THE MUNICIPALITY AND ITS UTILITIES

A thesis submitted to the faculties of
The School of Engineering and the Graduate School
The University of Kansas

For

THE DEGREE OF CIVIL ENGINEER

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1930

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PREFACE

This treatise has been written to correlate the information that the writer has found of value in his study of the problems connected with the Municipality and its Utilities. The problems include those of construction and operation. These problems are approached necessarily from the engineering standpoint, but certain of these problems will be discussed as they are affected by legal, accounting, or economic considerations.

This subject is a broad one and there are many mooted questions connected with it due in part to the newness of the industry and in part to different theories of the rights of private capital invested in public utilities.

It is the desire of the writer to reflect in this treatise what seems to be basic and the essential points of additional basic principles yet to be determined toward which we are striving in more or less enlightened channels. In outlining such a subject there are necessarily included discussions of points that have already been considered as accepted practice, in order that the thought shall be as complete as possible.

There is a considerable extraneous material in this treatise, but the writer has found all of this material instructive, interesting and fascinating and has felt it worth the inclusion.

It is ventured that this subject is of growing importance from the political, as well as from the engineering and economic approach, and that within the next decade there will be even more important discussion, and more interest aroused than has occurred to date.

CHAPTER I

INTRODUCTION

EARLY DEVELOPMENTS: In this age when one of the more important functions of government is to assist as it may in the development of business and to avoid as much as possible governmental interferences permitting the development by private capital; it is interesting to review the activities of the governments of previous ages and particularly as they apply to public works or utilities.

The occasion for the need of the utilities has been the growth of our cities. The beginning of the cities is set out quite clearly by H. G. Wells in "The Outline of History" when he tells of the tendencies during neolithic life,

> "One was leading to a more wandering life, towards at last a constantly migratory life between summer and winter pasture, which is called Nomadism; the other, in certain sunlit river valleys, was towards a water-treasuring life of irrigation, in which men gathered into the first towns and made the first civilization."

The earliest cities were not in fact cities, but perhaps the habitations for a family; that is, all members living together in a hamlet with a patriarch. There was need for little except means to protect themselves from a similar but marauding group.

The developments that have made the subject of the Municipality and its Utilities of importance are of recent time, but some of the conditions that have brought them to pass have developed through the centuries. These conditions are fascinating for they do not altogether depend on physical considerations, but are largely dependent upon the thought expressed by the school of philosophy then in vogue.

The basic industry for centuries has been agricultural, and therefore it is logical that such developments as occurred should be centered about it. We find this true as relates to the ancient aqueducts, for the early aqueducts in Babylonia, Assyria and Egypt were for the benefits of irrigation. In Egypt storage reservoirs and systems of canals were in existence in the time of Ramesis II in the 14th Century B. C.. There are traces of aqueducts built by Phoenicians in Syria and Cyprus, including syphons that conveyed water to temples. Jerusalem had conduits dating from the time of the Kings of Judah.

Our first cities of size and importance of which there is record were in Egypt and in the Euphrates Tigris Valley, built about 4000 B. C., and because of the need of water and food their locations were near the sizable rivers of bountiful flow, with rich alluvial valleys.

The early cities of Egypt were built of brick and wood. The ruler of the IV Dynasty about 3700 B. C. built the pyramids, which were tombs for themselves. This seems to be the only contribution of lasting value from these people and it was of no service value particularly to the succeeding generations. The Egyptians, somewhat later, but previous to the time of the Roman Empire, built a large number of temples and shrines.

There are a number of large pyramids near the City of Mexico that were built hundreds of years ago. They were built so long ago that there is some question as to whether they belong to the Toltec or Maya civilization. It seems they were the center, however, of ecclesiastical cities. They also seemed to serve as shrines.

The largest municipality up to the time of the Christian Era was Carthage, which could probably boast of a million people at the zenith of its power and importance. The founding of the City by the Phoenicians was the result of maritime trade, developed by transportation and communication facilities furnished by ships. Carthage was not easy of access from the land.

ATHENIAN CONTRIBUTION. The Athenian democracy which reached its pinnacle of power and influence under Pericles (491-429 B. C.) was based on the theory that the state must furnish "a good life" for its citizens, and adorned Athens with temples, public buildings, and works of sculpture. Their ideas were expressed in an address by Pericles as recorded by Thucydides,

> "Our laws secure equal practice for all in their private disputes, and public opinion welcomes and honours talent in every branch of achievement ---- Yet ours is no work-a-day city only. No other provides so many recreations for the spirit - contests and sacrifices all the year around, and beauty in our public buildings to cheer the heart and delight the eye day by day."

UTILITARIANISM. The utilitarian idea has not yet taken hold of the communities although as far back as Elisha there was recognition of the need of good water, and we find the following recorded in II Kings 2: 19-22 regarding the City of Jericho,

> "And the men of the City said unto Elisha, 'Behold, we pray thee, the situation of the City is pleasant, as my lord seeth: but the water is naught, and the ground barren.'
> "And he said, 'Bring me a new cruse, and put salt therein.' And they brought it to him.
> "And he wentforth unto the spring of the waters, and cast salt in there, and said, 'Thus saith the Lord, I have healed these waters; there shall not be from thence any more death or barren land:
> "So the waters were healed unto this day, according to the saying of Elisha which he spake."

We also find in the rules set down by Moses certain instructions covering sewage disposal. In Deuteronomy 23: 9-13 we have,

"When the host goest forth against thine enemies, then keep thee from every wicked thing.
"If there will be among you any man, that is not clean by reason of uncleanness that chanceth him by night, then shall he go abroad out of the camp, he shall not come within the camp,
"But it shall be, when evening cometh on, he shall wash himself with water: and when the sun is down, he shall come into the camp again.
"Thou shalt have a place also without the camp, whither thou shalt go forth abroad;
"And thou shalt have a paddle upon thy weapon; and it shall be, when thou wilt ease thyself abroad, thou shalt dig therewith, and shalt turn back and cover that which cometh from thee:"

Later, however, governments began to build utilities for the cities, particularly aqueducts to bring water to the cities. With the present knowledge of water borne diseases, it is easily appreciated why life could go on even if the sanitation of the area inhabited was not up to present requirements, for the water used, was as a general thing, pure and wholesome.

ACQUEDUCTS:

The most famous of the Greek Viaducts was the Hadrian Aqueduct constructed in A. D. 134-40. This acqueduct was built by Hadrian while Governor of Greece before he was Rome's Emperor. This acqueduct has been recently studied and found to be about 16 miles long, 30 to 130 feet deep and 3.6 by 1.3 feet. It was built of brick and mortar and its 1926 capacity was 2,600,000 gallons per day. The water was obtained from springs, galleries, and wells, and consequently hard, forming incrustations through the centuries. Mr. James F. Case in an article in the 1928 Transactions of the American Society of Civil Engineers on page 281 says regarding the Hadrian Aqueduct and the incrustations in it,

"In cross-section this accretion probably shows graphically, by its texture, the sway of Greek power- rapid use at first in the heyday of the State's success, decline to the merest trickle in the mid-period, and renewed intensive flow for the modern city, synonymous with the rise, the fall, and the re-birth of Greece."

The aqueducts serving the City of Rome were as follows:

Time	Name of Aqueduct	Builder of Aqueduct	Length in Miles	Description
312 B.C.	Via Appia	Appius Claudius Caecus	10.6	Squared Masonry-covered conduit.
272 B.C.	Anio Vetus		41.0	Contract Job- Rectangular Form 3'7" wide, 8'1½" high
145 B.C.	Marcia	Marcius (still in use)	58.4	Upper End- 5'7" wide 8'2" high
127 B.C.	Tepula			Partly built of concrete
33 B.C.	Julia	Agrippa	14.6	6 Miles on Arches 2'4" wide- 4'7" high
20 B.C.	Virgo	"	13.0	1'7"wide- 6'7"high
33 B.C.	Alsietina	Augustus	21	Unpalatable water
36 A.D. to 50 A.D.	Claudia	Caligula	44	3'3" wide- 6'7" high
36 A.D. to 86 A.D.	Anio Novus	"	55.6	3'3" wide- 8'0" high Concrete- Brick Work Facing
109 A.D.	Aqua Trajana		20	
220 A.D.	Alexandrina		14	

The value of utilities was recognized by Sextus Julius Frontius who had charge of the aqueducts about 100 A. D. who said, "Will anybody compare the idle Pyramids, or those other useless though much renowned structures of the Greeks with these many indispensable aqueducts". Frontius appreciated the value of records and drew up plans of his viaduct, they were profilesin a way, for they showed the hills and valleys, the raised and arched portions,

His records sound not unlike the evidence of a modern operator for he tells of the

(1) Surreptitiously bleeding of the aqueducts enroute by proprietors of adjacent lands.

(2) The tampering with the meters, then bronze meter orifices.

(3) Tapping of mains.

(4) That the old construction was better than that of the more recent day.

(5) That deterioration was worse above ground where heat and frost could attack the structure.

(6) That tree roots were of concern to underground structures, and

(7) That masonry work should be done between April 1 and November 1.

Calculations would indicate the total water delivered by the aqueducts of Frontius' time was about 130,000,000 gallons per day, of which about 92,000,000 was used in Rome.

Frontius further tells of a settling basin at the head of the Marcian aqueduct so that the water might come to rest and clarify itself.

Of these various aqueducts the Virgo and Trajana were restored to use in 1570 and 1611 and the Alexandrina was replaced by the Acqua Felice built by Sixtus V in 1585. The water formerly conveyed by the Marcian viaduct is now carried by a new one known as the

Pia Marcia built in 1870.

To compare with these Roman aqueducts the following aqueducts in the United States are interesting:

To	From	Capacity in Gallons per Day	Length of Aqueducts in Miles			
			Tunnel	Cut & cover	Pressure Pipes	Total
Los Angeles	Owens River	280,000,000	42.90	166.46	14.05	223.41
San Francisco	Hetch Hetchy	400,000,000	84.90	----	70.90	155.80
New York	Catskill Mountains	600,000,000	14.00	55.00	23.00	92.00

HIGHWAYS:

The Romans were probably the inaugurators of our present highway system for they appreciated the value of well maintained roads on the main routes of travel.

CANALS:

Kublai Khan the famous Chinese emperor of the 13th Century built over 600 miles of the Peking-Canton canal. This was no doubt done principally with slave labor.

Practically all of the early projects of any size were built by the governments, and the idea of private development as relates to these functions now generally performed by the utilities was not beginning to take shape until about one hundred and fifty years ago.

CHAPTER II

DEVELOPMENT OF UTILITIES:

GENERAL:

Our utilities have developed rapidly in recent years due to many contributing causes. In a treatise entitled, "Empire and Democracy" by C. S. Veitch, Lecturer in the University of Liverpool, he records certain conditions in England not foreign to our own country. The following extracted paragraphs from this treatise outline many of the causes,

> "The rapid increase in the manufacturing population, and the growing importance of the industrial towns, the immense extension of the wage-paid classes and the altered conditions of their employment, together with the advance, both in wealth and numbers, of the middle class whose interests differed widely from those of the land owning oligarchy, made it impossible to avoid drastic changes in political organization, ---- The old hysterical fear of innovation was fading from the minds of intelligent men, --- The raising of wages and the reduction of the hours of labor, The wave of humanitarianism, ---- The mind of the nation was quickened. Newspapers and railroads widened the horizon and enlarged the experience of whole classes of the community, --- It was still more significant that a new spirit stirred in the wider world of science and speculation, --- the golden age of 'self help'."

President Hoover, then Secretary of Commerce, stated before the World Power Conference in 1924 that,

> "The factor that has been primarily responsible for the tremendous changes of the last century and without which modern civilization could not exist is mechanical power. The form in which in increasing degree such power is being applied is electrical energy- the greatest tool that has ever come into the hands of men. The degree to which we utilize this tool as a substitute for manual labor will largely determine the rate of our industrial and social progress. To reduce human labor, to increase its productivity, is the most profound basis of social advancement."

The development of the utilities has been an outgrowth of scientific interest which Huxley has so well defined as,

> "that which stirs their pulses is the love of knowledge and the joy of discovery of the cause of things---the supreme delight of extending the realm of law and order even farther toward the unattainable goals of the infinitely great and the infinitely small, between which out little race of life is run."

This scientific development is gauged by the standards by which all progress is measured namely is it:

1. Human achievement
2. Mastery of the forces of nature
3. Elimination of poverty and disease
4. Prolongation of life
5. Advancement of learning
6. Growth of right living- serious thinking- good understanding among men, or to say it tersely it must be of constructive service to society.

DEVELOPMENT OF POWER:

The growth of the cities is discussed elsewhere in this treatise so it will not be gone into here in detail. The new spirit in the world of science however will be referred to here briefly. The effective harnessing of steam into a controlled and adaptable source of mechanical energy was not an accomplished fact until the time of Watt and his inventions of 1763 to 1781, although in the "Pneumatica" of Hero of Alexandria (130 B. C.) there is the description of an aeolipile which was a primitive steam reaction turbine. The principles of thermodynamics were not understood by Watt, nor at the time Stephenson developed the first successful locomotive in 1829. There was no definite recording of an understanding, until 1824, of the relation of work to heat.

It is just within the last century that there has been the

scientific understanding needed to develop even the more primitive forms of the great prime movers, which within recent years have been seemingly increased without limit as to size and efficiency.

The developments in the power field have had such an integral part in the development of utilities that a brief outline of steps in its development are included. Reciprocating steam engines were used until 1905 when steam turbines came into use and the advantages of their high speed and floor space requirements were appreciated and by 1914 they were building turbine-generators of 20,000 kw. capacity; in 1919 the size had reached 50,000 kw.; in 1928, 160,000 kw.; and in 1929, 208,000 kw. Boiler developments were rapid and the pounds of water evaporated per hour by the largest single boiler units for the respective years were,

Year	Lbs. evaporated per hour in a single unit
1880	10,000
1890	20,000
1910	60,000
1920	300,000
1930	1,250,000

Stokers of the automatic type were used in 1900, first the chain grate and overfeed types, and the underfeed type about 1910. Pulverized coal became a factor about 1920 and by 1923, it was realized that a water cooled furnace was needed. Maximum steam pressures considered good practice during the time central power stations have been in use are as follows:

Year	Lb. Pressure
1880	72 - 125
1890	200
1918	300
1921	400
1924	600
1925	1,200
1929	1,600

Superheaters in 1902-03 gave temperatures of 450 degress Fahrenheit, but since 1922 temperatures of 750° F. have been used.

The improvements in combustion and utilization of steam have reduced the amount of coal used to generate a kilowatt hour as follows:

Year	Amount of Coal per K.W. hour generated
1883	10.0
1900	5.0
1910	4.0
1920	3.0
1925	2.1
1926	1.95
1927	1.84
1928	1.76
1929	1.66

The oil and gas engine development started about 1880 with a single cylinder unit using gasoline for fuel; in 1895 the first oil engines were put on the market and between 1898 and 1928 there were installed 2,260,000 h.p. of the Diesel type.

FUELS:

The proper burning of bituminous fuels has also developed recently and the discovery of oil and its uses in this country has had an impressive effect on our industrial development and upon forms of prime movers. The use of natural gas as a fuel also has contributed materially. The knowledge of the availability and use of these fuels has all contributed to the development of the conversion of heat units into work. However, it is the forms into which this mechanical energy could be converted that have been most valuable; that is the development of the understanding of how to make and use electrical energy.

POWER PRODUCING EQUIPMENT:

The amount of power producing equipment in the United States as of January 1, 1930 is given in an article by Geo. A. Orroh in the Proceedings of the American Society of Civil Engineers for March, 1930, as follows:

		Horse Power
Central Station	(Steam	30,000,000
	(Water	15,000,000
	(Railway	5,000,000
Industrial Power	(Steam	20,000,000
	(Oil	3,000,000
	(Gas	3,000,000
Mining		7,000,000
Stationary, not industrial		5,000,000
Steam railway locomotives		135,000,000
Ships		20,000,000
Agricultural and traction		300,000,000
Automotive		650,000,000
Total		1,193,000,000

The horse power is usually assumed as equal to 6 man power. This means there is the equal of 60 man power in this country in

the form of mechanical energy for every person living here, and such mechanical power can produce more than eight hours per day, the usual time man works, so the actual potential production is greater than 1 to 60. Expressed as of the times of the Pharaohs, there is available for every man, woman and child in the United States power to do the work of sixty slaves.

OTHER CAUSES FOR DEVELOPMENT OF UTILITIES:

There are a number of things that affect the development of a utility aside from its own scientific physical development. The philosophy of the times may have a distinct bearing. For instance at the present time practically all utilities are developed by the use of borrowed money and interest is the means of compensation for the owner for the use of his wealth.

The attitude of the thinking men of the past towards interest is fascinating and somewhat enlightening. Solon, a law giver, founder of Athenian democracy who did his work about 590 B. C. found that the introduction of money and money lending had practically enslaved the poor as debtors to the rich, and he cancelled the entire debt of the agricultural population. In our modern language he had indeed helped the farmer.

Aristotle spoke very strongly against interest in his "Treatise on Government" in which he said,

> "Now money-making, as we say, being twofold, it may be applied to two purposes, the service of the house or retail trade, of which the first is necessary and commendable, the other justly censurable; for it has not its origin in nature, but by it men gain from each other; for usury is most reasonably detested, as it is increasing our fortune by money itself, and not employing it for the purpose it was originally intended, namely exchange.

"And this is the explanation of the name (---) which means the breeding of money. For as offspring resemble their parents, so usury is money bred of money. Whence of all forms of money-making it is most against nature."

These ideas of Aristotle on interest had a strong influence for many centuries, in fact during the Roman Empire some thought interest taking was "as bad as murder." The effect of Christianity was to strengthen these teachings. At the Council of Vienna in 1311, interest was prohibited "absolutely and universally", regardless of the civil law, and by the fourteenth century this provision was a part of the civil law in many places, however, in 1545 a law was passed in England legalizing an annual interest not in excess of 10 per cent.

After a period of business, in which the law was used to back up commercial trading which was known as mercantilism, there came into the thought of the thinkers, the philosophy of "laissez faire", (let us alone) a doctrine quite essential to private development and insisted upon by many as necessary for individual incentive.

The philosophy of "laissez faire" (let us alone) is:

(1) A doctrine that demands minimum interference by government in economic and political affairs.

(2) An idea started at the end of the 17th or beginning of 18th Century which permitted

(3) Competition under equal rights.

(4) Power of uncontrolled individual action to produce some good, and which has the following basis

(5) Economic thought

a. As a theory of exchange- Maximum satisfaction to participants.
b. As a theory of production- Maximum benefit of employment.
c. As a theory of distribution- Maximum harmony between capital and labor,;

and which theory reached its apogee in 1870 and since

> then it has been a combination, for it was found that liberty of contract only begins where equality of bargaining power begins.

The recent rapid acquisition of higher living standards by the people of the United States, together with their receptiveness to new ideas and acceptance of new devices, coincident with a tremendous production of such things, has resulted in added demands for service from the utilities that serve municipalities.

This added service has not only resulted in a substantial increase in the number of consumers, but more particularly in the amount consumed by the individual.

The growing importance of the problems of the municipality and its utilities is readily understood when one considers the unusual growth of these utilities within recent years. It has been authoritively stated that ninety-five percent of the investment in public utilities having to do with municipal service has been made in the last thirty years.

GROWTH IN WATER SYSTEMS:

This growth is reflected in all types of municipal utilities, and in connection with the water systems the following facts are recorded:

	No. of Waterworks Plants		
Year	Total	Public Plants	Private Plants
1800	16	1	15
1830	44	9	35
1860	136	57	79
1890	1878	806	1072
1896	3196	1690	1489 (17 unknown)
1924*	9850	6900	2950

*Estimated

The number of plants has more than tripled in less than 30 years. There are usually causes that hasten such improvements; for instance the Chicago fire accelerated the building of water systems in the United States.

The average daily consumption of water per capita throughout the United States is large, amounting to approximately 100 gallons, or about three times that of representative European cities.

The average daily consumption of water per capita for domestic, industrial and public uses has increased in recent years as evidenced by the following data from New York City:

Year	Daily Consumption Per Capita
1910	79.1
1915	74.6
1920	98.5
1925	103.5
1926	103.2

SANITARY SEWER SYSTEMS:

The increase in the number of sanitary sewer systems has been very marked within the last twenty-five years, and has been following closely the growth in public water supplies for they afford the means of carrying off the liquid wastes. This increase has also been actuated by the fuller knowledge of the potential health menace of improperly disposed sewage, and by the activity of State Boards of Health. There is no good record of the number of systems. Sewage disposal has certainly increased in number of plants and in extent of disposal. Of the sixty-seven cities having a population of over 100,000 according to the 1920 census, in 1875 none of these cities had a disposal plant, in 1900 only two had disposal plants

and in 1926, twenty of them had sewage disposal plants serving a total of 6,500,000 people. In the State of Kansas there are fifty-two sewage disposal works., in first and second class cities.

ELECTRIC LIGHT AND POWER SYSTEMS:

The growth of the electric light and power industry has been phenominal, and there seems to be no end to this growth in sight. The statistics of the capital invested and the kilowatt hours generated in the United States for a number of years is as follows:

Year	Capital Invested	No. of Kilowatt hours generated
1907	$ 1,367,239,000.00	5,862,277,000
1912	2,289,622,000.00	11,569,110,000
1917	3,245,185,000.00	25,438,303,000
1922	4,817,000,000.00	40,291,536,000
1927	9,500,000,000.00	74,686,000,000
1928*	10,300,000,000.00	82,927,000,000
1929*	11,100,000,000.00	92,737,000,000

*From Electrical World; the rest of the statistics are from U. S. Census Bureau

This shows a doubling in the last seven years of the kilowatt hours generated.

This is impressive but even more so is the extent of the distribution of this remarkable commodity to the people of the country. This is as follows:

Year	Population in Electric Lighted Homes: Number	Population in Electric Lighted Homes: Per Cent of Total of U.S.	No. of Consumers: Total No.	No. of Consumers: Domestic Lighting	No. of Consumers: Commercial Lighting	No. of Consumers: Industrial Power and Others
1907	7,500,000	8.0	1,946,979	1,526,579	400,000	20,400
1912	14,000,000	15.9	3,837,518	3,100,918	605,600	131,000
1917	22,250,000	24.3	7,178,703	5,810,300	1,125,200	243,203
1922	43,100,000	38.9	12,709,868	10,211,232	2,030,324	468,312
1927	75,500,000	63.0	21,790,238	17,698,024	3,159,214	933,000
1928*	81,500,000	67.5	23,219,513	18,860,465	3,332,447	1,026,601
1929*	85,000,000	70.0	24,257,159	19,721,486	3,456,434	1,079,239

*From Electrical World; the rest of the statistics are from U. S. Census Bureau

This is an increase of over ten times in people in lighted homes in twenty-two years, and an increase of over twelve times in the number of consumers in this same period.

