500,000
Total	$59,000,000

The Master appointed even wished to present the Consolidated Gas Co. with $20,000,000 for its franchises, but the court thought that was going too far.

This deplorable blunder of the court appears to have been the result of entire ignorance of English law and precedents and of the actual factors of cost in gas works.

It emphasizes, even more than the instance of the capitalizing of the Boston Consolidated Gas Co. by the Massachusetts State Legislature, our people's and our honest corporations' bitter need for their own protection, of the rational and practical methods of fair dealing with public service corporations, so clearly established and practiced in England.

There the parliamentary committees have the facts presented to them by parliamentary guilds, of engineers, accountants and solicitors, who, making a specialty of this work, have an intimate knowledge of all the facts and precedents of the case under consideration and of the principles established.

Since the above was written the United States Supreme Court has overruled the Circuit Court and dismissed the bill without prejudice, directing the Consolidated Gas Co. to test the results of selling gas at 80c. per 1,000 cu. ft. before again resorting to the courts.

As its reasons for this action the Supreme Court declared its belief that the value of the plant was overestimated, and that gas sales would increase at the reduced price (80c.), yielding a profit of 6 per cent, and made no allowance for value of franchises, save the initial amount fixed under a special law of New York (1884) since repealed.

After the first exploit of its inexpert legislators in the Boston gas case, we can pardon Massachusetts citizens for their apprehensions over their proposition to pass a general sliding scale law for gas companies in that state.

To test out this universal and equitable dividing scale the best way is to apply it practically to the groups of companies mentioned.

THE METROPOLITAN GROUP.

In this group the data is as follows:

Total common stock	$4,290,000
Common stock per 1,000 cu. ft. sales	m = $1.82

This is a special valuation of m in cents for use in dividing scale only.

Preference securities	$680,880
Five per cent interest on	34,044
Interest cost per 1,000 cu. ft. sales	14c.
Operating cost per 1,000 cu. ft. sales	61c.
Special dividing scale cost per 1,000 cu. ft. sales	75c.
Let standard price be	90c.
Let standard dividend be per 1,000 cu. ft. sales	20c.

per 1,000 cu. ft. sold, or 11 per cent = a. Then we have

$$2r = p - c - \frac{a}{100} m = \text{total divisible saving}$$

$2r = -5$
$r = -2.5c.$ or increase of 2.5c. in price.
$p - r = 90 + 2.5c.$ or 92½c. per 1,000 cu. ft. as the proper price.

$$a + \frac{r}{m} = \text{the proper dividend}$$

$$\text{computed } 11 - \frac{5}{2} \times \frac{100}{182} = 11 - 1.4 = 9.6\%$$

as the properly permitted dividend rate on the common stock after paying 5 per cent interest on the preference securities.

The increment of the standard dividend for profits is $\frac{1}{m}$, but when the standard price p is exceeded, the dividend vanishes when the increase of price $= r \times \frac{1}{m} = a$ or when

$$r = ma = \frac{11}{100} \times 182 = 20c.$$

That is to say for the figures used in the Metropolitan group the dividing scale ceases to be useful at 110c. price with 90c. as the standard price.

If the operating cost of gas, c, is reduced to 46c. per 1,000 cu. ft. in the above group

$2r = p - c - am = 10c.$ saving
$r = 5c.$ reduction
$p - r = 85c.$ price of gas

$$a + \frac{r}{m} = 11 + 5 \times \frac{100}{182} = 13.7 \text{ per cent dividend}$$

The $2 Group

This group may be said to represent the first venture in a small town selling about 6,000,000 cu. ft. annually and requiring an investment of about $40,000.

With proper expert control the whole of this investment should not be required at once or the operating cost of gas be greater than $1.50 per 1,000 cu. ft. sales.

The risk and delay of a new venture might be covered by a first issue of 10 per cent cumulative preferred stock with dividing scale dividend increments—

m = $6.67 capital per 1,000 cu. ft. annual sales might be assumed and

Operating cost of gas per 1,000 cu. ft......	$1.50
Pref. stock cost of gas per 1,000 cu. ft.....	0.67
Special d. s. cost of gas per 1,000 cu. ft....	$2.17

Probably a standard price of $2.15 and standard dividend of 10 per cent would be satisfactory to the company. Diligence and skill would be likely in time to reduce the operating cost of gas to $1.25; we would have

$$p - c - am = 2r = 215 - 125 - 67 = 23$$
$$r = 12\text{c. reduction}$$
$$p - r = \$2.03 \text{ price}$$

$$a + \frac{r}{m} = 10 + \frac{12}{6.67} = 12 \text{ per cent dividend nearly}$$

These applications will serve to clear up the practical methods of applying this universal dividing scale to other instances, given above.

The writer particularly wishes to state right here that the figures used in these examples are merely those suggested by the above average results, and are not to be regarded as having his final indorsement.

If any particular inferences can be drawn from his explorations in this new field of gas finances they are the following:

The case of each gas company must be treated separately if brought under the dividing scale.

Experts of incorruptible integrity, practically learned in the theory and practice of the business considered are the only persons who should be permitted to discuss the figures or present the results of a technical investigation of public utilities.

Inexpert legislators and inexpert courts or commissions, have always erred in their decisions, usually in favor of the larger corporations, at the cost of the people, and in the case of the smaller corporations, unjustly oppressing them with impossibly low prices. If honest, partisan commissions are easily influenced and dangerous, because the evil results of blunders are as serious as those of crimes.

Engineers of gas companies can add largely to their dividing scale dividends by reducing the cost of gas and increasing its sales.

They can also add to the dividing scale dividends by keeping down the capital expenditure and its capitalization.

The limited use of preference securities at low rates of interest also adds to the dividing scale dividends by reducing the capitalization per 1,000 cu. ft. sales.

Finally the dividing scale and publicity will prevent stock watering by adventurers and the various existing forms of corporate extortion and rascality resulting from it, because it will be to the company's interest to have as little capital and as high dividends as possible, and in order to reach this result it must lower the price of gas.

It protects the company from serious losses by allowing the raising of the prices of gas above the standard price, with a corresponding lowering of dividend to cover any increased cost of gas due to scarcity of raw material and productive labor.

COMPUTATION RULES FOR MARKS' DIVIDING SCALE FOR GAS.

(*1*) *To compute the divisible surplus saving per 1,000 cu. ft. of gas sales.*

From the standard price, subtract the cost and the standard dividend per 1,000 cu. ft. sold.

(*2*) *To compute the required reduction in price per 1,000 cu. ft. sales.*

Divide the divisible surplus saving by two.

(*3*) *To compute the per cent increment of the dividing scale dividend for each one cent reduction in price.*

Divide unity by the capital required by one 1,000 cu. ft. annual sales to obtain the fraction of one per cent required.

(*4*) *To compute the dividing scale dividend per cent.*

Add the standard dividend to the product of the reduction in price by the increment for 1 cent.

The accountant desiring to compute the dividing scale rule in gross quantities may proceed as follows:

Multiply the total annual sales by the standard price fixed.

From this result subtract the following quantity.

(1) The total operating cost of gas making plus.

(2) The total preferred interest charges plus.

(3) The total standard dividend charge on dividing scale stock.

The result will be the total divisible surplus saving.

This divided by 2 will enable the fixing of the reduction in price per 1,000 cu. ft. sales, and the dividing scale increment of dividends.