It has been authoritively stated that 70% of the urban homes in this country are electric lighted, and that electrical energy is now being furnished to 500,000 farms. There was an eight percent increase in electrical energy consumed in 1929 over 1928. The output of electrical energy in this country equals the combined output of the rest of the world. There are approximately 20,000,000 households electric lighted in this country, or approximately 68% of the total.

Interesting in connection with the electrical industry is the record of growth during the fifteen years from 1912 to 1927, in which period,

Population increased	24%
Electricity generated increased	626%
Number of customers increased	465%
Population in Lighted homes increased	520%

At the present time 75% of the industrial power in the United States is electrical, while in Germany this amounts to 66% and in England 48%.

GAS SYSTEMS:

The gas business, both natural and artificial, has grown at a very rapid rate within the last few years. The record of manufactured gas sold shows the following:

Year	No. of M. Cu. Ft. of Manufactured Gas Sold
1889	33,000,000
1899	62,000,000
1904	114,000,000
1909	143,000,000
1914	199,000,000
1919	307,000,000
1924	405,000,000
1929*	535,000,000

*Estimated by Alex Forward

The statistics of the growth of the natural gas industry is indicated for the last thirteen years in which time the number of domestic users and the amount of natural gas consumed for domestic and industrial use has doubled:

NATURAL GAS

Year	Produced and Delivered M.Cu.Ft.	Domestic Consumption: No. of Consumers	Domestic Consumption: M.Cu.Ft.	Domestic Consumption: Percent of Total	Domestic Consumption: Average Value at Point of Consumption	Industrial Consumption: M.Cu.Ft.	Industrial Consumption: Percent of Total	Industrial Consumption: Average Price at Point of Consump.	Average Price of All Gas Sold
1917	795,110,000	2,431,000	258,000,000	32	30.8	537,000,000	68	11.7	17.9
1918	721,001,000	2,509,000	271,000,000	38	31.4	450,000,000	62	15.2	21.3
1919	745,916,000	2,501,000	250,000,000	34	34.6	490,000,000	66	14.8	21.6
1920	798,210,000	2,615,000	286,000,000	36	38.2	512,000,000	64	17.0	24.6
1921	662,052,000	2,631,000	248,000,000	38	44.4	414,000,000	62	15.5	26.4
1922	762,546,000	3,015,000	254,413,000	33	49.9	508,133,000	67	13.6	29.1
1923	1,007,976,000	3,234,000	273,050,000	28	51.4	729,917,000	72	13.4	23.8
1924	1,141,521,000	3,443,000	285,152,000	25	54.0	856,330,000	75	11.6	22.2
1925	1,188,571,000	3,508,000	272,146,000	23	56.0	916,293,000	77	12.3	22.3
1926	1,313,019,000	3,730,800	289,175,000	22	53.1	1,023,678,000	78	12.3	22.8
1927	1,445,428,000								22.0
1928	1,568,139,000	4,366,000							21.4
1929*	1,890,000,000								

Est. by Alex Forward

It is authoritatively stated that over one hundred towns in the southwest were connected to natural gas supplies during 1929, and there are still more ambitious programs in contemplation and in process of execution.

A striking picture of this growth is shown in Texas where there were 48 towns using natural gas in 1921 and there were 442 towns using it in 1928. The amount of natural gas withdrawn in Texas did not average over 1/30 of the potential open flow in 1928. The discoveries of unusual gas reserves has materially increased the use, for the owners of reserves desire to sell their product and seek markets.

STREET RAILWAYS:

The street railways are not increasing as other utilities either in mileage, passengers hauled or number of cars. This is due primarily to the advent of the automobile. The data regarding the street railway situation is as follows:

Year	No. of Companies	Miles of Track Operated	No. of Passenger Cars	No. of Revenue Passengers in thousands	No. of Busses	Miles of Bus Route
1890	789	8,123.02	32,505	2,023,100		
1902	987	22,576,99	60,290	4,774,212		
1907	1236	34,381.51	70,016	7,441,115		
1912	1200	41,064.82	76,162	9,545,555		
1917	1307	44,835.37	79,914	11,304,660		
1922	1200	43,931.86	77,301	12,666,558	378	685.36
1927	998	41,417.65		11,802,917	3878	13,031.34

In 1890 of the 8123.00 miles of track operated, 5661.44 miles were animal traction, and 1,261.97 miles were operated by electric power and in 1922 all but 142.78 miles of a total of 43,931.86 were operated by electric power. The revenue bus passengers in 1922 amounted to 12,791,308 and in 1927 to 325,919,601.

In many cities the busses are operated by the street railway companies; and in some cities the taxicab companies are also controlled by the street railway company.

AIRPORTS:

The airports are new developments, particularly the private fields. The record of the number in the United States at the end of 1929 shows a total of 1561, classified as follows:

84 - Army, Navy and Government Fields
528 - Intermediate and auxiliary Fields
458 - Municipal Fields
491 - Commercial Fields
1561 - Total

It is understood there are 1361 listed for construction in 1930. The airports are being rapidly improved, and increased in usefulness and usableness.

TELEPHONE SYSTEMS:

The telephone systems have grown with tremendous rapidity since 1902. There are now over eight times the number of phones that there were in 1902. The data is as follows:

Year	No. of Systems and Lines	Miles of Wire	No. of Telephones	Telephones Per 1000 People
1902	9,136	4,900,451	2,372,044	30
1907	22,971	12,999,364	6,118,578	
1912	32,233	20,248,326	8,729,592	92
1917	53,234	28,827,188	11,716,520	
1922	57,253	37,265,958	14,347,395	130
1927			18,522,767	

Interesting in this connection are the data regarding the American Telephone and Telegraph Company and Associated Companies known as the Bell Telephone System. This company controls this utility service throughout the United States more completely than any company controls any other utility service. The data regarding the American Telephone and Telegraph Company is as follows:

Telephones in Bell System

Year	Bell Owned	Associated Companies	Total	Miles of Wire
1895			309,502	675,415
1900			855,911	1,961,801
1905			2,528,715	5,779,918
1910	3,933,056	1,949,663	5,882,719	11,642,212
1912			7,456,074	14,610,813
1917	7,031,530	3,444,148	10,475,678	22,610,487
1922	9,514,813	4,535,752	14,050,565	30,616,522
1927	13,726,056	4,639,430	18,365,486	56,822,895
1928	14,524,648	4,672,387	19,197,035	62,192,744
1929	15,323,240	4,705,344	20,028,584	67,562,593

The number of telephones in use in the United States are 60% of the world's total.

HIGHWAYS:

The increasing importance of adequate highways is clear when the tremendous increase in Motor Vehicle Registration is considered. The data on this are as follows:

(From Bureau of Public Roads- Department of Agriculture)

Year	Total	Passenger Cars	Trucks
1897	90	90	----
1902	23,000	23,000	----
1907	142,000	140,300	1,700
1912	944,000	902,600	41,400
1917	4,983,340	4,657,340	326,000
1922	12,239,853	10,864,128	1,375,725
1927	23,127,315	20,230,429	2,896,886
1928	24,493,124	21,379,125	3,113,999

INVESTMENT:

It has been estimated by Moody's that the investment in gas, street railways, light and power, considering the market value of the stocks and bonds as the measure, has increased from eight billions of dollars in 1916 to twenty-one billion dollars in 1927.

BEGINNINGS:

This recent increase in the number of utilities and the service rendered by them is even more remarkable when it is realized that the utilities are not an innovation, but that the first, of the various utilities to be put into operation in this country, were:

First	water plant.	1652
"	commercial gas plant . .	1817
"	natural gas corporation	1865
"	commercial telegraph . .	1846
"	cable car	1873
"	telephone	1876
"	commercial light plant .	1882
"	electric street car . .	1888

This extensive and generous use of the services rendered by the utilities is generally conducive to better social conditions particularly as they affect the welfare and health of the community.

URBAN POPULATION:

The relative importance of satisfactory service by the utilities within the municipalities has added importance as an increasing number of persons and increasing percentage of our total population become city dwellers. The following data referring to cities of over 30,000 is more impressive when one realizes that at the time of the first census in 1790, only four municipalities had populations in excess of 10,000, namely-

New York, N. Y., 33,131; Philadelphia, Pa., 28,522; Boston, Mass., 18,320 and Baltimore, Md., 13,503.

Cities over 30,000 Population

Year	Nation's Population	No. of Cities	Total Pop. of Cities	Pct. of Nation's Population
1890	62,947,714	103	12,612,389	20.0
1900	75,994,575	135	19,050,921	25.1
1910	91,972,266	184	27,316,407	29.7
1920	106,422,000	247	36,654,359	34.4
1926	117,136,000	250	41,840,033	35.7
1927	118,628,000	250	42,716,411	36.0

The total urban population of this country is now over fifty percent of the whole population. This great growth of the urban population has been the most important factor in bringing the public utilities into being.

These remarkable developments in utilities during the last few years, bring to mind the words of Tennyson, with added impressiveness,

> "Men, my brothers, men the workers, ever reaping something new;
> That which they have done but earnest of the things that they shall do."

CHAPTER III

THE MUNICIPALITY'S RESPONSIBILITY

GENERAL:

The municipality has a large responsibility in the development of its utilities, whether they be publicly or privately owned. This responsibility covers a broad field and includes, construction features, the character of the service to be rendered the public, and the price to be paid by the consumer for such service. The end, towards which the municipality should work, is to effect the best possible service at a minimum of cost to the consumer. These problems are of economic importance and an engineer well versed in municipal problems and with a proper vision of future possibilities and developments can be of invaluable assistance in helping work out a sound basis for the conduct of the relations between the municipality and its utilities.

In the solution of these relations there are certain considerations that it seems are fundamental, namely that, "A municipality is a corporation, its inhabitants are the corporators, its officers; its public agents," and that the public service corporations are instruments for the public good, and have been permitted by the State to be organized for that purpose. The relations between the public utilities and their consumers are those of contracting parties. The officers of the municipality should protect the rights of the utility as well as that of the consumer. The consumer should pay for the service, but should not be required to pay more than the cost of furnishing such service, which will include the payment of an amount which will

pay the utility enough to meet its operating expenses including taxes, a proper amount for annual depreciation, and a reasonable yet adequate return on the fair value of the property used and useful in rendering the service. The consumer should expect to pay these necessary expenses incident to the rendering of the service but no more, for his position is as set out by the Supreme Court in 1926 in the New York Telephone Case, namely:

> "Customers pay for service, not for the property used to render it. Their payments are not contributions to depreciation or operating expenses or to the capital of the Company. By paying bills for service they do not acquire any interest legal or equitable, in the property used for their convenience or in the funds of the Company. Property paid for out of moneys received for service belongs to the Company, just as does that purchased out of the proceeds of its bonds and stock."

It is apparent from this decision that if the consumer is paying enough to pay for the property, as well as for the service he acquires no title to the property. In view of this fact it is incumbent upon the municipality to see that the consumer of utility service pays no more than the cost of the service. This principle applies to privately owned utilities.

MUNICIPAL POWERS:

The municipal corporations have their powers delegated to them and they are divided into two main classes, namely governmental legislative or public and proprietary or commercial. In the first class the municipal corporation is not accountable to any individual, but in the latter it has to accept the responsibility of a private individual or corporation, rendering similar service because it acts as a business concern. This responsibility as a private concern is

clearly stated in Wheeler V. Philadelphia, 77 Pa. St. 338, decided in 1875, as follows:

> "The most that can be urged is, that the city is acting in a double capacity; in the one, exercising rights of sovereignty, in the other, performing the functions of a private corporation in the manufacture and sale of gas.xxx While it is no part of the ordinary and necessary duties of a municipal corporation to supply its citizens with gas and water, it is nevertheless true that it may lawfully do so.xxx Aside from the trustees, and they amount to nothing in our view of the case, the gas works may be considered as property belonging to the city, and operated, not for the purpose of speculation, but to promote the comfort of the whole body of the people. As their original acquisition and subsequent use were lawful, debts contracted therefor must be paid by the city."

The Municipality may use its own discretionary powers in deciding whether it will build its own utilities, it is not mandatory that it do so. The municipality can however exercise this right if they so desire as set out in State V. Toledo, 48 Ohio St. 112,26 NE. 1061, 11 L.RA 729, which was sustained by the Supreme Court of the United States, as follows:

> "Taxation implies an imposition for a public use.xxx But what are public purposes is a question that must be left to the legislature, to be decided upon its own judgment and discretion. Water, light and heat are objects of prime necessity. Their use is general and universal. It is now well settled that the legislature in the exercise of its constitutional power may authorize cities to appropriate real estate for waterworks, etc. What we have said in reference to waterworks is for the most part applicable to the erection and maintaining of natural or artificial gas works. Heat being an agent or principle indispensable to the health, comfort and convenience of every inhabitant of our cities, we do not see why, through the medium of natural gas, it may not be as much a public service to furnish it to the citizens as to furnish water. It is sufficient if every inhabitant who is so situated that he can use it, has the same right to use it as the other inhabitants. The establishment of natural gas works by

> municipal corporations, with the imposition of taxes to pay the cost thereof, may be a new object of municipal policy: but in deciding whether in a given case the object for which taxes are assessed is a public or a private purpose, we cannot leave out of view the progress of society, the change of manners and customs and the development and growth of new wants, natural and artificial, which may from time to time call for a new exercise of legislative power, and in deciding whether such taxes shall be levied for the new purposes that have arisen we should not, we think, be bound by an inexorable rule that would embrace only those objects for which taxes have been customarily and by long course of legislation levied."

These powers of going into the utility business are sometimes implied, but in decisions there are three grounds for them, namely, police power, general welfare and a public or municipal purpose. That this covers a great deal of territory is evident for one court said regarding police power, "it may be said it is known when and where it begins, but not when and where it terminates."

The municipality has limitations as to the indebtedness it can incur and consequently cannot always enter into any or all utility service even if the citizens should desire to have it do so. The municipality can however let a private company have a franchise to render a utility service for its citizens. The municipality's power however is subordinate to the state's. These franchises are, when accepted, contracts in which the courts cannot change rates for public service at the request of the utility, for this right remains in the hands of the state, this situation is well explained by the court in the case of Sumter Gas and Power Co. V. City of Sumter, 283 Fed. 931, says:

> "It is true this power to contract for the use of the streets and the conditions of the use, implied in the power granted to make regulations as to streets, is subject to the general police power of the state to

> regulate rates of public service corporations. Since the state legislature did not in express terms confer upon the municipality the power to make an irrevocable contract as to such rates, any rate fixed by such contract was subject to regulation under the police power of the state.xxx Therefore the ordinance of the city granting the use of the streets for gas mains with conditions as to rates to be charged, accepted, and acted upon by Rieha, in whose favor the franchise was granted, became a contract binding on both parties, subject to the exercise by the state of its police power to regulate rates. Since the state has not undertaken to exercise its right to alter the rates contracted for, they are still binding on both parties and are beyond the control of the court. The courts cannot grant relief against rates named in a contract binding on the parties. Southern Iowa Elec. Co. v. Chariton, 255 U.S. 539, 41 Sup. Ct. 400, 65 L. ed 764, xxx Having accepted the agreement and received the benefits of it, the gas company has no ground to complain of its subsequent legislative sanction and ratification."

The municipality should be very careful in granting franchises and should see that the franchise as granted imposes proper conditions and proper regulations on the corporations, which propose to furnish it service. In Phoenix v. Gaunon 195 N.Y 471 88 NE 1066 decided 1909 there is the following:

> "Primarily the power to grant franchises in the public streets resides in the state. Municipalities have only such power in this regard as has been delegated to them by the legislature. That this sovereign power has been thus delegated is not questioned.xxx If municipalities in granting such requests will hedge them about with proper conditions, individuals will not rashly or carelessly ask for franchises which they cannot hope to use."

UTILITIES CONSIDERED:

The utilities that will be discussed as those with which the municipality has a distinct responsibility are those which have had judicial recognition as public utilities serving municipalities and which are affected with a public interest and which warrant regulation of some kind. Reference will be

made to a few of the newer utilities that probably will soon be recognized as public utilities.

Municipal utilities may be classified as to function as,

(a) Services of transportation
(b) Services incidental to transportation
(c) Services facilitating transportation
(d) Facilities providing power, light, heat and refrigeration
(e) Facilities providing water and sanitation in urban communities.

The following utility systems are to be considered, namely, water sewer, electric lighting and power, gas, transportation, both bus and street railways, heating, garbage and refuse collection and disposal, airport, telephone and highways.

RELATIONS BETWEEN MUNICIPALITY AND UTILITIES:

The relation of the municipality to its utilities considered in this chapter is largely common to both publicly owned and privately owned utilities. These relations cover three separate yet correlated fields which include; the construction features; the character or measure of service rendered or to be rendered, and the cost of such service to the consumer. The measure of the service is specifically discussed in a subsequent chapter. The matters involve the public welfare, and therefore warrant regulation and supervision.

The construction features that should be looked after by the municipality, are that:

1. Adequate provision is made in streets, alleys and public utility strips for the satisfactory location of the various utilities to avoid either aerial or subsurface congestion or excessive cost of construction and maintenance of the utilities' distribution system.

2. Provisions be made for the definite location in plan for each utility, and that requirements be made as to the depth of distribution lines be laid below the established grade of the street, alley or utility strip.

3. Requirements of construction be authorized that will minimize the possibilities of accidents to workmen of any one utility either by its own or other utilities, and that will insure as much as possible the safety of the general public.

4. Definite records be kept by each utility, so that they are available for inspection or can be furnished to the city engineering department for use. These records should show the location of all main lines and services to minimize the accidental interference of service by the workings of the men of some other utility, and should furnish information so that plans for enlargements and extensions can be intelligently made and checked.

5. General plans for extensions be submitted to the City Engineer or to the Engineer with the Department of Utilities with sufficient information so that he may determine whether it will interfere with other needs or plans, and whether it seems warranted. There should be provisions that this same officer may have the power of disapproval subject to review of the City Governing Body, and that he be authorized to review and adjust controversies pertaining to location, and construction interference, which might arise between various utilities.

The conditions outlined above require the municipality to make provision in the City Plan for adequate room for the necessary construction of distribution lines, to establish the grades of streets, alleys and public utility strips ahead of the permanent improvement of the streets and to have a capable man or men in charge of the Department who passes upon the plans submitted by the utilities and who approves the contemplated construction both as to proper methods of construction and capacity for service.

The present practice of zoning is of very material help in connection with this feature of utility distribution, for it furnishes a guide as to the future use of areas, and as to the probable load factors for each type of utility within the areas. Zoning usually results in the prevention of a sudden change in the use of an area, and of undue congestion, both of which conditions

vitally affect a utility layout.

Although not yet adopted in the metropolitan area of Pittsburgh, Pennsylvania, the recent federated cities idea originated there, which is taking shape in some parts of the country and can develop into real constructive supervision of utility and community development, resulting in better facilities for service, and in lessened ultimate cost of such service. The joint City and County Planning Board at Tulsa, Oklahoma having jurisdiction over the acceptance of plans for additions in and around Tulsa is a partial application of this idea.

The placing of the lines of various utilities at different depths lessens the interference of their service lines with each other. Certain construction requirements of some of these utilities make such interference with each other highly improbable, for instance, sewers must be laid deep enough to drain basements, water lines deep enough to avoid frost and vibration effects which cause leakage. Gas lines must be laid deep enough for protection from vibration or from being struck, but the use of welded joints is reducing the possibility of leakage due to this cause very materially.

Any specific set of requirements covering the points outlined above will necessitate intelligent interpretation and enforcement, for the needs of a specific case or the development of the arts may alter a situation for which there are already general requirements.

Since it has seemed proper for our States to delegate to

its municipalities, "governmental and legislative power to care for rights and welfare of its inhabitants", it is very necessary that this be properly exercised.

In the case of a water system there are requirements that the system shall furnish an abundant supply for all uses, and it is quite essential that the City shall pay hydrant rental enough to furnish the proper amount of such hydrants and to pay interest on the investment necessary for such service.

In the case of the sewer system the municipality shall provide for proper facilities, and in justice to all users should impose a special charge for service upon a user who contributes sewage which requires special expense to handle.

The Municipality owes to its citizens the proper protections of their interests, and the proper distribution of cost of service in accordance with the needs and requirements of the different classes of consumers, and of the public uses as well.

CHAPTER IV.

THE MEASURE OF SERVICE

GENERAL:

The utility is under obligation to render service because the right to render such service has been delegated to it by the proper legislature authority. The delegation of authority has usually implied or created a monopoly in the performing of that particular service. The removal of the usual incentive to give the best possible service, namely competition, necessitates the creation of a power to order the quality and extent of service that is both fair and reasonable. Thus most of the measures of services have been established by the settled policies of companies and agreement by Commissions of what it is fair and reasonable to expect.

A general statement of the measure of service that a utility shall be expected to furnish up to the limit of its capacity, is that it shall be safe, reasonable and adequate. A utility should furnish service at uniform rates; these rates varying with the different types of customers except when there is,

1. A condition in connection with the particular service such as requires an unusually large investment and an inadequate return.

2. A condition putting a special load on the utility when it cannot stand an increased load. Such instances occurred during the late war.

3. Abuse of the use of the service by the consumer or failure of the customer to pay for it.

Satisfactory relations can best be procured by the utility when it owns and maintains the service from the main

or feeder to and through the meter, and when it owns the meters that measure such service.

A brief general outline of the measure of service, which the several types of utilities should render, is included in subsequent paragraphs.

WATER SYSTEM:

The water system shall furnish a palatable, pure and chemically safe water delivered in such quantities and at such pressure as to adequately care for the domestic, industrial and public requirements. There are several agencies, which check up the service furnished by the water company. The health boards of the states keep a close watch on the quality of the water and the actuarial board, a joint agency of fire insurance companies, check up on the capacity of the works and on the system to deliver the necessary amounts of water during maximum demand such as those occurring during fire. Practice now requires that fire hydrants be connected to a pipe, six inches or larger, and that the system have no dead ends if they can be avoided.

The public service commissions function in the measurement of service in determining what is proper service and how the public is to pay for such service. Water companies are required to lay their mains and services to protect them from freezing and from traffic vibrations; also so that those who may want service can get it unless to serve them requires unnecessarily long extensions entirely unwarranted by the prospect of present or future revenue.

Proper conservation of water, to insure adequate service by proper maintenance of mains and proper forms of rates, is incumbrant

upon the utility. Proper service does not necessarily mean absolutely clear water, but the amount of turbidity is usually kept low, and good practice now holds it a proper function of a water company to employ filtration, coagulation, aeration and chlorination, if need be, to produce a safe and palatable water free from tastes or odors. Recently the softness of water has become an additional important measure of the service, and a number of cities have already recognized the convenience and economic value of water softening. This number will no doubt increase.

In certain arid sections of the country the heavy demand on the system is not that necessary to render fire protection but to render service when the irrigation peak load is placed on the system. This demand usually occurs at from five to eight o'clock at night. This heavy irrigation load is unlike the fire requirements in that it is ordinarily heavier in the districts of medium or low valuation than in those of higher valuation. In such systems the measure of service is satisfactory delivery of sufficient quantities of water at the time when lawn sprinkling and irrigation are heavy.

SANITARY SEWER SYSTEM:

The sanitary sewer system shall have the capacity to carry off the sewage without gorging, and the effluent when turned into a stream or river shall be in such a condition that it will create no nuisance. The storm sewer system shall immediately carry off the runoff reaching its inlets, excepting, of course, the excessively large amounts resulting from very infrequent storms of high intensity, provision for which would be impractical.

It has been recently recognized in connection with the sanitary sewer system, that it is an abuse of this service to turn into the sewer any and all sorts of industrial wastes without previous treatment, also that it may be necessary to admit these gradually into the sewer. Until sewage disposal became necessary in so many cities, there was no general recognition that there was a difference in the sewage load contributed by the industries; at this time it became apparent that service should be measured, and the user should very properly pay in accordance with the amount of sewage contributed and the strength of the sewage. Both of these factors vitally affect the cost of sewage disposal. A system which can be universally used in measuring this service has not yet been worked out; no doubt local conditions will effect the solution.

ELECTRIC LIGHT AND POWER SYSTEM:

The electric light and power system shall deliver, at the time of peak loads; current, whose potential shall not vary over five percent from the normal operating potential. The street lighting system shall deliver the current at all times so that the amount of light required and guaranteed shall be available. Adequate service requires freedom from interruption and proper maintenance; also ability to take on additional load as the system grows either because of increased population or in change of the requirements of the consumers. The requirements for adequate service make it necessary to have in a plant some reserve equipment to take care of breakdowns or excessive loads.

It is quite generally accepted that electric service now

should be a continuous service; but there are certain industries that avail themselves of limited service and secure lower rates by taking current at off peak periods. Such service is usually the result of special contracts. The utility cannot require the consumer to use a certain type of equipment to insure a satisfactory power factor but the consumer can be required to put in devices to limit the starting current, where such loads cause difficulty in maintaining uniform voltage on lighting circuits.

GAS SYSTEM:

The gas system shall furnish plenty of gas at a satisfactory operating pressure at all times; gas of uniform heat value and of the same chemical and mechanical qualities. These requirements are applicable to artificial, natural and blended gases. Proper tests of the gas are required to insure a uniform product and many companies have integrating and recording calorimeters to indicate and insure a means of knowing their products and of being able to adjust the product at once if necessary.

The heat value of themanufactured gas in British Thermal Units will differ due to the availability of the raw ingredients used to make it. The quality of the natural gas differs with locations.

Where it is required, service standards limit the content of hydrogen sulphide to from a trace to one grain per 100 cubic feet, and of ammonia to not more than ten grains per 100 cubic feet. The objection to the hydrogen sulphide is the odor.

In Kansas reasonable pressure for domestic use is defined

to be not less than four ounces nor more than eight ounces. There are often requirements as to amount of leakage permitted and the company is held as negligent in its maintenance if this limit is exceeded for such neglect adds to the cost of the product and ultimately has to be paid for by the consumer.

There is at least one large purchaser of natural gas in Kansas who buys on the basis of heat units, his unit of purchase is 1,000,000 B.t.u. or the equivalent of an average 1000 cu. ft. of the natural gas in that community. This certainly is a good method of measure for the industrial user, or for the domestic consumer using natural gas for heating, provided of course that the variation in heat unit content is not excessive.

Recently a number of proposals have been made to enrich manufactured gas with natural gas, resulting in a better product than the present artificial gas, and there are some pipe lines now being built to provide such service. In these cases the cost of this additional heat value should be carefully analyzed to determine whether it is of economic advantage and whether the public would be receiving its share of the benefits.

STREET RAILWAY:

The street railway shall provide sufficient cars so that the time between cars is not excessive, and so that the patrons can be transported during rush hours quickly and without undue inconvenience; and shall provide equipment in good condition and so designed as to afford reasonably comfortable and safe transportation in all seasons. The bus system must fulfill approximately the same requirements, whether it operates as a separate system or

as an adjunct to the street railway system. Service requirements are such that a reasonably good roadbed and tracks must be maintained by the company.

The cars must be sanitary, safe and comfortable. The one-man cars are required to have more safety devices than the two-man cars to insure the safety of the passengers.

Motor vehicles used in transportation business must be equipped to protect the passengers from storms and must be adequately heated. They must be in safe and sanitary condition and have a door at each end. Regular schedules are required of motor bus transportation companies as they are of the street railway systems. Drivers of motor vehicles have to be experienced, reliable, temperate and careful.

HEATING SYSTEM:

The heating system shall deliver the required amount of heat and be practically free from danger of breakdown. When the service is paid for by the pound of condensed steam, the steam delivered to the consumer shall contain at least a certain minimum number of heat units. Service requirements include provisions relating to capacity of the central plant for the number of attached customers, pressure, sediment in mains, heating season, estimated amount of radiation, and the making of repairs and maintenance improvements during the summer.

GARBAGE AND REFUSE COLLECTION:

The garbage and refuse collection system shall be arranged to remove from the contributing citizen's premises the garbage and refuse as often as necessary to prohibit a sensatory and sanitary nuisance. The disposal system shall remove the possibility of

subsequent nuisance. This disposal system should be self-sustaining, and will often render a sufficient amount in addition to paying operating costs, to partially pay for the collection. Satisfactory service requires cooperation on the part of the contributer in providing substantial holders and in placing the containers where they can be easily collected.

AIRPORT:

The airport shall be as near as possible to the city's hotel and business center, and connected to these centers by adequate highways, and shall be usable at all seasons of the year. It should be well lighted, well drained, and well arranged. This is one utility, in the development of which, the public and private interests have joined hands, at least in many instances, for often the city furnishes the site and a few necessary structures for general use, but leaves to private development most of the commercial end of the project.

The general measure of aeroplane service is that it shall be safe, convenient, comfortable, reliable and reasonable in cost. Airports shall have the conveniences of a railroad station. Service requires provisions to maintain the port and equipment in first-class condition and to take care of the planes. The airport shall be located where fog and smoke conditions are at a minimum and where the drainage can be made satisfactory.

TELEPHONE SYSTEM:

The telephone system shall provide a quick and satisfactory connection to the right number. The introduction of the automatic

phone is reducing the number of connections with the wrong number and the resulting arguments, and is increasing the speed of the service. The cost of service on such a system increases with the number of customers, while practically all other utilities furnish service at a lower rate where there are more customers. This service is continuous, and is more universally interconnected than are the service plants of any other utilities. Interconnection in this case however is not to take over load from a breakdown, but to add value to the extensiveness of the service. The service can be procured in varying degrees, for one can have a single or a multiparty line. The customer can have connection by phone at long distance by paying proper charges. In a few places telephone meters have been installed to determine the load a certain party may place on the system.

HIGHWAYS:

The highway system shall provide the space necessary to facilitate quick movement of traffic over the highway and provisions should be made to reduce the accident hazard to a minimum. The highways should be operated as thoroughfares not as both thoroughfares and parking space. The highways should make access and exit easy to locations where there is heavy traffic and should be so built in alignment and grade and general plan that traffic can move over them with safety, ease and speed.

CHAPTER V

NOTES ON DIFFERENT UTILITIES

GENERAL:

In the second chapter of this treatise the remarkable growth of the public utilities has been given in a somewhat abbreviated and statistical form, and it has seemed advisable to include in this chapter a fuller discussion of the several utilities to indicate their development as relates to the art, some problems of operation, and distribution, and a brief discussion of problems peculiar to the several types of utilities.

This may make clearer the incentives that are actuating the various utility's operators and the reader may better judge how nearly the management of the utility is measuring up to the so-called usual statutory direction with respect to service, to wit:

"Every public utility shall furnish, provide, and maintain such service, instrumentalities, equipment, and facilities as shall promote the safety, health, comfort, and convenience of its patrons, employes, and the public, and shall be in all respects adequate, efficient, just, and reasonable."

There is included in this chapter a brief review of the status of the particular utility at the present time.

WATER

GENERAL:

In small towns in the United States the water works system, with general distribution system, is a development of the last fifty years. There are a number of causes for the building of waterworks systems among which are the disastrous fires that have occurred in some cities; the general recognition of the value of fire protection and fire insurance; the more favorable fire insurance rates to be secured where there is adequate fire protection; the importance of good water as relates to public health; and the more favorable public improvement legislation which made it possible to build waterworks in the smaller towns. A fuller realization of water borne disease has just occurred in this century. Practically all of the water filtration plants have been built since 1900 and all rapid sand type of filter plants built with concrete have been constructed since 1900. Chlorination by the use of liquid chlorine has developed largely since 1917. The detrimental effect of the lack of certain ingredients in water has been realized, and the effect of lack of iodine, which aggravates goiter conditions, is recognized and remedied in certain waters. The first plant to add sodium iodide to supply the deficiency of iodine was Rochester, New York; this practice was started in 1922.

The more recent developments in the waterworks science have been more particularly in the field of improvements in color, odor, and taste, and in improving water softening.

COLOR REMOVAL:

Color in water usually occurs where there is iron, and super-chlorination or storage, which results in oxidation of the iron or other coloring matter, has made it possible to remove the color by precipitation. The use of the chlorinated copperas, developed by Hedgepath, together with lime and sulphated alumina has removed color effectively and is a relatively cheap method of accomplishing the result.

Quite noticeable results have been effective in color removal by control of the hydrogen-ion concentration and improvements of mixing devices.

FILTER CONTROL:

There have been a few developments in filter operation among which is the more successful removal of mud balls, effected by the use of air during washing, and the use of a horizontal stream of wash water when washing; this stream being approximately at the top of the filter bed.

The better understanding of wash water requirements has resulted from the knowledge developed by Hulbert and Hering of Detroit, Michigan in which they have shown that clean sand is essential to uniform filter operation; that sand can be kept clean by washing, producing a 50% to 60% expansion of the sand bed; that the variation in viscosity of water at different temperatures requires more wash water at higher temperatures; and, to get the same results, say 60% expansion, would require a 50% greater rise at 72° than it would at 32%. Recognition and application of this fact results in a reduction of the annual

use of wash water.

The operation of a filter plant to secure a safe water as viewed from the bacterial standpoint is now practically assured in most plants.

ODOR AND TASTE:

The odors due to phenolic compounds are extremely troublesome, and as a general rule it has been a practice to compel the plant which is contributing such a waste to a stream, to discontinue it; or to so treat the waste as to render it stable when discharged. It is sometimes treated with chlorination but recent treatments at the plants producing the product has been to absorb the phenolic bodies in scrubbers of light oil, benzine or caustic soda. The odor of over-chlorination and chlorophenole are removed by filtering through activated carbon. At times ammonia is used prior to chlorination to prevent tastes.

WATER SOFTENING:

Real care must be used in the selection of a method to treat the waters, which need softening. If the value of soft water is high, as is the case in laundries, it is wise to spend more for softening and to use the Zeolite process if the water is extremely hard, and if the relative cost of salt for regeneration is less than soda. In softening water recarbonization has made it possible to add lime to excess. This will precipitate the magnesium as a hydroxide, and reduce the hardness materially. Before recarbonization the danger of the carrying over and the depositing of the lime in the mains has made the use of an excess of lime dangerous. The value of

softening is being better appreciated each year, and there are constantly more plants being built.

Softening is a condition that can be handled in a partial or complete manner.

CLARIFIERS:

The use of mechanical clarifiers in plants where there is a lot of silt in the water, is increasing. The clarifiers are in what might be known as the grit basins. This makes it possible to clean the basins easily with but little loss of water and relieves the load on the main settling basin. These are quite valuable in connection with water softening plants.

OWNERSHIP OF PLANTS:

Water is essential to life and there is no substitute so it must be sold at a low price which will invite its use. It is quite expensive to build the plants and systems to pump and deliver water to people and because of the relative small return this form of investment is not particularly attractive to the investor. This is especially true in small towns and cities; therefore it has been necessary for many of the latter to build their own systems.

The number of plants and their ownership is given by the "Manual on American Water Works Practice" published in 1925 by the American Water Works as follows:

Year	Total Plants	Public Plants	Private Plants	Ownership Unknown
1800	16	1	15	
1810	26	5	21	
1820	30	5	25	
1830	44	9	35	
1840	64	23	41	
1850	83	33	50	
1860	136	57	79	
1870	243	116	127	
1880	528	293	305	
1890	1878	806	1072	
1896	3196	1690	1489	17
1924	9850	6900	2950	

The ratio of ownership is probably about the same at the present time.

PUMPING UNITS:

There have been wonderful developments in pumping units. The very efficient triple expansion steam pumping engine unit used in large plants is now being replaced by a much cheaper and slightly less efficient steam turbine driven centrifugal pump. The centrifugal pump requires a much smaller building to house it than that required for the triple expansion steam pumping engine.

Smaller plants have found the motor driven centrifugal pumps are cheaper to operate than was the case when it was necessary to have their own power plant and pump with steam. The deep well centrifugals have improved the efficiency in pumping and quantity production of wells.

ADVANCE IN ART:

There is a much better understanding now of how much can be expected of ground water supplies, and there are methods to test them in advance of their development. The amount of water to be secured from certain drainage areas, and the size of reservoir

to build to insure a definite daily supply has been worked out in an accurate way. The per capita consumption is quite definitely known; that is, where water is metered. The principles of design of the system to meet fire requirements has been established by the fire insurance organizations. The public at times feels these requirements for fire protection are too rigid, but the general trend is to meet them as nearly as possible.

Elevated storage is being used more and more, to relieve pumping plants of the fluctuations of flow; and to have available, at pressure, large amounts of water in case of an unusual heavy draft or in case of a breakdown at the pumping plant.

The use of water increases somewhat per capita, but since metering has become more or less general, this is not increasing rapidly for water is cheap and people use without hesitancy what they need, but do not waste it.

SEWERS

HISTORICAL:

Sewers were built many centuries ago but no residences were connected directly to them. It is said the excavations on the sites of the ancient cities show sewers; in Nippur; in Babylonia clay pipe with tee fittings have been found that probably date back to at least 2000 B. C.; an arched drain built of brick was also found there. Clay drain pipe systems have been found in Crete that probably date back 3500 years. There were sewers of some kind in ancient Egypt and Athens, and there is the record of a law passed by the Roman Senate at the request of the Emperor about 80 A. D. which speaks of the need of conservation of water for it is needed to flush sewers.

The sewers built previous to the nineteenth century were largely what are commonly known as storm sewers, and no doubt were somewhat like combined sewers although human excreta was not expected to enter them. A great deal of the domestic wastes were thrown into the streets though, and street washings carried them into the sewers.

The water carriage system of handling domestic sewage brought the sanitary sewer system into prominence.

The first sewer that corresponded to present practice with the residences connected to it, was built in Hamburg, Germany about 1842. This sewer was built at the same time that a section of the city which had been destroyed by fire was being rebuilt.

A report by the London Sewage Commission about 1860 tells

of insanitary conditions in London that are hardly believable. The filth was terrible. Records seem to indicate that during the dark Ages the people were living under the most filthy conditions, and there were great plagues of cholera and other water borne disease. Moses was right when he said that "Cleanliness is next to Godliness." Cleanliness produces healthier bodies and healthy bodies better minds and so all the agencies of health are not only progress within their own art but result in bringing about progress in mankind.

PRESENT STATUS:

Sewers and particularly sanitary sewers are considered a necessity now by practically everyone even though Baltimore completed its extensive sanitary sewer program as late as 1915. It is recognized that sanitary sewers are indispensable to a city for the sewers furnish the means which

(a) promotes comfort and convenience and remove nuisances;
(b) prevents transmissible disease and improves the health of the community;
(c) extends the average life span;
(d) enhances property value and development;
(e) develops civic pride;
(f) attracts industry.

SANITARY SEWERS:

The development of the sanitary sewers has been just as great relatively as any other form of utility development within the last fifty years, and the laws of the land have been so drawn as to be more favorable to this type of improvement than to any other. Most of the States have a sanitary sewer law which permits the ordering in of such an improvement by the legislative body, of the municipality when in their judgment it

is necessary for the health and convenience of the people of the city or any part thereof. The utility to be paid for by the people served and by the particular method or methods prescribed by the statute for this particular class of city.

Sewage has been described as the spent water supply of a community, and the human excreta, domestic wastes and industrial byproducts conveyed by it, often create a nuisance and menace to public health. The proper disposal of this sewage is usually accomplished by dilution in a stream, or the treatment of the sewage either in primary or secondary treatment plants or both. In this treatment the solids are practically removed and stabilized under favorable conditions, and the effluent is oxidized or mineralized and is stable when it leaves the plant and will cause no nuisance in the stream into which it is discharged.

The science of design of sanitary sewers is well developed as relates to sizes and capacities of different sized pipe laid on different gradients. Methods of arriving at the amount of sewage a certain sewer will probably have to handle is also well understood.

A sewer system when properly built does not require a great deal of attention, but it is quite essential that it have some. Within recent years since the use of the automobile and gas has increased so much, there have been more explosions in sewers. Some of the petroleum products reach sewers from garages, and then become ignited in the sewer. It is well for sewers to be well ventilated, and inflammable materials should not be put into a sewer. Gas leaking from the distribution system often

collects in the sewers and when concentrated enough is easily ignited and explodes.

SEWAGE DISPOSAL:

There are a great many sewer systems built that handle both storm and sanitary sewage in the same system, while there are others handling only sanitary sewage or storm sewage. Special means of disposal are not required for ordinary storm sewers, but are required for sanitary sewage. The dry weather flow of the combined system is practically all sanitary sewage and therefore in locations where some means of disposal is needed for sanitary sewage this has to be intercepted and taken to a proper disposal works.

The fuller appreciation of the community obligation to the community below its sewage outlet, has helped materially in working out these problems. There are some localities where the cities in a district which form a natural drainage outlet band together to work out their sewerage and sewage treatment problems. There is a growing understanding that a sewage disposal plant is a utility and needs proper supervision, and in many instances should have technical supervision of trained operators.

In many recent plants grit chambers have preceded the sedimentation tanks. Sedimentation tanks used for primary treatment are usually Imhoff Tanks or clarifiers and hopper bottomed tanks, these latter two are used in conjunction with separate sludge digestion. In many of the separate sludge digestion tanks the gases of decomposition are collected and used to heat water which is circulated through coils in these

same tanks to maintain temperatures favorable to bacterial action throughout the entire year.

Chlorination is used in some cases to sterilize or reduce the bacterial content of the effluent and for elimination of odors. Recently it has been found that the introduction of chlorine into sewers will reduce certain odors and eliminate certain sulphur bacteria and reduce the deterioration occasioned by the presence of dilute sulphuric acid. Chlorination has also aided the oxidation of sewage under certain conditions.

Trickling filters and activated sludge plants are those most commonly used for secondary treatment, for the oxidation of the sedimentation tank effluents. The trickling filter will not produce an effluent of as good appearance as an activated sludge plant but the effluent is reasonably staple and the operation cost of the plant is less. The first cost of the trickling filter is however ordinarily higher than an activated sludge plant. Aeration is accomplished by mechanical aerators and by air blowers and porous plates. The latter method seems to be the one fitted for large plants.

The problem of handling sludge is of some importance in all sewage disposal plants and particularly in activated sludge plants. Sludge filters or drying beds with sedimentation tanks and separate sludge digestion tanks are common, and, in order to make these beds available the year round, glass houses of the greenhouse type are being built over some beds; this increases the capacity of the beds. Proper ventilation is essential in such installation to change the air over the beds as often as possible which improves the drying conditions. Such a building

was built over the sludge drying beds at Wahiawa, Hawaii for the rainfall exceeded a hundred inches per year and a great deal of this moisture fell during the warm weather. Sludge is treated in many different ways in activated plants to dry it because it accumulates fast and becomes septic easily and has to be handled properly and quickly after removal from the final clarifiers. All efforts are towards reducing the cost of handling sludge. This sludge is sold at the Milwaukee plant and brings in quite a revenue. There have not been many major developments in sewage disposal in the last two years but there have been refinements made in the processes now in vogue.

CHARGES FOR SEWER SERVICE:

The usual custom in the United States has been to build a sewer and pay for it, and forget it, and pay such small operating charges as there were out of the general fund of the City. The heavy cost of sewage disposal has changed this situation and there has been applied a charge for sewage service in places, and there is agitation for it in many other places. It has seemed that to raise the money to pay for the cost of such disposal works and for their operation and maintenance by general taxation is not equitable in a great many instances.

There have been a number of suggestions presented as to the method to use in computing a sewerage service charge, and among these are the following:

1. A graduated scale based on water used.
2. A two part rental- based on readiness to serve and on water used.
3. A percentage based on the water bill.
4. A flat rate for different types of property.
5. A scale of rates based on number and kind of plumbing fixtures.

6. A combination of 4 and 5.
7. A schedule based on not only volume, but on suspended matter and biochemical oxygen demand.

Such charges will require intelligent handling both in the establishment of the rates and in their application, and it is doubtful if an equitable rate could be devised by the application of any one of the above suggestions, but rather from a combination. The charges must be applied and collected at small cost to be practical, and to keep it low.

Such charges are worthy of careful consideration particularly where secondary sewage disposal treatment is required for certain types of industrial wastes are very hard to oxidize and are detrimental to the normal operation of such a plant. Such wastes create a special load on the disposal plant and necessitate extra expense, and should very properly pay it.

SANITATION OF CITIES:

A recent bulletin of the National Geographic Society states that the oldest continuously inhabited community in the United States is Oraibi, an Arizona Indian village, which was in existence in 1370. Damascus is supposed to be the oldest city in the World in continuous existence. It was a city in the days of Abraham 2000 or more B. C. Cairo in Egypt has been in existence over 2400 years but probably not on the same site. Athens and Rome were probably started about 1000 B. C. Cuzco, Peru is supposed to have been founded by the Incas in the tenth century A. D. Mexico City is believed to be the oldest city in continuous existence on the North American mainland, it was founded according to tradition, by the Aztecs in 1325. The lack of sanitary facilities is believed by

the writer to be one of the principal reasons that we do not have older cities. The soil of the city site became so contaminated that the city had to be removed to a different site, or disease became so prevalent that the site was abandoned. This disease may not have taken its toll as a plague but the general health average of the people was lowered and they either were conquered by stronger groups or the population dwindled away. Reports by the London Sanitary Commission of this last century tell of the filth there, of buildings undermined with overflowing cesspools; of areas practically occupied by these structures so that there was room for no more. The Commission mentioned that it did not appear that people could live under such conditions.

ELECTRIC LIGHT AND POWER

DEVELOPMENT OF ART:

A vision of the growth of the electric light and power industry has been set forth in statistics elsewhere in this report and are of added impressiveness as one contemplates how recent have been the major electric developments. A brief outline of progress in the development of this science follows:

(1) Magnetic action such as the attraction of lighter objects by amber after it had been vigorously rubbed was known by Thales of Miletus who died in 546 B. C.;

(2) Lucretus who was active in the field of knowledge from B. C. 96 to 55 tells of iron attraction to lodestone; The Odyssey of Homer mentions the Compass.

(3) The Chinese are credited with the discovery of the magnetic needle in A. D. 121; and Chinese sailors used it in the eleventh Century A. D.

(4) William Gilbert, (1544-1603) an Englishman invented the electric needle in 1600.

(5) Alessandro Volta (1745-1827) an Italian made clear in 1790 the idea of current, the idea later used in the development of the electro magnetic Generator.

(6) Oersted in 1819 set forth the idea of eltro dynamic force.

(7) Luigi Galvani (1737-1798) made experiments with the electric current in frog legs, and Andrew Marie Ampere (1775-1836) developed electro dynamics.

(8) Coulomb (1736-1806) invented the torsion balance which measured electrical attraction. He also studied fluid resistance.

(9) Ampere (1775-1836) clarified the work of Oersted explaining the dynamic action between a conductor carrying an electric current and a magnetic needle.

(10) George Simon Ohm (1787-1854) a German in 1827 outlined what has been since known as Ohm's Law. This law set forth the relation between current, resistance and voltage.

(11) Humphrey Davy (1778-1829) developed the arc in 1801 and King the incandescent filament in 1845 which were the basic ideas that later resulted in the use of electricity

for lighting. Davy's work was principally in electro chemistry.

(12) In 1801 Davy also showed the fact that this arc light energy was the dissipation of energy as heat; Joule in 1818 showed that in a resistor electric energy may be made to create heat.

(13) Michael Faraday in 1831 developed the D. C. Motor, principles in his discovery and exposition of electro-magnetic induction; effect of magnetism on polarized light, positive and negative charge; he also developed the electro plating idea in the electro-disposition of metals, which latter was used in the silver volta meter.

(14) James Maxwell (1831-1879) worked out the laws discovered by Faraday namely "how to reduce all electric and magnetic phenomena to stresses and motions of a material medium"; this helped materially in the perfecting of a generator. Gramme in 1870 invented a dynamo. Dr. Werner Siemens produced a self-exciting dynamo in 1866.

(15) In 1849 Nollet developed the first commercial alternating machine, and in 1873 the development of the present motor was begun after it was found the gramme type generator could be used as a motor.

(16) In 1890 Dolivo Dobrowolsky developed the use of the three phase circuits. Ferraris in 1885 had discovered the rotary magnetic field and also developed the knowledge of alternating currents.

All of the above discoveries were constructive but the art had not developed, up to 1880, so that there were no:

1. Generators to produce cheap electricity.
2. Methods of use to develop the need of the energy.
3. Methods to distribute the electrical energy.
4. Methods to charge for the energy.

In reviewing the accomplishments of the men listed above it appears that the work of Gilbert, Volta and Oersted contributed to the development of the electro-magnetic generator; the work of Ohms to transmission of electricity; the work of Davy and King to the use of electricity for lighting; the work of Davy and Joule to electric heat; and the work of Faraday and Ferraris to the use of electricity for power.

LATER DEVELOPMENTS:

The brief outline of the development of the electric science shows that the most of the steps that have been used in our electric development of the last fifty years, in which electricity has become a commodity of almost universal use, were made in the one hundred years just preceding this period. Paul Jublochkov developed the electric candle in 1876 and it was improved on by C. F. Brush two years later. The Edison lamp discovery was made in 1879. It was not so much a discovery as a development that made it of commercial value.

The first central station for the generation of electricity for lighting was opened by Thomas A. Edison on Sept. 4, 1882 in what is now known as the Pearl Street Station. This of course was a direct current station. It has been stated that when the station opened it had 400 lamps attachedand within fourteen months thereafter had 12,732 lamps. The plant started with 59 customers and by November 1883 had 508 customers. The plant had six Edison Jumbo dynamos, weighing 30 tons each, and four boilers of 1000 h. p. each. The engines operated at 350 r.pm. The capacity of the first plant was 600 kw. The first Chicago Plant was started in 1887. The plant had 78 employes when it was started while in 1929 there were 279,000 employes connected with the electrical generation and distribution industry in the United States.

There were further developments in lamps and in 1897 the Nornst lamp was developed and in 1904 the Von Bolton tantalum lamp, and following close after this the tungsten lamp and then the mazda process lamp.

Immediately after electric energy was put on the market, it was realized that the energy must be sold on a quantity basis of some sort. In 1881 the Edison meter based on electrolytic disposition was developed and in 1888 Thomson developed the motor type meter which bore his name. The electric industry no doubt has done more than any industry to develop metering for in this industry the very close relationship of the amount of energy put in as fuel and amount of converted energy as electricity taken out was appreciated early in its use.

The development of the use of the alternating current was the big factor in the low cost of generation and distribution because direct current required such large wire to convey any great amount without a great drop in potential. Alternating current however changed this situation.

PRODUCTION OF ELECTRICITY:

The matter of production of electricity and its reduction in cost per unit has been remarkable. The reduction in the cost has been due both to quantity production and development of the art. In fact until very recently the electric power industry has been able to replace its equipment frequently to avail itself of developments with art, resulting in substantial savings in cost of production per unit. A very interesting fact regarding the development of the art is found in lighting in 1907, the year the filament lamp was introduced, the carbon lamp gave 3.4 lumens per watt and in 1928, the tungsten lamp produced 14.5 lumens per watt.

The relation of the amount of energy consumed per customer, the revenue per customer, the production per unit of plant capacity,

the investment per customer and per unit of capacity, the average revenue per unit of electrical energy both as a whole and per domestic consumer is interesting and instructive, this data follows:

	1907	1912	1917	1922	1927	1928	1929
Kilowatt-hours per customer-	3010	3000	3540	3427	3462	3551	3800
Revenue per customer in dollars-	90	79	73	84	82	83	87
Kilowatt-hours generated per kilowatt-	2163	2230	2828	3043	2894	2993	3100
Investment Per Unit of Generating Cap. in dollars-	419	354	288	268	320	324	327
Investment Per Customer in dollars-	700	597	452	378	437	457	458
Average Revenue per kilowatt sold-	2.99	2.61	2.07	2.46	2.37	2.34	
Average Revenue per kilowatt-hour sold to domestic consumer				6.90	6.75		6.50
Annual Consumption per domestic consumer in kilowatt-hours					456	475	512

This indicates an increase in consumption, a decrease in amount paid per unit of energy and an increase in production per unit of generating capacity. The increase in consumption and in plant output per unit will tend toward still further reduction of rates.

The increasing loads are the outgrowth of the works of engineers and scientists who have contributed remarkably in the arts of generation, distribution and better utilization of electrical energy.

IMPROVEMENTS IN THE INDUSTRY:

There are still more improvements being made in the industry which include,

(a) System planning; designed to reduce losses and the initial investment. This is important when it is realized 60% of the total capital investment is in the distribution systems.

(b) Simplification of wiring.

(c) Improvements in Transmission of Distribution, among which improvements there is contemplated the generation of electrical energy at the voltage at which it will be used, and its transmission at this voltage to cut out transformer losses, this of course will have to be within limited areas; also there are improvements in underground distribution. The realization of the need of preparation of the oil used in transformers has improved their efficiency.

(d) Improvements in power production, resulting from increased steam pressure as increased steam temperatures are used; it is possible plants may be built using 1400# steam, but most of the plants built at present are for 400# to 500# because the steam temperature cannot well be above 750° Fahrenheit until new alloys are developed to use in the boilers and piping. Water cooling of the furnace walls where pulverized fuel is used, makes even larger boilers possible, for individual stokers had limitations.

(e) Better understanding of hydro-electric projects, a realization that runoff varies much more than rainfall; during the last year the City of Tacoma and Seattle-Washington which depended on a hydro electric plant altogether had to get the U. S. Airplane Carrier Lexington to help them out.

PROBLEMS IN OPERATION:

In spite of all these remarkable developments and growths the thinking men of the industry are at work on further developments for they realize there are certain trends they will have to face among which are:

(a) the stabilizing of the average revenue per kilowatt hour sold.
(b) the rising investment per kilowatt hour of generating capacity installed.
(c) the time of capital turnover is lengthening.
(d) the possible additional markets are decreasing.

In substantiation of these statements the following comparisons for 1922 and 1927 are submitted regarding power generated,

In 1922- 7.54 kilowatts hour were generated for each dollar invested- in 1927- 6.61 kilowatt hours, a decrease of 12½%
In 1922- Price per kilowatts hour sold was 2.81- in 1927- 2.61
In 1922- Revenue per dollar invested 21.1 cents and in 1927- 17.9 cents
In 1922- Capital turnover was once in 4.72 years and in 1927 once in 5.58 years.
In 1922- Investment per K.W. was $312 and in 1927 was $367
In 1922- For interest, dividend & surplus equals 7.30% and in 1927- 7.48%

Since the more profitable business has already been secured a certain amount of the increase in investment per k. w. sold is occasioned by the reaching out for business where the return is less per dollar invested.

The domestic sales are regarded by many operators as the backbone of their business and they are most zealous to increase it, for they feel it is uniform; industrial use of power reflects the prosperity of the industry in question and fluctuates; domestic sales also carry fixed expenses and the chief expense of added use is the cost of generating energy; domestic sales (if increased) improve the load factor and indicate satisfaction on the part of the user; domestic sales increase is a social duty for it results in higher standards of living. More sales can be induced by lower rates.

The ability to reduce rates is largely due to,

(a) Larger and more efficient units of production
(b) Greater productivity of labor
(c) Interconnection of utilities
(d) Increased economy of operation and management
(e) Increased use of the commodity

REGULATION:

The electric light and power industry is probably as

generally subject to regulation as any of the municipal utilities, for 89.27 per cent of the power generated is used in the State where it is generated. The following is a brief outline of the status of the electric light and power industry as related to regulation.

Electrical energy consumed in State generated (subject to local control)	89 Per Cent
Electrical energy consumed in one State by the same company generating it in another (subject to local control)	7 " "
Total subject to State Regulation	96 " "
Generated by one Company and sold to another Company in an adjoining State for further distribution (not subject to local control)	4 " "
Total Consumed	100 " "

The idea of transmission conveys the idea of long distance transmission, and to some the idea of freedom from regulation, but the data above shows that almost all the electrical energy produced is subject to regulation, and the fact is that the average travel distance of electrical energy in the United States is twenty-two miles, and eliminating California from consideration the average travel is reduced to eighteen miles. The matter of transmission is an economic problem rather than a physical one.

The lack of competition, which is one of the fruits of regulation, has resulted in the free exchange of ideas that have spread the successful methods rapidly, and particularly has this been true in the electrical industry. State regulation has safeguarded in most instances the public interests. When there were mergers, whose excuse for forming was reduction of expenses, improving service and reducing prices, the unification of ownership, and control of operation and management, the commissions have usually

permitted them.

The public right to regulate is discussed elsewhere, but it can be restated that the public certainly does more for regulated industries than for any other type of industries, and should share in the benefits. This regulation usually results in efficient employment of capital, and only interfers to the extent of establishing standards for service, rates, and amount of capitalization, which in the opinion of the regulatory body is fair and reasonable for safe and adequate service.

The wholesome approach for an operator is to feel that his company owes the public, for the privileges granted to the company,

(a) technical service of high order which is ample, safe and unfailing,
(b) a service that is broadly human and helpful
(c) square dealing and economical management
(d) a share in the benefits of the improvements in the art in reduction of rates.

ELECTRIC INDUSTRY:

In Moody's Manual on Public Utilities there is given a general picture of the growth of the urban population and the census of the electrical industries. In this Manual we find the population in cities and villages of the U. S. was in - 1850 - 2,897,586
in - 1900 -30,380,433
and in- 1920 - 51,406,017,

this latter amounting to 51.4% of the total population.

The Census of the Electrical Industries shows:

		No. of Companies, Stations or Systems			
Census Year	Total	Electric L & P	St.Railways	Telephones	Telegraphs
1927		4,327			
1922	8,902	6,355	1,200	1,323	24
1917	10,076	6,542	1,307	2,200	27
1912	8,424	5,221	1,260	1,916	27
1907	7,612	4,714	1,236	1,636	26
1902	8,783	3,620	987	4,151	26

and the people employed in the industries to be:

Census Year	Total	Electric L & P	St.Railways	Telephones	Telegraphs
1927					
1922	810,250	150,762	300,523	290,333	68,632
1917	696,431	105,541	294,826	244,490	51,574
1912	582,452	79,335	282,461	183,361	37,295
1907	428,765	47,632	221,429	131,670	28,034
1902	277,474	30,326	140,769	78,752	27,627

A general picture of what the industry is doing is given in the following table,

Electric Light and Power

Year	1929	1928	1927	1922
No. of establishments				
Total	*2801	4063	4335	6355
Commercial	1480	2153	2137	3774
Municipal	1321	1910	2198	2581
Prime Movers				
Number			12,007	13,242
Horse Power	41,601,800	39,069,800	35,622,593	19,850,860
Kw.Cap.Generators	29,495,000	27,440,000	25,420,000	14,313,438
Kw.Hrs.Generated	91,249,900,000	81,868,420,000	74,335,070,000	40291,536,035
" " " by fuels	58,877,450,000	49,381,876,000	46,543,740,000	
Kw.Hrs.Generated by water power	32,372,450,000	32,486,634,000	27,791,330,000	
Fuel Used Equiv. Short tons coal	48,87,000	42,633,000	41,700,000	
Lbs. coal- Per Kw Hr.	1.66	1.73	1.79	
No. of Customers. Total	24,249,000	23,204,000	21,834,100	12,709,868
Domestic (Inc.Farms)	19,999,000	19,072,000	17,913,900	10,211,232
Commercial	4,250,000	4,132,000	3,920,200	2,498,636
Revenue from sales	$1,955,979,000.	1,801,438,000	1,664,775,000	940,162,000
Average Rev. per Kw. Sold	2.57¢	2.64¢	2.70¢	2.79¢
Annual Use (Domestic) kw. hr.	502	459	429	359
Av. Annual Bill "	$31.02	30.10	29.20	26.50
" Revenue per kw.hr.	6.18¢	6.55¢	6.80¢	7.39¢
Population July 1-	121,400,000	120,013,000	118,628,000	109,248,000
Percent of homes served with electricity	68	66	63	39

*Small ones omitted

The value of electricity to mankind and particularly in this country has been stated by Mr. Thomas N. McCarter as follows:

> "There is no man, woman and child living within our borders who has not profited, whose life has not been made easier and more worth living because abundant and cheap electtical energy is at our command."

MERGERS:

There is a great deal of discussion of the immense mergers of electric light and power companies, and these mergers are attributed to a number of causes among which are those classified as

(a) legal (b) political (c) technological (d) economic factors (e) changes in popular feeling.

All of these no doubt enter into it. Some of the most important reasons for these mergers are the possibility of good return on the investments, and economies effected by consolidation and centralized production and management.

There has been a marked reduction in the number of individual establishments, both in municipal and commercial plants. The reduction of municipal plants means that they have been purchased by private parties while the reduction in commercial plants means only mergers of privately owned properties.

A study of Table No. 1 which is a list of Sales of Municipal Electric and Water Properties in Kansas compiled from data published in Bulletin No. 77 of the Kansas Municipalities is worthy of study. It will be noted that a large number of the properties sold were in cities that could not afford their own generating plant nor would the business warrant much help in looking after service or caring for the financial end of the business. The private company having a number of plants could well afford to take care of the business

and add to their output at a central station, using transmission lines to deliver the power to the respective communities. Cities might have consolidated for mutuall good had the legal provisions of the statutes permitted such extension of lines, and the necessary capital investments.

The remarkable progress made in this utility in recent years has been so great that it is foolhardy to predict its future. One large operator has said that the companies owe it to society as a whole to do all in their power to relieve the housewife of drudgery by as full a development and application of electrical energy as it is humanly possible to accomplish.

TABLE NO. 1

List of Sales of Municipal Electric & Water Properties in Kansas
Bulletin No. 77- Kansas Municipalities- Page 14-19; March, 1930

Sales between July 1- 1926 to July 1- 1930

Town	Population	Date of Sale	Sold to	Vote For	Vote Against	Property Sold	Sales Price
Agra	394	Nov.9-1928	Kansas Power Co.			Elec.Dist.Sys.	$ 5000
Alexander	191	Nov.13-1929	West.P.&L. Corp.	97	2	" Transt&Dist."	9000
Almena	619	Feb.13-1930	Kansas Power Co.	264	24	" " " "	30000
Alta Vista	473	Nov.12-1928	United P & L Corp			Elec.Dist.Sys.	10547.04
Athol	277	August-1928	Kansas Power Co.			" " "	4000
Atwood	1004	May 1,1928	Kansas Power Co.			" L & P Plant	120000
Bazine*	351	July -1927	West. P & L Corp.			" Trans&Dist.Sys.	1
Bern	330	April 4-1927	United P & L Co.			" " " "	4000
Bird City	585	Dec. 10-1928	Cent.Kans. P. Co.			" " " "	12500
Bison	372	Dec. 4-1928	Kansas Power Co.			" " " "	8000
Bluff City	270	Feb. 20-1929	West. L & P Corp.			" " " "	6000
Brewster	464	Dec. 6-1928	Pub.Utl.Cons.Corp.			" " " "	26000
Brownell*	178	July -1927	West. L & P Corp.			" " " "	1
Bucklin	828	Nov. 7-1928	Kansas Power Co.			" Dist. Sys.	20386.25
Burns	400	June 15-1926	Kans.Gas & ElecCo.	117	25	" Trans&Dist.Sys.	5900
Byers*	187	Jan. 1-1926	Dwight Chapin,Jr.			" " " "	1000
Caldwell	2031	Apr. 3-1928	West. P & L Corp.	323	204	"P&L Plant&DistSys	205000
Cedarvale	954	Jan. 24-1927	Inland Utl. Co.			" " " " "	26000
Chase	260	Mar. 6-1929	United P & L Corp			" Trans&Dist.Sys.	8000
Circleville	208	Jun. 7-1928	Kansas P & L Co.			" " " "	3500
Claflin	579	Dec. 27-1927	United P & L Corp			" " " "	28500
Clayton	197	Oct. 18-1928	West. L & P Corp			" " " "	12480
Coldwater	1173	Jan. 27-1928	" " "	244	79	"P&L Plant&DistSys	55000
Copeland*	230	Oct. -1926	Dwight Chapin,Jr			" Trans&Dist.Sys.	1
Collison	307	Aug. 15-1928	West. L & P Corp			" " " "	12000
Cunningham*	467	Nov. 15-1926	Dwight Chapin,Jr			" " " "	1
Danville*	89	Nov. 26-1926	West. L & P Corp			" " " "	1
Dolphus	610	Nov. 7-1927	United P & L "			"P&L Plant&DistSys	25000
Denison	186	Oct. 25-1928	Kansas P & L Co.			" Trans&Dist.Sys	5000
Derby*	285	Mar. 1-1926	Dwight Chapin,Jr			" " " "	1
Downs	1540	Dec. 27-1927	WSBarnes,Ks Pr Co	357	225	"P&L Plant&DistSys	21000
Dresden	195	Nov. 20-1928	CentKansPowerCo			" Trans&Dist.Sys.	19700
Dwight	360	Dec. -1928	United P&L Corp			" Dist. Sys.	8000

TABLE NO. 1 (Continued) -2-

Town	Population	Date of Sale	Sold to	Vote For	Vote Against	Property Sold	Sales Price
Easton*	209	Mar. 7-1927	Kans.E.P.Co.			Elec.Dist.Sys.	$ 1
Fairview*	365	Jan. -1927	" P & L Co.			" " "	1
Fontana	200	Mar. 21-1928	Mun. P & T Co.			" Trans&Dist.Sys	9000
Ford	315	Oct. 18-1928	Kansas Power Co			" " " "	4559.39
Freeport*	109	May -1927	West.L & P Corp			" " " "	9000
Grainfield	338	Dec. 3-1928	Cent.Kans.P.Co			" " " "	15000
Greeley	458	Sept.14-1926	Mun. P & T Co.			" Dist. Sys.	2000
Gridley	520	Nov. 22-1928	Kans. Utl. Co.			" " "	6500
Grinnell	274	Dec. 1-1928	Cent.Kans.P.Co			" Trans&Dist.Sys	15000
Harper	1601	Apr. 8-1929	West.L & P Corp			"P&L Plant&Dist"	105000
Havensville	263	Dec. 18-1928	Kansas P & L Co.			" Trans&Dist.Sys	7500
Haviland	480	Feb. 4-1929	Rezeau Bros.			"P&L Plant&Dist"	10000
Hazelton	260	July 10-1928	West.L & P Corp			" Trans&Dist.Sys	9500
Hoxie	712	June 4-1929	Cent.Kans.P.Co	269	94	"P&L Plant&Dist"	40000
Hudson	211	July 23-1929	United P & L Corp	98	1	" Dist. Sys.	10000
Hunnewell*	225	July 5-1926	West. L & P Corp			" Trans&Dist.Sys	1
Hunter	208	Dec. 31-1928	Kansas Power Co.			" " " "	5500
Huron	151	Feb. 6-1928	" P & L Co.			" " " "	2500
Irving	358	June 18-1929	United P & L Corp	113	23	" Dist. Sys.	7500
Jennings	227	Dec. 7-1928	CentKans.P.Co			" Trans&Dist.Sys	18000
Kanorado	358	Nov. 14-1929	W. B. Foshay Co	83	4	" " " "	24000
Kensington	522	Nov. 5-1928	Kansas Power Co.			"P&L Plant&Dist"	25000
Kiowa	1586	Nov. 10-1927	West.L & P Corp.	272	179	(" " " "	
						(" Water System	150000
LaCygne	1033	Apr. 29-1928	Mun. P & T Co.	346	6	"P&L Plant&Dist"	40962.50
Lane	332	Oct. 24-1927	" " " "			" Trans&Dist.Sys	14000
Lenora	454	Feb. 22-1929	Cent.Kans.P.Co			"P&L Plant&Dist"	6750
LeRoy	811	Feb. -1930	Kans. Utl. Co.	183	Majority	" " " " "	30000
Logan	616	Feb. 14-1929	Kansas Power Co.	108	31	" Dist. Sys.	20000
Long Island	212	Oct. -1928	" " "			" Trans&Dist.Sys	5500
Lyndon	905	Sept.13-1929	Mun. P & T Co.	234	4	" Trans. Sys.	1600
Madison	1355	Nov. 21-1926	Kans.E.P.Co.			"P&L Plant&Dist"	25000
Marquette	689	Jan. 2-1929	United P & L Corp			" Dist. Sys.	10000
Mayetta	279	Oct. 16-1928	Kansas P & L Co.			" Trans&Dist.Sys	15000
McCracken	519	June 18-1929	West. L & P Corp	160	105	"P&L Plant&Dist"	60500
McDonald	413	June 13-1929	Cent.Kans.P.Co	162	1	" Trans&Dist.Sys	9500
McLouth	477	Nov. 12-1928	Kansas P & L Co.			St.Lighting Sys	75
Medicine Lodge	1491	Oct. -1929	West.L & P Corp	454	243	Elec.P&LPlant&Di"	140000

TABLE NO. 1 (Continued) -3-

Town	Population	Date of Sale	Sold to	Vote For	Vote Against	Property Sold	Sales Price
Minneola	469	Nov. -1928	Kansas Power Co.			Elec.Trans&DistSys	$ 20000
Montezuma	317	Dec. 14-1926	Elec. Service Co.			" " Sys &SbSta	1
Morganville	302	Sept.28-1928	United P & L Corp			" Trans&DistSys	15000
Morland	327	Oct. 23-1929	Cent.Kans.P.Co.			"P&L Plant&Dist"	1
Mound Valley	687	Dec. 6-1928	Kans.E.P.Co.			" Dist. Sys.	13000
Mullinville	388	Jan. 15-1929	Kansas Power Co.			" Trans&DistSys	8173.50
Nashville	224	July 10-1928	West. L & P Corp	140	0	" " (12Mi)" "	7500
Natoma	636	Jan. 11-1930	Kansas Power Co.	208	15	" " " "	12500
Neosho Falls	500	Dec. 27-1928	Kans. Utl. Co.			" Dist. Sys.	5000
Nickerson	1027	Oct. 25-1927	United P & L Corp			" St.Lt." &	20000
Norcatur	467	Dec. 13-1928	West. L & P Corp			" Trans&DistSys	22000
Oskaloosa	744	Oct. 15-1928	Kansas P & L Co.			Whiteway&St.Lt.Sys	854
Parker	360	June 1-1928	Kans. Utl. Co.			Elec.Dist&TransSys	16000
Plains	604	Feb. 18-1927	Dwight Chapin,Jr			"P&L Plant&DistSys	10000
Portis	351	Oct. 27-1928	Kansas Power Co.			" Trans&DistSys	4000
Powhattan	294	Nov. 14-1928	" " "			" " " "	5500
Prairie View	190	July 10-1928	" " "			" " " "	2750
Preston	410	July 16-1927	United P & L Corp.			" " " "	15000
Ransom	385	June 27-1927	Western L &P Corp.			" " " "	9000
Reading	284	Aug. 27-1929	Kansas E.P.Co.	141	8	" " " "	5000
Rexford	339	Dec. 4-1928	Cent.Kans.P.Co.			" " " "	27200
Robinson	405	Dec. 5-1927	Kansas P & L Co.			" " Sys.	1000
St. Paul	826	Sept.10-1929	" E.P.Co.	217	13	" Dist. Sys.	22300
Sawyer	260	Sept.17-1928	West. L & P Corp			" Trans&DistSys	9000
Selden	363	Nov. 21-1928	Cent.Kans.P.Co.			" " " "	27200
Sharon	312	Aug. 1-1929	West. L & P Corp			" " " "	11500
Soldier	275	July 7-1928	Kansas P & L Co			" " " "	6500
South Haven	417	July 6-1926	West.L & P Corp	156	12	" P&L Plant&DistSys	5000
Speed*	161	Nov. 20-1928	Kansas Power Co.			" Dist.Sys&St.LtSys	1
Sublette*	567	-- 1926	Dwight Chapin,Jr			" Trans&DistSys	1
Sylvia	482	Mar. 19-1928	United P & L Copp			" " " "	10000
Sylvia Grove	518	Sept.16-1927	Kansas Power Co.			" L &PPlant&DistSys	12000
Syracuse	920	Apr. 5-1927	Inland Utl. Co			" " " "	21000
Utica*	374	July 19-1927	West. L &P Corp			" Trans&DistSys	1
Walton*	230	Feb. 2-1928	Kansas G & E Co			" Dist. Sys.	1
Walda	218	Jan. 12-1928	Kansas Power Co.			" Trans. Line	6000
White City	278	July 24-1928	United P & L Corp			" Dist. Sys.	12503.44

(next page)

TABLE NO. 1 (Continued) -4-

Town	Population	Date of Sale	Sold to	Vote For	Vote Against	Property Sold	Sales Price
White Cloud	509	Sept. 2-1929	West. P.S. Co.	108	47	Elec. Dist. Sys.	$ 9500
Whiting	382	Aug. 10-1929	Kansas P & L Co	191	--	" " "	14000
Willis	229	Feb. 3-1930	City of Horton	91	--	Trans. Line	2000
Winchester	381	Sept. 6-1928	Kansas P & L Co			St.Lighting Sys	150

*Sales Price plus other valuable considerations

Total 53,862 1,952,107.12

Total No. of Cities- 112 of which 17 disposed of plants according to record for nominal sum and other valuable considerations

In the 93 cities whose sales price is indicated there are 49,191 persons and the total sales price of the plants and systems was $1,951,091.12 or an average per capita of $39.66.

GAS

GENERAL:

The gas industry has developed tremendously since 1920 and particularly the natural gas section of the industry; the amount of natural gas produced and delivered in 1929 was over double that of 1920 and the number of domestic customers using natural gas has practically doubled in the same time.

The production of natural gas has developed along with the tremendous production of petroleum. A great deal of the natural gas is produced with the oil. The natural gas serves as the lifting force to bring the oil to the top of the ground. The low price of petroleum would have been an impossibility if its production had not been accomplished largely by the use of the natural gas occurring with it. This natural gas occurring with petroleum is usually wet and is treated in casinghead gas plants and the gasoline is taken out and the dry gas marketed.

RELATION OF NATURAL GAS AND NATURAL GASOLINE PRODUCTION:

H. J. Struth, a petroleum geologist, states that the amount of natural gas produced, follows closely the amount of casinghead gas treated for gasoline, seeming to infer that the production of natural gas is the result of the casing head industry and the development of the markets for the gas are incidental. Interesting in connection with the statement is the following table No. 2:

TABLE NO. 2

Natural Gas and Natural Gasoline Production

Year	Nat. Gas Produced and Delivered in Billion Cu. Ft.	Natural Gas Treated in Billions of Cu. Ft.	Natural Gasoline Produced in Million Gallons
1919	799	480	352
1920	861	496	385
1921	724	465	450
1922	763	545	506
1923	1008	876	815
1924	1142	1016	934
1925	1189	1040	1127
1926	1313	1206	1354
1927	1445	1341	1627
1928	1568	1474	1814
1929 (estd)	1900	1790	2208

It will be noted the recovery of gasoline in recent years has increased per M Cu. Ft. of Gas. This is in part due to the development of better extraction plants and also to the use of a wetter gas.

CONSERVATION OF NATURAL GAS:

There is a decided tendency at the present time to conserve natural gas, and to eliminate a practice of the past, that regarded natural gas as an incident in the production of petroleum and let it blow into the air as it came out with the oil. The California Supreme Court has just recently upheld a law passed in that State which limited the amount of gas that should be allowed to be produced from an oil well with the oil. This will no doubt have a double reaction in conservation, namely a conservation of the natural gas, and a larger ultimate recovery of oil.

Natural gas must be conserved in nature's reservoirs for it is impractical to store it as one does petroleum because compared on the heat energy basis one volume of petroleum will be equal to about 1000 equal volumes of natural gas.

DEVELOPMENT IN USE OF GAS:

Natural gas has been known to exist for centuries, for there are records of its existence in ancient China, Persia and British India. It was worshipped as a fire god or the work of some supernatural agent. The oracle of Delphi was located at a point where natural gas escaped from the earth, in fact its location resulted from the people inhaling the gas and becoming talkative and light headed. It is said natural gas was used years ago to evaporate water to reclaim salt.

In 1821 the first gas well in the U. S. was drilled near Fredonia, New York and the first gas well in Pittsburgh for commercial purposes was drilled by George Westinghouse, Jr. in 1884. As the supply in Pittsburgh began to decline in 1890, the gas meter was introduced, charges heretofore had been on the size of pipe leading into the premises.

The developments of the use of natural gas are interesting to note. Natural gas was first put to practical use in China, when piped from a coal mine to a salt works through bamboo pipes to evaporate the water and leave salt.

William Murdock in 1792 distilled gas from coal to furnish it for lighting his own home, and in 1804 built a plant in Manchester and lighted a cotton mill with 900 burners. In 1816 Baltimore lighted its streets with gas lights. Interesting in this connection are some of the objections against the use of gas which objections were printed in a New England paper which are said to have represented the best and most serious thought of the time;

> "1. A theological objection. Artificial illumination is an attempt to interfere with the divine plan of the world which had preordained that it should be dark

during the night time.

"2. A medical objection. Emanations of illuminating gas are injurious. Lighted streets will incline people to remain late out of doors, thus leading to increase of ailments by colds.

"3. A moral objection. The fear of darkness will vanish, and drunkedness and depravity increase.

"4. Police objection. Horses will be frightened and thieves emboldened.

"5. Objections from the people. If streets are illuminated every night, such constant illumination will rob festive occasions of their charm." (From Gas Service)

In 1865 the kerosene lamp was put on the market and it was between 1865 and 1875 that gas for home lighting began to come into favor. The inverted gas mantles were not used until 1900 and the introduction of the incandescent lamps, which increased the lighting power over six times that of the flat-flame burner also came into use about 1900.

TRANSMISSION OF NATURAL GAS:

In 1926 about 50% of all natural gas passed thru transmission lines. This long distance transmission of gas is growing because of

(a) the increased demand for natural gas in the country as a whole,
(b) a more general recognition of the worth of natural gas,
(c) a realization of dependability of estimates of available supply predicated on the rock pressure decline or Boyle's Law, and on the measurement of thickness of the sand bed, porosity of sand, extent of sand bed and rock pressure,
(d) the success of long transmission systems already in use.

The first transmission line of considerable length for the transportation of gas was built in 1883 and was a 5 5/8" line from Murryville to Pittsburgh, Pennsylvania. This line was capable of delivering 5,000,000 cu. ft. a day. At the present time, there are transmission lines as large as 36" bringing natural gas into the

Pittsburgh district; there is a 20" line 220 miles long bringing gas from West Virginia and Kentucky to the same district. There is one line in the Houston, Texas Territory approximately 500 miles long and built in 12"-16" and 18" pipe. A 22" pipe line from the Monroe, Louisiana gas field to the Standard Oil Refinery at Baton Rouge is 175 miles long and delivers up to 70,000,000 cu. ft. of gas per day. This refinery is said to be the largest industrial user of gas in the world.

A number of other large transmission lines are shown in the following table:

TABLE NO. 3

Data Regarding Natural Gas Transmission Lines

To	From	Length in Miles	Size	Capacity in Cu.Ft. Per Day	Construction Started	Construction Completed
Memphis	Guthrie, La.	212	18"O.D.D.C	75,000,000	1st Wk Sept	Dec.28,1928
El Paso	Lea Co. N. Mex.	210	16" W.	45,000,000	Jan.15,1929	June 18,1929
Monterey, Mex.	Zepata Co-Texas	143	12 3/4" O.D.W	21,000,000	July - 1929	Dec. 2, 1929
(Birmingham,Ala.)		(284.7	22" D.C.	50,000,000		Dec.31, 1929
(Atlanta,Ga)	Monroe Field	(176.4	20" D.C.	100,000,000	May - 1929	Jan.25, 1930
Clarkville, Ark.	Little Rock	96	10"			
Eldorado, Ark.	Emmett	60	12			
Waskon,Texas	Richland Co.Lousiana	137	20"			
		51.5)	16")A.W			
San Francisco	Kettleman Highs	190.2)	20")E.W			
		39.8)	22")			Aug. 16, 1929
	"	(13.0	20" A.W	138,000,000	Oct. 1929	
" "	" "	(42.0	22"			
	"	(24.8	24"			
		(120.7	20"			
Denver	Amarillo	340	22"O.C.P			
Enid, Okla.	Wheeler Co. Texas	165	14"			
Ottawa, Kas.	Pampa, Texas	250	20"			
Shreveport,La.	Monroe, La.	137	20"			
St. Louis, Mo.	" "	526	16"-22" D.C.P			
San Antonio,Tex.	Miranda, Tex.	250				
Salt Lake City	Baxter Basin, Wyo.	247	14"-16"-18"		Oct. 7,1928 Co. Incorp.	in 11 months
Houston and Port Arthur	Waskon, Texas	280	16"-18"-22" D.C.P			
Fort Worth,Texas	" "	160	16"-18"-20"			
Omaha, Nebraska	Hugoton	900	24"	185,000,000	April, 1930	

CONSTRUCTION CONDITIONS:

There have been certain construction features that have been instrumental in the extension of transmission lines. Among these are the following,

(1) Development in the methods of manufacturing which not only results in the production of larger sizes of steel pipe in tube mills, but also the development of a method of making pipe on the ground from sheets shipped as flat steel to the site of the work, and which makes larger sizes easily procurable. This is a development due to the advance in welding science.

(2) Development in the use of the welded joint.

(3) Development in the understanding of methods of combating corrosion which cuts down cost of maintenance, leakage and replacements and results in a much longer life of pipe lines.

(4) Construction machinery which materially reduces the cost of ditching and backfilling, of unloading and transporting and placing of the pipe, and reduces the time of construction so that the interest on the idle investment is relatively small. Where data was available as to the time of construction it is included in Table No. 3.

The machines having to do with the construction features are the gin pole trucks with the winch mounted on the truck, the trucks for hauling and stringing, the ditching machines now made more durable and capable of practically continuous operation. There have been improvements in pneumatic drilling and effective blasting so that classified material can be taken out with the ditching machine. Backfilling is done with a machine and pipe is

placed under railroad and road crossing through culvert pipe which is forced through the fill with a Seminole winch.

The natural gas industry, due to all of these contributing causes is emerging from a local to a national distribution system.

PRESENT STATUS OF NATURAL GAS INDUSTRY:

The largest development in the utility field today is that of natural gas distribution and it is claiming the attention of the financial world to an unusual degree. It is becoming a factor in the price of fuel for heating and industrial power. It is relatively cheap to deliver natural gas by pipe line. The Engineering News Record in the issue of March 27, 1930 in an article entitled "Natural Gas to the Fore in Western Fuel Markets", has this to say regarding the relative costs of gas and electric transmission,

> "The new natural gas picture is not complete without some comparison of modern gas pipe lines and electrical transmission lines. A basis for rough comparative cost estimates is given by the following figures, believed to be representative for California:
>
> "A 220,000-volt transmission line bearing two circuits, each capable of transmitting 100,000 kw., ordinarily ranges in cost from $25,000 to $30,000 per mile, including rights-of-way but without any pro rata of plant or substation costs. Such a line would suffice for a 200-mile delivery.
>
> "A 200-mile, 26-in. pipe line to carry gas under a pressure of 450 lb. per sq. in. is estimated to cost, including right-of-way and a pro rata of the necessary intermediate compressors about $40,000 per mile. The rate of delivery through such a line could be expected to be 5,400,000 cu. ft. of gas per hour.
>
> "Taking natural gas at 1,175 B.t.u. per cubic foot and allowing 12,000 B.t.u. per kilowatt-hour (a value obtained in modern steam plants of high efficiency), a rough ratio of 1 kw. of continuous power for each 10 cu. ft. per hour of constant gas flow. On this basis an hourly flow of 5,400,000 cu. ft. of gas is the equivalent, in heat units of 540,000 kw.
>
> "In other words, the cost of transmission is, roughly, half as much when delivering potential energy in the form of

gas in a pipe line as when delivering electric energy over a transmission line. To make the comparison complete, of course costs at the delivery end involved in transforming natural gas into the form of energy required must be included, as must certain costs involved in converting the 220,000-volt energy into the form in which it will be commercially applied."

It must be said however that there are a great many plants using gas which find they cannot produce 1 kw. of electrical energy with less than about 20 cu. ft. of gas of natural gas. This is due in part to lesser efficiency and in part to a leaner gas. Such a figure would make the transmission costs of gas and electricity about equal. Electric distribution has an advantage over gas distribution in cost, but the production cost of the gas is less per unit of energy than electricity.

Natural gas is becoming a real factor in fuel problems as evidenced in the record of fuels used in the production of electric power, the record according to Moody's for three recent years is as follows:

000 omitted

Year	Coal (Short tons)	Fuel Oil (Barrels)	Natural Gas (M Cu.Ft)
1926	41,330	9,389	51,104
1927	41,635	6,780	62,804
1928	41,369	7,123	77,158

This shows the increasing use of natural gas, with the use of coal at about a standstill, or decreasing. The use of fuel oil has decreased.

USE OF NATURAL GAS:

Alexander Forward is authority for the statement that the average increase in sales per customer has increased 17.4% in the last ten years. The average annual consumption(of natural gas) per domestic consumer throughout the United States has been in,

1926 - 77,500 Cu. Ft.
1927 - 74,300 " "
1928 - 73,500 " "

The following is the average annual consumption in M Cu. Ft. of natural gas per domestic consumer in three cities:

Year	Amarillo, Texas	Forth Worth, Texas	Wichita, Kansas
1918		102.7	
1919		104.0	
1920		103.6	
1921		81.5	
1922		81.7	98.9
1923		80.5	91.9
1924	* 159.03	80.8	84.7
1925	* 157.46	78.3	70.4
1926	136.13	81.3	84.2
1927	130.59	71.1	89.4
1928	124.49		86.1

*Include Commercial Users.

The following Table No. 4 gives in a brief manner the Natural Gas Statistics for 1928,

TABLE NO. 4

Natural Gas Statistics for 1928 (From Bureau of Mines-
Dept. of Commerce)

(1) Natural Gas Delivered to Consumers - 1928:

1,568,139,000 M Cu. Ft.
160,000 M. Cu.Ft. Canada & Mexico

1,567,979,000 U. S. Consumption

(2) Increase over 1927 - 8%
Petroleum Increase Same Period - .04%
Carbon Black " " " - 25%
Natural Gasoline " " " - 11%

(3) Producing States: Oklahoma (first) Texas (second) California (third) Louisiana (fourth)

(4) No. of Domestic Consumers in 1927 - 3,984,000
in 1928 - 4,366,000 Increase is 10%

(5) Largest No. of Nat. Gas Consumers: Ohio (first) California (second) Pennsylvania (third)

(6) Total Consumption by Domestic Consumers - 320,877,000 M Cu.Ft. or 20% of Total. Increase of 8% over 1927.

(7) Average Consumption per domestic consumer - 73,500 Cu.Ft. in 1928
" " " " " - 74,300 " " in 1927
" Price Paid by Domestic Consumers - 62.0 cents per M Cu.Ft. in 1928
- 60.8 " " " in 1927
- 58.4 " " " in 1926
" Bill per Domestic Consumer - $3.79 Per Month in 1928
- 3.76 " " " 1927
- 2.82 " " " 1918

(8) Consumption of Natural Gas for Industrial Uses.
(22% increase over 1927):

Drilling & Field Purposes	573,698,000	M.Cu.Ft.	46%	in 1928
Carbon Black	175,137,000	" " "	14%	" "
Fuel in Refining Petroleum	114,950,000	" " "	9%	" "
(23% increase in 1927):				
Electric Public Utilities Fuel	77,326,408	" " "	6%	" "
Other Purposes	305,990,592	" " "	25%	" "
Total	1,247,102,000			" "

9% above 1927.

Average price per M Cu.Ft for Industrial Purposes 13.2 cents in 1928.
" " " " " " " " " 12.0 " " 1927.
" " " " " " " " " 12.8 " " 1926.

Outside of Gas Used for Field Purposes Price in 1928 was 15.8 cents per M Cu.Ft.

Outside of Gas Used for Field Purposes Price in 1927 was 16.5 cents per M Cu. Ft.

The use of natural gas for industrial fuel has an indirect value on a much larger number of persons than does its domestic use.

In "Facts Relating to the Production and Substitution of Manufactured Gas for Natural Gas" by Wm. W. Odell published by U. S. Department of Commerce- Bureau of Mines as Bulletin 301, there is an extended discussion of the gas problem, dealing particularly with the possibility of the exhaustion of natural gas, which at the present time does not appear imminent. It is brought out that when the natural gas is exhausted-the study of the situation should include investigations as to

(1) Raw materials to use to make gas and their availability and costs,
(2) Location of additional natural gas supply as regards population centers,
(3) Effect of production of artificial gas
(4) Effect of gas of less calorific value
(5) Relative fuel value of gas and other fuels
(6) Variation in the customer demand
(7) Possibilities of generation of substitute gas
(8) Tendency toward lower calorific value in manufactured gas.

The value or sales price of natural gas as sold to consumers was as follows:

	1922	1923	1924	1925	1926
Domestic Gas per M Cu. Ft.	49.9	51.4	54.0	56.0	58.1
Industrial " " M " "	18.6	13.4	11.6	12.3	12.8
Industrial and Domestic Gas per M Cu. Ft.	29.1	23.8	22.2	22.3	22.8
Average Price of gas at wells per M Cu. Ft.	11.1	10.0	9.3	9.4	9.5

In the distribution of natural gas there is a direct relation between the price of domestic gas and consumption. The cost of gas depends to a considerable extent on

(1) Peak Load Requirements
(2) Storage
(3) Classification of Customers
(4) Scale of Gas Prices, Av. price per M Cu. Ft.
(5) Av. Cons. per consumer
(6) Relation of price to consumption and to class of consumers.

The variation in monthly sendout for manufactured gas is sometimes greater than for natural gas.

GAS RATES:

The price charged for gas is predicated on different basis among which are the three part rate, the customer charge, the service or maximum and demand charge and the commodity charge.

The customer charge is fixed on a percentage of equipment devoted to the customer, and on depreciation and on manufacturing charge. The service and maximum charge demand is based in part on fixed charges on equipment devoted to supplying in part on maximum hourly demand and partly on max. demand and such rates are supposed to

(1) Increase customers
(2) Increase consumption per customer
(3) Lower average rate per M Cu. ft.
(4) Allows Max. service and sales with minimum of expense
(5) Allows consumers to take advantage of decreased price
(6) Does not penalize poorer class
(7) Does not penalize smaller consumer
(8) Allows utility to give better service
(9) All classes of consumers pay just share of return on investment.

The following shows the average price paid for gas per 1000 Cu. ft. from 1913 to 1926:

Year	Av. Price to Householders		Aver. Value of Gas Sold	
	Man. Gas(44 cities)	Natural Gas(8 cities)	Natural Gas	Coke Oven Surplus gas
1913	$ .95	.34	.151	.088
1914	.94	.34	.159	.098
1915	.93	.34	.161	.102
1916	.92	.34	.160	.098
1917	.91	.35	.179	.087
1918	.95	.39	.213	.087
1919	1.04	.44	.216	.086
1920	1.09	.44	.246	.140
1921	1.32	.49	.264	.168
1922	1.29	.54	.291	.167
1923	1.25	.55	.238	.162
1924	1.24	.59	.222	.165
1925	1.23	.65	.223	.170
1926	1.23	.66	.228	.163

MANUFACTURED GAS:

Gas should be made of coal and petroleum to produce a gas high in calorific value. Mixing of natural with artificial gas has been done in a number of places. Coal gas can be mixed with natural gas. One of the manufactured gases known as water gas is made by passing steam over incandescent carbon. Carburetted water gas is made by cracking oil and is popular because of

(1) Low initial investment
(2) Ease equipment can be put into operation
(3) Ease of generating gas of the quality wanted
(4) Repairs are small - labor requirements are low
(5) 540 B.T.U. Gas is derived from the enriching material,

This gas is of high specific gravity.

Producer gas is made by passing air with water vapor through a bed of fuel and makes a gas of 110 to 125 Btu. per cu. ft. and as high as 155 Btu. This can be used in connection with natural gas within limitations. It recommends itself because of

1. Low cost
2. Simplicity of operation
3. Wide variety of fuels- that can be used for generator fuel
4. Ease of starting and stopping

The objections to producer gas are its,

1. Low calorific value of gas,
2. High specific gravity- Large investment cost and,
3. Impossibility of interchange

Oil gas is made by cracking of oil into gas, tar and lamp black and 8 gallon of fuel oil will produce 1000 cu. ft. of 550 Btu. gas with an efficiency of from 43 to 52%. The advantages of an oil gas plant are it is,

1. Easy to put in operation
2. Small ground space
3. operation simple
4. Labor small
5. Calorific quality changed at will

and the disadvantages are it requires,

1. cheap oil
2. Large quantities of oil on gas property
3. large amount of lampblack

A reformed gas which is a leaner gas made of natural gas, has been made of Signal Hill and Ventura natural gas.

The limitation factors affecting selections of substitute gases are the

1. Flexibility of the gas making units
2. Cost of manufacture
3. Cost of pumping and distributing gas
4. Cost of metering
5. Size of mains and services
6. Corrosion effects
7. Adjustment of burners
8. Properties of the flame
9. Efficiency of utilization- Calorific value.

CHANGING FROM NATURAL GAS TO ARTIFICIAL:

There are problems that occur when natural gas is turned into an old artificial system, one of the most apparent is that the mains are too small because the amount of gas used increases and the system has to be reinforced. Natural gas is much drier than artificial gas and so far as internal corrosion is concerned there is no trouble. A great deal of steel mains have been used for natural gas distribution. The joints have for years been made with Dresser or Dayton couplings, but recently there have been many miles of pipe laid with welded joints. The small pipe used to be all screw joints but now they are largely welded.

In the past when natural gas was turned into an old artificial system one of the problems was that its dryness took the moisture out of the jute in the joint and the joint leaked. Collar leak clamps entailing great expense were applied to stop this leakage.

At Salt Lake City in order to avoid this leakage problem steam and oil vapor are introduced into the gas as it leaves the City Gate Stations. This keeps the jute in the joints from drying out. The gas is also cleaned at Salt Lake City.

When artificial gas is turned into a system that has been distributing natural gas it is usually necessary to put in drips and at times grade the lines if this was not done when they were laid.

LIFE OF STEEL MAINS:

Steel mains have probably a much longer service life now than formerly because of the study made of corrosion problems. There has been a great amount of progress made in coatings for steel mains.

ECONOMIC ASPECTS:

In outlining "The Economic Aspects of Natural Gas Projects" Thomas R. Weymouth in Natural Gas for December 1929 says the three problems are (Production including gas leaseholds and gas wells,
(Transmission which involves gathering field and main lines, city borders and compressor stations and
(Distribution which involves delivery from city borders to the point gas is delivered to the consumer.

He states that early prices for gas regarded it as

(a byproduct and sold at a
(flat rate per year then or a
(small price per appliance per month,

This permitted waste and the result is serious because of exhaustion of the fields, for instance the Okla. Natural taps over 30 fields.

It has been found that most transmission systems work best with looped systems. The security of service on lines is good for there are instances where important cities have depended on single lines for forty years. The present operating pressure of transmission lines is about 400# per sq. in. and it is proposed to

raise it to a maximum of 2000# per square in.

As a general rule natural gas is not stored in a holder and - lines are not laid as deep as for manufactured gas because there is no condensate. Ordinarily the delivery of manufactured systems will be 20 to 40 thousand feet per customer per year, while many natural gas systems will deliver 90 to 125 thousand feet per customer per year which is the result of the cost per unit of natural gas sold being less than artificial gas. Mr. Weymouth suggests that all gas distribution systems should be built with the thought of ultimate use as manufactured gas systems.

This caution, for fear of the exhaustion of natural gas, seems a little over conservative if it adds much to the cost of the system at least in certain localities, for in 1894 Branot Island was purchased as a site for a manufactured gas plant at Pittsburgh, Pennsylvania and there is no need for its use for this purpose to date.

SERVICE REQUIREMENTS:

The requirements, that should be applied to gas service, are; those relating to the quality of the gas, these being generally expressed in terms of the British Thermal Units per cubic foot and those relating to pressure at the burner, which is a measure of the ability to deliver adequate quantities;

The companies should be equipped to test the accuracy of meters and to test the gas for the presence of sulphurated hydrogen, particularly if it is artificial gas. Gauges to measure gas pressures and a standard calorimeter for determining the heating value of gas should be owned and used by all companies.

STREET RAILWAYS

GENERAL:

The street railway companies have had a difficult time operating since the World War. This is due to increased costs of operation and to the competition of private motor transportation. Reference to the data in Chapter II shows that the street railway companies have not been extending their lines and that their business has not increased commensurate with other utilities.

An idea of the street railway industry is seen in the list of employees engaged in the industry which is as follows:

Year	No. of Employees
1890	70,764
1902	140,769
1907	221,429
1912	282,461
1917	294,826
1922	300,523
1927	262,725

This lack of increase in employees may be due in part to economies in the operations, and in part due to the purchase rather than production of its own power, but the principal reason is because the industry is at a standstill in growth and may be going back. In this country a utility that is at a standstill is in fact losing ground, at least relatively. In spite of the private motor transportation competition, surveys show that from 65 to 85% of the people going into the downtown districts are carried there by the transportation utilities.

Early franchises, under which many street railways operate, often impose conditions which it is impossible for the street railways to fulfill and which if imposed would bankrupt the company and impair the service. Others are so worded that the rights of the public are not properly protected. Such conditions should be rectified, and good

faith on the part of both will provide a fair and adequate return on the property used, and a service of good order at a reasonable price. To meet this situation there have been adopted a number of franchises, in which there are "service-at-cost" agreements. Such agreements are embodied in the franchises at Boston, Cincinnati, Cleveland, Kansas City, Youngstown and a few other places.

Investors in street railways state that the indeterminate permit in franchises is of great value in financing, and if properly worded is a satisfactory provision from the City's viewpoint. If it facilitates financing it should reduce the actual cost of doing business and this should ultimately accrue to the benefit of the car rider.

One of the provisions of early franchises that has been a bone of contention is the maintenance of the paving between the rails and usually from 18" to 20" outside the rail.

This provision is an outgrowth of the old horse drawn car days when in fact the pavement was worn out by the hoofs of the horses drawing the cars. At the present time such a condition does not exist but very often the pavement is better between the tracks and the automobiles use this pavement in preference to the rest of the street and delays the street car. It does seem however that the car company wears the pavement out faster between the rails than in the rest of the street due to vibration; necessity of cutting into ties or rails and patching after such a cut; and due to the added wear along a rail that does not occur in a street without the rail.

In one instance a city paved a street on which there was a car line, and the people along the street paid the amount they would have

paid in case there had been no car line there and the street railway paid for all extra expense of construction. This seems fair on first cost but whether it will ultimately work out is not clear. The argument used against such an arrangement is that the street was paved wider because the track which was there was of no value to the property owner. It is also true that streets on which car lines are built usually become traffic arteries and have an extra amount of travel over them. This however, gets into the question of distribution of the costs of improvements on arterial streets which cannot be discussed here. It seems that paving parts of streets may be an excessive burden, but it is true that there is a part of this expense that the street railway should pay. The paving will need to be replaced more often due to the existence of the car line in the street and there is a question as to who should bear this expense.

The problem of speed of travel is of real concern to this type of transportation for it competes in a way with the private motor car is very often the agency that slows its progress. There have been movements in some cities to forbid parking on streets where there are street cars, at least during the rush hours. Other cities have established arterial highways on streets on which there are no street cars. The street railways are very often operated with the skip-stop to make more speed.

To cut down the costs of transportation there are now in use a large number of one-man operated cars.

CONTROL OF ALL TRANSPORTATION UTILITIES:

In order to facilitate transportation and make it possible for street railway companies to enjoy the more lucrative returns from

mass transportation, these companies control the bus systems in many cities. There are about 375 cities in the country where such is the case. Such co-ordination has certain advantages of which the following are the more apparent;

1. Co-ordination of routes and schedules and elimination of duplication.
2. Use of type of service justified in the territory.
3. Reliability of service.
4. Transfer privileges.
5. Combination rates
6. Reduction in overhead costs.
7. Reduction in total investment.

In Philadelphia, St. Paul, Grand Rapids and Kansas City, Missouri, the street railway company are gradually acquiring the taxicab business. The transportation utilities can be better operated as a monopoly and the public protection should be secured as to rates by the vigilence of its own local officials or by the State commission having jurisdiction in such matters.

HEATING SYSTEM.

GENERAL:

The heating systems in the larger cities are much more efficient now than a number of years ago because of the more effective insulating materials now in use, and because of the better understanding of the value of insulation.

The losses due to radiation are also much better understood and the facilities for heating can be well balanced against the needs.

There are many large buildings built at the present time in the larger cities, and in these it is economical for them to produce their own heat. The economy of the purchase of heat depends altogether on the price for which it can be purchased.

A number of years ago exhaust steam was a by product and heating load was a desirable adjunct to an electric light plant but today with the economies effected by condensation under vacuum, and the conservation of heat effected in boiler plants, a market for steam is not particularly attractive. When electric light plants were first built and direct current was used, generating plants were spaced close together and the heating load was usually within reach of the plant in each respective district. Today such power plants are usually removed from the business district.

Heating by steam conveyed to buildings in underground piping is still a utility but its expansion is somewhat doubtful.

Rates for this commodity are generally fixed today upon the meter basis with a demand charge.

GARBAGE AND REFUSE DISPOSAL.

GENERAL:

Garbage and refuse disposal is one of the utilities that has developed along with the great growth in urban population. It is one of the services that is very essential to public health and comfort. The proper handling of these wastes will result in the decrease of objectionable insect life, and rodents. Collection is the problem that gives communities their most serious concern, because of cost and difficulty in making the collection as effective as desired.

The ratio of the cost of garbage collection and disposal and sanitary sewage collection and disposal has been vividly set forth by Mr. Samuel A. Greeley, who states that in a city of several hundred thousand people, the initial investment in collection facilities is 30 to 40 cents per capita for garbage while for sanitary sewage it is $30 to $40, but that the operating force in connection with garbage collection may number from five to six times that of the operating force of the sanitary sewer system; also that the per capita investment for garbage disposal where reduction plants are built is from $.75 to $1.00 per capita, while sewage disposal plants would range from $3.00 to $10.00 depending on the degree of purification undertaken. The annual operating cost of collection of garbage is about seventy-five per cent of the total annual operating cost of collection and disposal.

Garbage is usually disposed of by incineration or hog feeding. The collection of garbage is done by contract or by municipal forces. Collection should be developed to insure satisfactory service and reasonable economy. The site of disposal plants or for concentration

units should be selected to fit into the collection system and also be of as little nuisance as possible. The manner of operation of the disposal plant or concentration unit will have a great deal to do with the extent of the nuisance.

There are a number of patented systems of garbage disposal and if a system of this type is adopted, it should be carefully gone into before adoption. Where the residents cooperate well in the separation of garbage, there are more possibilities of disposing of it at a good price for animal feed; but if the cost of processing the garbage is high there will be little left for profit and it may cost more to process than the sale price of the processed garbage.

There is a good deal of garbage produced by a person in a year, the record in Kansas City for the year ending July 15, 1929, showed approximately 220 pounds per capita per year, but this reduced to dry matter will equal about .15 pounds per capita per day.

There is considerable discussion of the disposing of garbage by the fermentation process, and also of mixing it with sewage sludge, this latter process might be used in the smaller cities. The garbage no doubt would have to be ground to be effectively treated with sewage sludge. Fermentation ordinarily produces an acid reaction which is not considered advantageous in sewage sludge digestion.

The product produced by the fermentation system of reduction sells for $25.00 a ton at Scarsdale, New York, and is used as a fertilizer.

The general trend at present seems to be to incinerate municipal refuse and such methods often include garbage as well.

Some refuse plants salvage the saleable refuse, as is done at Baltimore. This saleable refuse amounts to more than would be expected

by just viewing a pile of refuse. Refuse incinerators are rated on the number of tons per day that can be put through the plant.

AIRPORTS

GENERAL:

Airports are the most recent type of municipal utility and have attracted a great deal of attention since the famous Lindbergh flight from Roosevelt Field to Paris. This one feat seems to have made this country air-minded and developments of airports have been rapid. It is of interest to recall that it is just a little over twenty-five years ago that Wright flew the first heavier than air machine. The Federal Government has exercised more control over this form of transportation and over the depots, which the airports constitute, than they have over any other utility. This has been due primarily to the hazard of this type of transportation and the necessity of properly designed ports for landing.

The vital statistics issued by the Department of Commerce show a total of 1122 air accidents during the year 1928, which were classified as follows,

	Pilots	Passengers
Fatal Injury	161	223
Severe Injury	163	181
Minor Injury	180	185
Uninjured	618	1184
Total	1122	1773

The data is not available to determine the percentage of fatality. A casual observation of this data indicates that most of them must have occurred with small planes, and that there were few with the larger ships that carry several passengers.

There are several important items of engineering that have to be taken care of in connection with an airport. The suggestion has been made that there should be a standard set of specifications written for

airport improvements, which should include paving, runways, taxiways, lighting and fire protection and could well include a standard arrangement of hangars, runways and taxiways. The art is young and no doubt the knowledge of the science is so meager that a set of standards would be of no value in the near future.

The growing importance of airports is realized when the growth in route miles of airways in operation is reviewed, this is as follows,

Year	Route miles of airways in operation
End of 1926	8,500
" " 1927	9,500
" " 1928	20,000
" " July 1929	32,200

SELECTION AND DEVELOPMENT OF SITE:

The essential factors that enter into the selection of an airport site, are

1. Accessibility - for mail, passenger and delivery of goods.
2. Freedom from fog and smoke conditions.
3. Prevailing winds
4. Soil drainage
5. Size of site
6. Surroundings.

A suitable site should not slope more than two and one-half feet in a hundred feet at any point, and a flatter site is preferable for landing. The site must be well drained and the better airports have paved runways so they can be used the year round. When dry the natural earth is really better for landing than paved areas. The ideal field would be one in which the landing could be made in all-ways.

Runways where built should be of such a color as to be readily discernable from the air. The buildings about an airport should be carefully planned to meet present and anticipated needs. The buildings should be so arranged that they are,

1. Close to highways
2. Close to the desirable landing area of the port.
3. Free of obstructions to view.
4. Fulfill the needs of an airport.
5. Fit in architecturally with the setting.

The lighting problem of an airport is very important and to be effective must be carefully planned. The landing field must be clearly marked and all obstructions must be marked with proper lighting.

These problems of airports are being rapidly worked out and if the air traffic continues to grow it may be that the depots will become congested as has occurred to many of our other utilities.

TELEPHONES

GENERAL:

The telephone has come into almost universal use and is the one utility that has practically universal interconnection, that is in the United States. The universal interconnection is one of its most valuable assets. Due to the fact that one company controls the major part of this business in this country, the character of service rendered is more nearly uniform in cities of corresponding size than that rendered by other types of utilities. The telephone has been so well developed that it has become a necessity of life. In re Southern Bell Telephone and Telegraph Company (Ga) P. V. R. 1921 C 833 the Georgia Commission says,

"Our country districts are thinly settled, living therein has been less desirable because of its isolation. People like to come in touch with their fellow creatures and lack of such contacts has been one of the causes, there are many others, bringing about the removal to the towns and cities of many of the best people on the farms. Among the great things which are already giving to farm life a new attractiveness, dispelling isolation and making it more comfortable and safer, are good roads, good schools, the parcels post, rural mail delivery, motor vehicles, the rural telephones, and the last is not the least. When one can, from the farm residence, ascertain the daily market prices of the farm's products, call the family physician, hold converse with the neighbor, or ask in a moment his or her assistance in sickness or danger, some of the moving factors of dissatisfaction with rural life are eliminated. With good schools and the church, with good roads and fast motor trucks and cars, the daily mail and

newspaper, the parcels post bringing and carrying the smaller needs of merchandise and farm products, and telephonic communication with the world as well as neighbor, contentment in the home will keep company with industry on the farm".

This is a vivid picture of the value of the telephone to the man on the farm.

The telephone service is the one type of service costing more in the large city where there are more connections than in a small one, but it is the only type of utility in which the larger number of connections makes the rendering of service more costly.

There have been many advancements in telephone service that are increasing its usefulness. The multiparty line permits a lower cost to users and has added many subscribers. The twenty-four hour service feature has had a material effect in making it a necessity of life; it being always available in the time of an emergency. The dial phone now being installed in many cities cuts down the labor costs and the time element in making connection with the party called.

Construction of the main lines of communication are now being built underground where warranted. This form of construction removes the possibility of a breakdown in service due to wind and electrical storms. The first cost of this construction is higher but the maintenance and replacement cost should be materially less.

The cost of long distance phoning has decreased considerably in the last few years. The general efficiency of telephone service has been improved.

HIGHWAYS

GENERAL:

The heading highways, in reference to a municipal utility may be confusing, but the title refers to those streets now built to serve as arterial streets, and which very often lead to the highways connecting cities. The development of motor transportation has brought this utility to the front. The possibility of rapid transportation, the heavier loads, the larger number of private vehicles, and the increasing congestion and size of the cities has increased the requirements of the principal lanes of traffic.

There has been considerable progress made to determine what will be required of main traffic ways. Extensive surveys, including the count of the vehicles passing over a street through a given period, and at times of high congestion, have been made. The determination of the probable average speed that can be maintained under heavy traffic has also been carefully worked out. It is believed that zoning will help materially in the plans for trafficways because it will give an idea of the probable congestion. Zoning has been adopted by a great many cities, who are attempting to have a definite city plan for growth; the following is the record of cities that have zoning regulations, as published on page 964 of the Proceedings of the American Society of Civil Engineers for May, 1930;

Number of Cities	Population
53	Less than 1000
144	1000 to 5000
102	5000 to 10000
103	10000 to 25000
79	25000 " 50000
47	50000 " 100,000
55	More than 100,000

The importance of proper arterial streets connecting with the highways outside the city is being realized more and more. The improvements of these highways has stimulated travel to a remarkable degree. The report of the United States Bureau of Public Roads for 1928 showing the state of improvements of highways at that time visualizes what has been done to improve our road system and is an explanation for our tremendous inter city traffic. This record of improved highways is as follows,

	Miles
Sheet asphalt	1498
Brick and block pavement	3326
Bituminous pavement	5392
Sand clay and top soil	13499
Bituminous macadam	15200
Water-bound macadam	18142
Graded and drained highways	31755
Cement concrete	42957
Gravel	93124
Unimproved highways	81549
Total	306,442

TRAFFIC CONTROL:

The first thing that was done to take care of the increased traffic was to widen the traffic ways, and to pave them with a material that would remain smooth and wear well under the heavy load. This was not all that was needed however, and one of the next steps was to designate certain streets as arterial streets. A car entering the arterial street had to stop before attempting to drive into such a street. This last provision reduced the number of accidents and permitted the driver on the arterial street to drive more rapidly and not feel afraid of collision with incoming traffic which might have entered the arterial street at high speed and not under complete control.

Traffic lights have materially aided traffic at points of crossing, but this may not be the answer on very heavily congested intersections. At these intersections separation of grade may have to be used. The prohibition of curb parking on main thoroughfares, particularly during rush hours has assisted in speeding up traffic and added to the roadway capacity.

There are still additional suggestions to help traffic conditions and control that apply more to very heavily congested districts, some of which are,

1. Separation of the pedestrian and vehicular traffic planes in business districts.
2. Creation of new thoroughfares
3. Unobstructed express highways between important community centers.

These problems of traffic control are important. Much progress has been made, but there is still much to be desired.

CHAPTER VI

REGULATION

GENERAL:

The matter of regulation of public utilities is an outgrowth as are all other forms of regulation, of the abuse of certain privileges, by certain operators. This regulation is due also to the realization of society as a whole of the necessity, because of the very character of the business of the need of some sort of control. Regulation is a function of government and is but a part of the action expressed by President Hoover, "government can remove abuse and help put the signs on the road".

It has been set out in early paragraphs of this treatise that for centuries back, the undertaking of large projects, and in fact any project which had as its objective the welfare or happiness of a people was undertaken by the Government. It was near the end of the 17th Century or the beginning of the 18th century that the philosophy of "laissez faire", (let us alone) became an important doctrine in economic and political affairs. It is a doctrine that demands the minimum interference by government. It contemplates competition under equal rights, and the production of good through the power of uncontrolled individual action. It is supposed to provide the maximum satisfaction to the participators, the maximum benefit of employment, and the maximum harmony of capital and labor. This idea reached its height about 1870.

This philosophy is still prevalent with certain modifications. It was recognized after a few years that the liberty of contract only begins where equality of bargaining power begins. It was further

recognized that the rights which utilities were exercising were States rights merely delegated to them; therefore they were creatures of the State, protected from competition who were permitted to furnish utility services at a profit. In order to insure equality of privilege and rights, it became apparent that there must be some regulation. This regulation was necessary in the field of service rendered; the price paid for the service; and the financing of the means to render the service.

The need of regulation has been of recent date because utilities have developed so fast.

The occasion for and functions of public utilities have been suggested elsewhere in this thesis, but to sum it up tersely, they are for the purpose of supplying fundamental wants of communal living and are a very necessary part of our developing civilization.

The public utilities sell these services to the general public at prices governmentally fixed. There are certain obligations that are practically law in such undertakings namely:

(1) That the public utility shall render reasonably adequate service where they operate to all who apply.

(2) That the public utility shall render service up to the limit of its capacity.

(3) That the public utility shall not discriminate between customers similarly situated.

(4) That the utility shall receive a reasonable return.

(5) That the service to be rendered shall be measured by reasonable rules and regulations.

The obligations outlined above are the outgrowth of certain

notions that are synonymous with the idea of public utility namely;

(1) That a utility is a monopoly and a common necessity.

(2) That having the monopoly affords the possibility of the maximum of physical output at a minimum of money cost, since larger production units have lower energy requirements and can produce at lower fixed charge per unit of volume.

(3) That a utility has been delegated certain functions of the State for the benefit of the citizens, which include,

(a) right of eminent domain
(b) Free use of street and alleys
(c) Emergency relief in time of distress
(d) A uniform charge for service
(e) right to conduct a business that does not fluctuate a great deal, year in and year out.
(f) Freedom from competition.

A good definition of a public utility was given in the decision of the Charles Wolff Packing Company vs Court of Industrial Relations of State of Kansas, decided June 11, 1923, to-wit, "A public utility is a public or private enterprise designed to furnish a service to a community that is deemed by the community to be necessary or desirable for the public welfare, and the furnishing of which is commonly considered to be a public function".

The functions usually performed by public utilities include,

(a) Services of transportation
(b) Services incidental to transportation
(c) Services facilitating communication
(d) Facilities providing power, light, heat and refrigeration
(e) " " water and sanitation in urban communities
(f) " regulating water supply for agricultural purposes.

All such services should be regulated.

FORMS OF REGULATION:

The regulation has taken three forms, namely (1) franchise

stipulations, defining the character of service and its price; (2) legislative acts; (3) regulation by state or local authorities.

The third method has seemed to be the more successful, and particularly the State Commissions for,

(1) They can afford to have a qualified Board with a good staff or engineers, accountants, lawyers and technical experts capable of intelligently determining the merits of the case.

(2) They should be less affected with local prejudice or subject to less local political pressure than a local board.

(3) They can view the problem from its larger communal aspect, and they standardize both bookkeeping and rules of conduct and a company having many plants in the same State need not be affected in each town by a different requirement.

The public is often poorly prepared in its appearance even before a commission due to the

(1) frequent changes in corporation council
(2) political changes
(3) lack of engineering and accounting assistance.

This situation makes the need of a good State Commission more essential.

It is quite apparent that the local governments should be zealous to protect their citizens rights.

HISTORY OF REGULATION:

This matter of regulation has been more or less of a recent development, for the Wisconsin Commission was not organized until 1905 and did not have to do with municipal utilities until 1907, the same year that the New York Public Service Commission was formed. The matter of railroad regulation came earlier for the Interstate Commerce

Commission was organized in 1887.

The matter of the rights of regulation and the basic idea back of it began to take form in the judicial mind and to be expressed in decisions as early as 1876; for in an elevator storage case styled Munn vs Illinois (94 U. S. 113, 24 Led 77) the following extract is found

"Property does become clothed with a public interest when used in a manner to make it of public consequence, and affect the community at large. When, therefore, one denotes his property to a use in which the public has an interest, he, in effect, grants to the public an interest in that use, and must submit to be controlled by the public for the common good to the extent of the interest he has there created. He may withdraw his grant by discontinuing the use; but as long as he maintains the use he must submit to the control". (Underlining the authors).

This idea was expressed about 200 years ago by Chief Justice Hale in England in a treatise entitled "De Portebus Maris" in which the expression used is "affected with a public interest and had ceased to be juris private only".

PURPOSES AND POWERS OF REGULATORY COMMISSIONS:

The right of regulation is based fundamentally on police power, which is inherent in every sovereignty, but is not unlimited; and is, as police power, subject to review by the judiciary, when requested by either party because it does not have the right to deprive anyone of property or liberty "without due process of law".

Rate making is a legislative power and function, and as usually exercised by regulatory commissions, is delegated legislative power.

Some of the ideas back of regulation are that the State has delegated the right to engage in the public utility business to certain groups, by providing for the creation of public utilities, which are basicly creatures of the State. The State has granted them the right to render utility services which are of common necessity at a profit, and protected the utilities from competition, namely, given them a monopoly, and provided many valuable rights and privileges which include: right of eminent domain, free use of streets and alleys, no franchise tax, a uniform charge for service, relief of gratuitous service, protection to a degree from politicians, and relief generally in times of distress. The giving of a monopoly to the public utility in fact creates the markets, advertises to a limited degree the business, and removes the risks of competition. In return for these privileges the rate payer, who is a part of the public which has granted the privilege, is within his rights when he expects the public utilities to furnish of their own free will or by regulation the following:

1. Uninterrupted and adequate service to all who apply.

2. Maintainance of the property to insure safety and adequacy.
3. Reasonable rates, equitable arranged between different types of customers.
4. That the rate include but reasonable returns on the investment which guarantees its integrity.
5. That the rate include only a return on well advised investments.
6. That no money for expansion of plant be furnished through operating expenses.
7. That no money be raised for expansion through the reserve for replacement, that is no excess be created through this means, other than the fair needs of the property for retirements and replacements.
8. That the rate does not allow for duplication of maintenance and depreciation charges, and supersessions charges be not included in the present rate, at least not to an excessive extent.

The rights of both the utility and the public outlined above is

established in the main in the famous case styled, Smyth vs Ames 169 U. S. 466, 42 Led 819, 18 Sup Court 466, decided in 1898, extracted as follows;

"We hold, however, that the basis of all calculations as to the reasonableness of rates to be charged by a corporation maintaining a highway under legislative sanction, must be the fair value of the property being used by it for the convenience of the public, and in order to ascertain that value, the original cost of construction, the amount expended in permanent improvements, the amount and market value of its bonds and stock, the present as compared with the original cost of construction, the probable earning capacity of the property under particular rates prescribed by statute, and the sum required to meet the operating expenses, are all matters for consideration, and are to be given such weight as may be just and right in each case. We do not say that there may not be other matters to be regarded in estimating the value of the property. What the company is entitled to ask is a fair return upon a value of that which it employs for the public convenience. On the other hand what the public is entitled to demand is that no more be exacted from it for the use of a public highway than the services by it are reasonably worth".

There are a number of other decisions whose essence is approximately the same. The usual Utility Act provides this authority to the Commission. Section 72 of the Indiana Utility Act says, "The Commission shall determine and by order, fix just and reasonable rates when, after investigation, it finds the rates to be unjust and unreasonable", etc.

The regulatory bodies usually have the powers to

1. Grant certificates of convenience and necessity before

admitting a utility to a given field, or determine whether service may be discontinued.
2. Go into all phases of utility financing and either approve modify or reject the plan.
3. Establish rates, which involves valuation, depreciation allowance, etc.
4. Control service.
5. Establish uniform accounting systems.

In the United States all states except Deleware have a regulatory body of some kind, but all of them do not cover municipal utilities. This omission of municipal utility supervision is due generally to either one or both of the following reasons,

1. The cities desire to retain "home rule".
2. The utilities prefer to deal with the communities one at a time in which case they are usually not required to furnish annual reports nor are they usually intelligently investigated.

Of the forty-seven public service commissions that regulate forty-three restrict earnings, and twenty-three supervise security issues.

In this country the major part of our utilities are privately owned and regulation has been a logical development, while in Europe most utilities are either nationally or municipally owned. In England regulation is by "private bill legislation", each enterprise being by specific act of Parliament conferring a franchise and of laying down regulatory standards.

The regulatory bodies have certain limitations in rate-making as follows:

(a) They have the right under police power of the State and are delegated the legislative power and function to handle rate making, but it is subject to judicial review.
(b) they are not a management, nor do they have the power to substitute management nor plant in its study of rates,
(c) They cannot be arbitrary or capricious.
(d) They must follow rules of procedure, having full hearings in the usual court manner, but perhaps not quite as technical in its rulings on the admissibility of evidence
(e) They cannot make deductions in value of a property due to

the fact that rates are too high and the public has contributed excessively.

(f) They cannot prescribe confiscatory returns or inadequate returns.

It is evident from the above facts that Commissions are created to exercise a more intelligent and continuing supervision and regulation over utilities than can be exercised by any body primarily legislative with its varied problems and its intermittent meetings. Such regulatory bodies should strive to see to it that their,

(1) Regulation is effective because it is readily administrable, at low cost, providing prompt revision of rates according to changing conditions
(2) Regulation does safeguard the investment, providing thereby financial stability under changing conditions
(3) Regulation safeguards the public rights.

It can very properly be said that State Regulation has accomplished improvement in service, rendering capacity, reduction in rates and public investment support, and has introduced scientific rate making, eliminated wasteful utility competition, has developed the indeterminate permit in place of the long term franchise.

CHAPTER VII

VALUATION AND THE RATE BASE

PURPOSE OF VALUATION:

The valuation of public utilities may be made for a number of purposes of which the following are the principal ones:

1. Taxation
2. Reorganization, consolidation, and capitalization
3. Public purchase
4. Rate making.

There have been a number of methods used to determine the value of a property, among which are the following,

1. Value in use
2. Cost of reproduction
3. Market value

The different meanings of value have their application under certain circumstances, and for certain purposes.

Valuation in this treatise will be discussed primarily from the standpoint of rate making.

BASIS OF VALUATION:

The basis of valuation (for rate making purposes) of the physical elements of property of public service utilities is much better established now than it has been for some time. In the past there have been different schools of thought that debated as to whether the basis of valuation should be on the present cost of reproduction of the property or the original cost to date (sometimes called the historical cost).

This argument as to the basis of valuation no doubt began one of the early valuation cases, and one of the most famous, namely Smyth vs Ames, and in which it is said that the late William Jennings Bryan coined the phrase reproduction cost new less depreciation.

This decision, which included a definition of fair value, refers to all considerations to enter into a rate base determination and includes considerations other than those applying to the physical property only. The court in Smyth vs Ames said;

"And in order to ascertain that value (fair value), the original cost of construction, the amount and market value of its stocks and bonds, the present as compared with the original cost of construction, probable earning capacity of the property under particular rates prescribed by statute, and the sum required to meet operating expenses, are all matters for consideration, and are to be given such weight as may be just and right in each case. We do not say that there may not be other matters to be regarded in estimating the value of the property".

This broad approach is restated in the Minnesota Rate Case, 230 U. S. 352, 434, 57 Led 1511, 1556, 33 Sup. Court 729, 48 L. R. A. (N. S.) 1151, Ann. Cas. 1916 A, 18, the court said:

"The ascertainment of that value is not controlled by artificial rules. It is not a matter of formulas, but there must be a reasonable judgment, having its basis in a proper consideration of all relevant facts".

The reference to original cost of the property was argued for and against by the companies and the states at times of depression in prices of physical units, where accurate records were kept, the owner argued for original cost and when prices were high he argued for cost of reproduction new. It is found that very often there is no accurate record of the original cost of the property. Where there has been a sale of the property, the cost to the present owner may be far in excess or far below the value of the property if measured by the reproduction cost new less depreciation at current prices.

Again it has been found that due to improper bookkeeping original cost records do not always include all of the properties, or some of the property may have been acquired at no cost and yet have value.

It has been ruled that no matter how the property is acquired or its original cost, the value of the physical elements are to be considered at the time of the hearing upon the basis of their present cost. In the Indianapolis Water Case (decided November 22, 1926) 272 U. S. 400, 71 Led 316, 47 Sup. Ct. 144, the court said:

"*** It is true that, if the tendency or trend of prices is not definitely upward or downward, and it does appear probable that there will be a substantial change of prices, then the present value of lands plus the present cost of constructing the plant, less depreciation, if any, is a fair measure of the value of the physical elements of the property".

The owner of the utility is entitled to any increase in value of his property as indicated in Lincoln Gas and Electric Company vs Lincoln, 223 U. S. 349, 358, 56 L. ed 466, 470, 32 Sup. Ct. 271, in which the Court said:

"That the company is entitled to a fair return upon the value of the property at the time of the inquiry is the rule".

The public is not required to pay a return on property that may have cost too much, as outlined in San Diego Land and Town Company vs National City, Supra decided (1899), at page 757, the court said:

"The property may have cost more than it ought to have cost, and its outstanding bonds for money borrowed and which went into the plant may be in excess of the real value of the property".

Referring again to the Indianapolis Water Case, the court said:

"It is well established that values of utility property fluctuate, and that owners must bear the decline and are entitled to the increase".

The Supreme Court indicates in these decisions that the property to be considered is that used and useful at the time of the inquiry, and the value of the physical elements of the property is to be determined on present cost if there are no very good reasons for some other basis.

The method of valuing a substitute plant is not now seriously considered in valuation cases, because it is the property used which is under consideration. It is of course possible at times to secure functional depreciation because the property is overbuilt for the present or apparent future needs. In the Kenneke Water District vs City of Waterville case, Judge Savage says:

"We think the inquiry along the line of reproduction should, however, be limited to the replacing of the present system by one substantially like it. To enter upon a comparison of the merits of different systems - to compare this one with more modern systems - would be to open a wide door to speculative inquiry, and lead to discussions not germane to the subject. It is this system that is to be appraised, in its present condition and with its present efficiency".

This decision is very much to the point as regards a substitute plant or system and shows the difficulties of such a comparison.

PREPARATION OF SCHEDULE OF PROPERTY:

The preparation of the inventory for the valuation must be

thorough so that it will include all elements of physical property used and useful in rendering the service for the public. It should include a careful study of the local conditions so that the valuation may reflect the cost of reproduction at present prices of the property as actually built. In explanation of this the following case is an illustration. An engineer presented a valuation of a gas distribution system, and in the calculation of the unit prices per foot of pipe laid; he figured the depth of cover over the pipe as 24" or more, which was the practice of the company at the time of the hearing. The facts are that over half of the pipe had less than an 18" cover and probably seventy-five per cent less than 24" cover. Such an incorrect basic assumption resulted in an incorrect answer and in this particular case placed the valuation too high.

The proper scheduling of property includes its classification into groups of similar items, preferably following an established classification of accounts, prescribed by the regulating body in the state where the property is located. Complete field notes should be kept describing the unit of property, its location, condition and any other item that would have some bearing on its reproduction cost and on its present condition. All plans and records relating to the property should be checked to be sure to include all items of property, this check is particularly valuable in connection with underground or other inaccessible property. The interviewing of the men operating the property is usually valuable in straightening out charges in plant or actual conditions of inaccessible property for which there are no plans or which are not in accord with plans as checked by accessible property.

A field inspection should be made of all elements of the property, so that the appraiser is fully informed in regard to the property and familiar with the conditions under which it would be reproduced, and familiar with its present condition.

The valuation of the physical items of property used and useful and priced at present costs contemplates the reproduction of all of the property under the physical conditions existing at the time of its installation reproduced by the use of present construction methods and at current prices. This idea is brought out in the ruling relating to paving over mains, which paving has been built subsequent to the construction of the main at no cost to the utility, and as given in the case styled Des Moines Gas Co. vs City of Des Moines, 238 U. S. 153, (decided June 14, 1915) page 171-172 as follows:

"These pavements were already in place. It may be conceded that they would require removal at the time when it becomes necessary to reproduce the plant in this respect. The Master reached the conclusion that the life of the mains would not be enhanced by the necessity of removing the pavements, and that the Company had no right of property in the pavements thus dealt with, and that there was neither justice nor equity in requiring the people who had been at the expense of paving the streets to pay an additional sum for gas because the plant, when put in, would have to be at the expense of taking up and replacing the pavements in building the same. He held that such added value was wholly theoretical, when no benefit was derived therefrom. We find no error in this disposition of the question".

This refers to the inclusion of items that were not a part of the original conditions.

The same thought is a little more specifically covered in City of Ripon vs Ripon Light and Water Company, 5 W. R. C. R. 1, decided by the Wisconsin Railroad Commission (at page 10)

"Every legitimate expenditure in adapting the utility to the demands of progress and community growth is a proper charge to construction, and as such the investment therefor is entitled to participate in the distribution of the earnings from operation. Obviously expenditures for paving incurred by the utility in response to assessments levied therefor by the city, or the cost of cutting through such pavement for construction purposes and its replacement, are proper capital charges. It does not necessarily follow that the utility is to capitalize expenses for municipal betterment in which it has not participated and where such accruing benefits to the utility are remote and incidental, and thus compel the subscribers for utility service to pay increased rates because of public improvements. The improvement is not a proper element of value where the pavement has not been paid for by the utility, nor any expense in connection with it directly incurred, in determining a value which shall serve as the basis for an adjustment in rates. The item of "Paving" in the tentative valuation is for this reason excluded".

UNIT PRICES:

The unit prices developed to apply to the physical elements of property, should be carefully built up. An intelligent handling of this matter requires experience and knowledge of construction costs. To do this properly one must be thoroughly familiar with local condi-

tions relating to construction difficulties, cost of materials, freight rates, labor rates, local contract prices, and company experience if available.

In the development of the unit prices, all items of cost that can be directly applied to the unit should be, and such items include the cost of the material f. o. b. factory, freight, stores expense, public liability, performance bond, transportation, testing and inspection and installation, with a provision to cover omission and contingencies. The installation costs include cost of labor, compensation insurance and direct supervision together with the charges for tools and equipment.

These unit prices are figured either on the basis of the price at which the company could contract the work, or on the basis of the company building up its own organization and doing the work.

The unit prices are properly developed on the basis of the reproduction of the property as one operation; built in an economical manner and in proper sequence. This of course is based on the consideration of all elements that will effect the methods used and the order of the work.

The use of costs developed by piecemeal construction to the reproduction cost new valuation, is not consistent. This is the application rather of an original or historical cost figure experienced on a few parts of the property applied to all of it and not predicated on a program of building the property in one operation and consistent with a well planned job of this character.

It very often happens that the historical costs or book value

of a property, if available, do not support the figure arrived at by the use of the unit prices based on the so called piecemeal construction experience. This may be due to the fact that all proper charges to capital account may not have been turned in, that is, they were paid out of operating expenses, or the major part of the property has not cost as much as reflected by the piecemeal construction price.

Certain parts of a property are necessarily built by piecemeal methods; that is, they cannot be regarded as being straightforward, i. e., the laying of a water main or the construction of a transmission line, but the unit prices developed in the reproduction cost new valuation take these limitations into consideration and allow for them.

COMPARISON OF REPRODUCTION COST NEW AND MARKET VALUE:

A number have advocated the market value of a property as the basis on which the property should be allowed to earn rather than the cost of reproduction new which has been discussed in this chapter and which the Supreme Court of the United States indicates is the basis to use in valuing the physical elements of the property. The market value could become a part of a viscous cycle, for instance suppose when the property was built the city was small and of little promise, and to secure the money a high rate of interest had to be paid; subsequent conditions change and the utility in this particular city is growing, its business is well established and there is no hazard, the result would be an increase in the market value of the company's securities with no addition of physical property; the company was permitted a rate by the state regulatory body based on the property

used and useful and the company after its increase in market value returns to the commission and asks for a return equal to their former rate of return but based on the enhanced value. If such an increase in return were granted, this would no doubt result in further increase in market value, and so the viscous cycle would continue to go on.

The reverse of this situation, which might occur, to an isolated utility, would be as unfair to the owner as the example cited above is to the customer of the utility.

OVERHEADS:

In the building of a utility property there are certain expenses which are inseparable from the costs of construction and are often designated as structural overheads.

These structural overheads include a number of different items that are briefly described in the following paragraphs.

The cost of promotion is a proper charge for no idea can be an accomplished fact if it involves the construction of a utility until some expense is gone to in securing the market and in the formation of a corporate organization to bring the idea into being. The amount allowed for this should not be excessive. There is a big difference in legitimate expenses for this item between different utilities and between the same utilities of different size.

There is the cost of financing and securing the necessary capital with which to develop the enterprise, and which includes the brokerage expense incident to the issue of and sale of stocks and bonds. This item often results in argument for some hold financing to be very costly and others hold that a sound project should not cost over the normal brokerage fees of an established business, for the laws of the state

insure a fair return on the property used and useful. This charge should not be excessive, and in some cases it is not included in the valuation.

The decision in Minneapolis vs Rand Supra (285 Fed. 818) the United States Circuit Court of Appeals for the Eighth Circuit, says in substance what several decisions of the U. S. Supreme Court cases have also said, as follows,

"The cost of financing is assumed upon the theory that a company, desirous of establishing such a plant, should not be possessed of sufficient capital to pay for the plant and should be compelled to borrow money by floating securities through brokers and should be exposed to large discounts if compelled to obtain money in this way. The fair value of the plant should not be estimated upon such a basis of impecuniosity and exactions, but upon the theory if used, of reconstruction, by those financially able to build the plant, paying reasonable prices therefor".

This decision would indicate that the inclusion of cost of financing is dangerous and in fact unfounded. In other words the public is to pay all proper and unavoidable expenses, but this it not to include any fees paid to another to get into the enterprise.

The cost of organization, includes the items of securing franchises and the incorporation of the company after it has been decided to proceed with the project. It occurs sometimes that this expense and promotion charge is practically one and the same thing.

The cost of engineering includes the expenses of preliminary investigations and plans, construction plans and specifications, engineering supervision of construction, preparation of preliminary

and construction estimates, inspection of materials and miscellaneous work in the development of the property.

The cost of administration includes salaries of general officers, office clerks, accountants, agents and other supervision expense not included in engineering or legal expense; together with all administration expense of rent, supplies, traveling expense, etc.

The cost of legal expense includes all the expense of law officers of the company and litigation. This item may vary considerably. The cost of interest during construction is that amount paid on money borrowed or invested while the property is being built. Taxes and insurance are the costs of these items incurred during the construction period.

The item of omissions and contingencies are applied to the unit costs and are not included in these overheads.

These expenses are all more or less tangible costs. There are also intangible items of value, which constitute a part of the value of each utility, and unless eliminated from consideration should be included in each valuation of a utility.

These tangible costs or structural overheads are usually expressed as a per cent of the cost of the physical items of property and as a total to from ten to twenty-five per cent of the value of this property; with the average of other than very small plants close to fifteen per cent.

INTANGIBLE VALUES:

There have been a number of items that have been included in appraisals in the past as intangible values, a number of which have been denied by the Supreme Court as having no place in the valuation

of a public or municipal utility. The items that have been eliminated will be discussed first.

Goodwill is not considered as enhancing the value of a property, for as given in the case styled Willcox vs Consolidated Gas Company, 212 U. S. 19, 53 L. ed 382, 29 Sup. Ct. 192, 48 L. R. A. (N. S.) 1134, the court says it has a monopoly there is no other source for this service so goodwill means nothing and has no value, the case reads:

"We are also of the opinion that this is not a case for a valuation of good will. *** The complainant has a monopoly in fact, and the consumer must take gas from it or go without. He will resort to the old stand because he can not get gas anywhere else. The court below excluded that item and we concur in that action".

Franchise value and past losses of operation are excluded in fixing the Rate Base as explained by the court in the case styled Georgia Railway and Power Company vs Georgia Railroad 262 U. S. 625, 67 L. ed. 1144, 43 Sup. Ct. 680, the court said:

"Two objections to the valuation relate to the exclusion of items from the rate base, namely: The franchise to do business in Atlanta, said to be worth $1,000,000.00, and so called losses from operations during recent years, alleged to aggregate $1,000,000.00. These items were properly excluded. The franchise in question is not a monopoly. It is merely a perpetual permit, granted by the legislature of 1856, to maintain gas mains in the streets, alleys, and public places of Atlanta without the necessity of securing the consent of the municipality. That such franchises are to be excluded in fixing the rate base was settled by Cedar Rapids Gas Light Co. vs

Cedar Rapids, 223 U. S. 655, 669, 56 L. ed 594, 604, 32 Sup. Ct. 389; Des Moines Gas Co. vs Des Moines, 238 U. S. 153, 59 L. ed 1244, 35 Sup. Ct. 811, ***".

The other so called intangible item of value is going value or going concern value and is rather difficult to define, because there has been no definite method set up for its measure. Perhaps as good a definition as any is one describing going value as the difference in value between two identically similar plants, one complete and ready to do business, with no customers attached, and one with the business attached. This item of value should be included if the present general trend of decisions is followed. In the Des Moines Gas Case, the court said:

"That there is an element of value in an assembled and established plant, doing business and earning money, over one thus not advanced, is self evident. The element of value is a property right and should be considered in determining the value of the property, upon which the owner has a right to make a fair return when the same is privately owned although dedicated to the public use".

There is a cost or expense to secure business, which a utility entails before it becomes a really operating and going concern and it should be a part of the rate base or investment on which a return should be paid. Where there is no historical record of this cost or expense, the estimate of its cost very often includes the following,

1. Cost of training personnel, establishing forms of records and coordinating the operating organization into a smooth running concern.
2. Cost of attaching customers, which includes new business solicitors.
3. Cost of maintenance and depreciation of the idle plant.
4. Interest and taxes on idle plant.

There is considerable variation in this item, decisions allowing amounts that range from three to twenty per cent of the total cost of reproduction of the properties.

Working capital should be added to the valuation and usually is equal to the average receipts of the company over a period of forty-five to sixty days. Stores and supplies are also added either from actual inventory value or as an average figure for the year preceding the date of the hearing.

RATE BASE:

When the reproduction cost new and the reproduction cost new less depreciation have been determined the rate base has not yet been determined for there are many items that must be considered in arriving at the rate base or fair value. The items generally included in this consideration of the rate base were listed in Smyth vs Ames (1898) as having bearing and are:

1. Original cost of construction (not so popular at present)
2. Amount expended in permanent improvements.
3. Amount and market value of its bonds and stocks.
4. Present cost of construction
5. Earning capacity of property
6. Operating expenses
7. Other matters.

The rate base is the fair value of the property used in rendering the service to the public, determined as of the date of inquiry from evidence submitted to the body under whose jurisdiction the hearing is held.

The rate of return allowed on the rate base should be fair and there are a number of items which have to be considered in determining it of which the following are a part:

1. Rises and hazards in the business.
2. The rate of return of similar investments in the same section of the country.

3. The legal rate of interest.
4. The general financial conditions and attitude of financiers toward this type of investment
5. The financial history and connections of the utility.
6. The management and operating experience and practice of the company.

RATES:

The rates charged by different types of utilities are varied for there are different conditions of service among the utilities. Some types of utilities such as water and gas, can store and handle their product as the demand requires it, but electricity, telephone and transportation utilities have to serve upon demand. This latter form of utility is known as the performance type, and they are measured by the service they render at the time of peak demand. This type of utility requires more standby equipment in the plant than the storage type. Such companies were the originators of the demand charge.

Rates are generally classified as flat or meter; but there are few flat rates left in force, and these should be replaced as soon as possible in most utilities, except perhaps the telephone. Even in the telephone business there is classification of customers, who have to pay an amount commensurate with the service they require.

Meter rates are quite different in different utilities. Some companies have a service charge which is in addition to the meter rates, while some have a minimum charge which allows a certain amount of the product for the minimum charge. The purpose of all these plans is to make each customer pay a return on that part of the property which is allocated to his service.

Rates show decreased cost where larger amounts are used, because after the fixed charges are paid on the investment allocated to serve the user, the only expense to the utility is the production of the commodity. Improvements are constantly being made in rate structures

to properly adjust them so that every user pays for his service in accordance with his needs and use.

CHAPTER VIII

DEPRECIATION

INTRODUCTORY:

The subject of depreciation is one of the controversial points that comes up, as to the allowance for it from the rate base and as to proper provision for it by deduction from earnings. The difficulty in part, is due to the failure to make the meaning of the word clear. Some consider depreciation as the loss in value due to wear and tear and natural decay- the wasting of assets while others consider it to include as well the decrease in service value due to obsolescence, inadequacy, changes in art, and public requirements. The first part of the definition might be considered as that due to natural causes and the second as that due to failure to function. A committee of the American Society of Civil Engineers stated that depreciation was, "in effect a payment from the rate payer to the corporation of a part of its investment", Such a definition recognizes the diminution of value. Another definition is that depreciation "is the exhaustion of service life of the property in service", while still another is the "wasting of assets- the decrease in the service value due to obsolescence, inadequacy, changes in the art and public requirements."

Depreciation has been recognized for centuries and in a monograph by C. J. Tilden published by Drexel Institute Feb. 16, 1916, there is this extract purported to be from the writings of Vitruvius, a Roman architect of note, who lived before the time of Christ.

> "No wall made of rubble and finished with delicate beauty- no such walls can escape ruin as time goes on. Hence whence arbitrators are chosen to set a valuation on party walls, they do not value them at what they cost to build, but look up the

> written contract in each case and then, after deducting from the cost one-eightieth for each year that the wall has been standing decide the remainder is the sum to be paid. They thus, in effect, pronounce that such walls cannot last more than eighty years."

There is a group who hold that there is no need for the setting aside for depreciation from natural causes because in a properly maintained and operated utility the property is not consumed. This idea is well expressed in the following quotation from P. U. R. 1923 B page 28 Re: Alabama Power Company, "The modern school of thought is that if a public utility property is kept in such a state of efficiency and maintenance that the public is furnished an extraordinary efficient class of service, the matter of depreciation should not enter greatly into consideration by the rate-making body. We repeat that what the public is interested in is service and not the age or life of the properties which provide such service." Those who entertain this idea object to the word depreciation, but prefer the word retirement fund. No matter what the nomenclature used, there should be some fund provided to take care of the adjustment required in the losses included under the full definition of depreciation as stated in a previous paragraph and this allowance should be handled as suggested in the "Report of the Special Committee to Formulate Principles and Methods for the Valuation of Railroad Property and Other Public Utilities" of the American Society of Civil Engineers to wit:-

1. "The method should be one which will insure, with as much certainty as possible, payments to the corporation sufficient to amortize the various items of property when they cease to have value.

2. "It should so adjust the annual depreciation allowance at to distribute the burden as equally as practicable among the rate-payers of different years."

METHODS OF DETERMINING DEPRECIATION:

In an effort to determine the sustained depreciation of a particular property or unit of property there have been two fundamental methods developed, one based upon the observation of the condition of the units by one well qualified to pass judgment, and the other predicated on the estimated remainder of life or the service life expectancy method.

Those advocating the observation method have won their point at least in the case in question for in the Indianapolis Water Case 272 U. S. 400, 71 L. ed. 316, 47 Sup. Ct. 144 (decided November 22, 1926) there is the following:

> "The testimony of competent valuation engineers who examined the property and made estimates in respect of its condition is to be preferred to mere calculations based on averages and assumed probabilities."

The testimony of engineers as to the amount that should be provided annually for retirements or to take care of depreciation, will be predicated ordinarily upon the remaining life of the property or perhaps upon company experience, which will be based on service life. Any of the methods therefore in one way or the other considers probable service life.

The observed depreciation is no doubt helpful, but the condition of the property may be due to excellent maintenance, paid for by the rate payer in operating expenses, or the result of intelligent management or the contrary may be true; the property may be run down due to the diversion of proper maintenance funds, or due to poor management.

The question arises in the mind of the impartial mind whether the good management should not be entitled to its showing, and whether the rate-payer should be expected to recompense poor management and neglect, and whether in the final analysis the measurement shall not be an average of service life of the type of equipment, tempered with local conditions which might make this use of average life improper or unfair.

In the case of waterworks and gas systems we have a large part of the investment buried as distribution mains and any so-called observation must be of a small percentage of the whole system. The method usually pursued in this observation is to pick out the location for a large number of test holes over the system, excavate down to and observe the condition of the pipe and apply a condition factor to the pipe. In a description of the condition percent to apply the difficulty is encountered as to determination and the condition marked "good" is found to apply to property varying from 60% to 90% of new and well it might, for a single badly corroded spot might be more serious if deep, than would be the surface corrosion over the entire surface of the pipe, if such corrosion was not deep. That such an examination cannot be at all complete is evident, and it seems to be the better judgment to use service life tables which are considered averages. If the soil in the vicinity is peculiarly active as relates to corrosion it will be necessary to provide for it in the depreciation allowances.

Corrosion, which has been the cause of the destruction of underground pipe lines, has now, by general agreement, been accepted as an electrolytic phenomenon. This corrosion has been defined as

of two types; electrolytic corrosion, due to current originating in electrical machinery, and soil corrosion, which is independent of currents originating in electrical machinery. Electrolytic corrosion is dependent on quantity of electricity transferred. Steel pipe, particularly, is coated with paints, enamels, etc., to keep moisture away from the surface of the pipe thereby removing the possibility of soil corrosion.

The question then arises as to whether the ratepayer who pays on a larger initial investment to provide the protective coatings, should not pay a lesser amount for a depreciation or replacement reserve, for the service life is lengthened. The same thought applies to the result in the lengthening of service life due to butt treatment of poles used in telephone and electric light and power distribution systems.

LEGAL DECISIONS:

In any discussion of depreciation one cannot proceed far until he has considered decisions given by the courts on the subject. In the development of all knowledge it seems that there occur times when someone states a situation in a way that appeals as logical and then the minds of many men begin to further clarify the problem. One of the earliest opinions which began to give, the then nebulous, thought of depreciation form was the dissenting opinion of Chief Justice Beatty in the San Diego Water Company vs. San Diego 118 Cal. 588 Oct. 1897 which was as follows,

> "Rates ought to be adjusted to the value of the service rendered, and this means that the water companies should be allowed to collect annually a gross income sufficient to pay current expenses, maintain the necessary plant in a state of efficiency, and declare a dividend to stockholders equal to at least the lowest current rates of interest, not on the par

or market value of the stock, but on the actual value of the property necessarily used in providing and distributing the water to consumers."....

"As to current expenses, all operating expenses reasonably and properly incurred should be allowed, taxes should be allowed, and the cost of current repairs.

"In addition to this if there is any part of the plant, such as main pipe, etc., which at the end of a term of years- twenty years for instance, will be so decayed and worn out as as to require restoration- an annual allowance should be made for a sinking fund sufficient to replace such part of the plant when it is worn out."

(Underlining by author)

This decision recognized the theory of the wearing out of property within a given period, a wearing out not taken care of by maintenance. A much more thorough discussion of the matter of depreciation was given in the famous Knoxville case styled City of Knoxville vs. Knoxville Water Company, 212 U. S. 1 Decided Jan. 4, 1909 by Justice Moody, extracted as follows,

"The cost of reproduction is one way of ascertaining the present value of a plant like that of a water company, but that test would lead to obviously incorrect results, if the cost of production is not diminished by the depreciation which has come from age and use. The company contends that the master, in fixing upon the valuation of the tangible property, did make an allowance for depreciation, but we are unable to agree to this. The master nowhere says that he made allowance for depreciation and the language of his report is not consistent with such a reduction. The figures which he adopts are those of a 'fair contractor's price.' The basis of his calculation was the testimony of an opinion witness called by the company. The witness submitted a table, which avowedly showed the cost of reproduction, without allowance for depreciation. The values testified to by him were adopted by the master in a great majority of cases. The witness's valuation of the tangible property was somewhat reduced by the master, but the reductions were not based on the theory of depreciation, but upon a difference of opinion as to the reproduction cost.

"The cost of reproduction is not always a fair measure of the present value of a plant which has been in use for many years. The items composing the plant depreciate in value from year to year in a varying degree. Some pieces of property, like real estate for instance, depreciate not at all, and sometimes, on the other hand, appreciate in value. But the reservoirs,

the mains, the service pipes, structures upon real estate, standpipes, pumps, boilers, meters, tools and appliances of every kind begin to depreciate with more or less rapidity from the moment of their first use. It is not easy to fix at any given time the amount of depreciation of a plant whose component parts are of different ages with different expectation of life. But it is clear that some substantial allowance for depreciation ought to have been made in this case. The officers of the company, alio intuituo, estimated what they called 'incomplete depreciation' of this plant (which we understand to be the depreciation of the surviving parts of it still in use) at $77,000, which is 14 per cent of the master's appraisement of the tangible property.

"A witness called by the city placed the reproduction value of the tangible property at $363,000, and estimated the allowance that should be made for depreciation et $118,000, or 32 per cent. In the view we take of the case it is not n necessary that we should undertake the difficult task of determining exactly how much the master's valuation of the tangible property ought to have been diminished by the depreciation which that property has undergone. It is enough to say that there should have been a considerable diminution, sufficient at least to raise the net income found by the court above 6 per cent upon the whole valuation thus diminished.".....

"The company's original case was based upon an elaborate analysis of the cost of construction. To arrive at the present value of the plant large deductions were made on account of the depreciation. This depreciation was divided into complete depreciation and incomplete depreciation. The complete depreciation represented that part of the original plant which, through destruction or obsolescence had actually perished as useful property. The incomplete depreciation represented the impairment in value of the parts of the plant which remained in existence and were continued in use. It was urgently contended that in fixing upon the value of the plant upon which the company was entitled to earn a reasonable return the amounts of complete and incomplete depreciation should be added to the present value of the surviving parts. The court refused to approve this method and, we think, properly refused. A water plant, with all its additions, begins to depreciate in value from the moment of its use. Before coming to the question of profit at all the company is entitled to earn a sufficient sum annually to provide not only for current repairs but for making good the depreciation and replacing the parts of the property when they come to the end of their life. The company is not bound to see its property gradually waste, without making provision out of earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired, so that at the end of any given term of years

> the original investment remains as it was at the beginning. It is not only the right of the company to make such a provision, but it is its duty to its bond and stock holders, and, in the case of a public service corporation at least, its plain duty to the public. If a different course were pursued the only method of providing for replacement of property which had ceased to be useful would be the investment of new capital and the issue of new bonds or stocks. This course would lead to a constantly increasing variance between present value and bond and stock capitalization- a tendency which would inevitably lead to disaster either to the stockholders or to the public, or both. If, however, a company fails to perform this plain duty and to exact sufficient returns to keep the investment unimpaired, whether this is the result of unwarranted dividends upon over-issues of securities, or of ommission to exact proper prices for the output, the fault is its own. When, therefore, a public regulation of its prices comes under question the true value of the property then employed for the purpose of earning a return cannot be enhanced by a consideration of the errors in management which have been committed in the past."

In this decision it seems to be clear that depreciation is recognized as only loss in value, and that it is the loss in value of the property then used by the company, and in the allowance to be made for it, no obsolete property is to be included.

A recent decision by the United States Supreme Court on the subject of depreciation is of value because it is clearer than many have been and states plainly the law. The extract following is a part of the decree of the U. S. Supreme Court in a case styled United Railways and Electric Company of Baltimore v. West decided Jan. 6, 1930,

> "The allowance for depreciation made by the Commission was based upon cost. The court of appeals held that this was erroneous and that it should have been based upon present value. The courts view of the matter was plainly right. One of the items of expense to be ascertained and deducted is the amount necessary to restore property worn out or impaired, so as continuously to maintain it as nearly as practicable at the same level of efficiency for the public service. The amount set aside periodically for this purpose is the so-called depreciation allowance. Manifestly, this allowance cannot be limited by the original cost,

because, if values have advanced, the allowance is not sufficient to maintain the level of efficiency. The utility is entitled to see that from earnings, the value of the property invested is kept unimpaired, so that at the end of any given term of years the original investment remains as it was at the beginning.'

"This naturally calls for expenditures equal to the cost of the worn out equipment at the time of replacement; and this, for all practical purposes, means present value. It is settled rule of this court that the rate base is present value, and it would be wholly illogical to adopt a different rule for depreciation. As the supreme court of Michigan, in Michigan Pub. Utilities Commission v. Michigan State Telegraph Company (1924) 228 Mich 568, has aptly said: 'If the rate base is present fair value, then the depreciation base as to depreciable property is the same thing. There is no principle to sustain a holding that a utility may earn on the present fair value of its property devoted to public service, but that it must accept, and the public must pay, depreciation on book cost or investment cost regardless of present value. We repeat, the purpose of permitting a depreciation charge is to compensate the utility for property consumed in service, and the duty of the Commission, guided by experience in rate making, is to spread the charge fairly over the years of the life of property'."

The United States Supreme Court has said that physical property in the utility service, aside from land, deteriorates from the date of its installation and placing in service; that this depreciation is a factor to be considered when one determines fair value; that the charge for depreciation is an operating expense, and should be figured on the basis of present fair value.

AMERICAN TELEPHONE AND TELEGRAPH PRACTICE:

The practice of the American Telephone and Telegraph Company, a company that has an immense depreciation reserve, stated in their annual report in 1911:

"Reserves are a provision for deterioration and obsolesence of plant beyond that which can be covered by current maintenance and current replacements.--- Any practice which does not, at the cost of revenue, pass the property on from the present to the future in at least as good a condition as received from the past, is a mistaken practice;

> it is using capital for the benefit of the present at the expense of the future."

and its annual report for 1914,

> "The policy of the Bell System with respect to depreciation and depreciation reserve has continued on lines that are recognized as sound and reasonable both by investors and by the telephone-using public.
>
> "That policy, briefly stated, is this: Each Bell Company makes charges to its operating expenses for the purpose of creating and maintaining proper and adequate depreciation reserves, and these reserves are used to meet the expense of depreciation.
>
> "The Interstate Commerce Commission defines expense of depreciation as follows:
>
> "(a) The losses suffered through the current lessening in value of tangible property from wear and tear (not covered by current repairs).
> "(b) Obsolescence or inadequacy resulting from age, physical change, or supersession by reason of new inventions and discoveries, changes in popular demand, or public requirements, and
> "(c) Losses suffered through destruction of property by extraordinary casualities."

SERVICE LIFE:

Those who advocate no depreciation allowance, but who advocate a reserve for retirements to equalize the cost of retirements during the years; very often set forth the theory that a utility is of perpetual life and that the property never actually wears out. This is no doubt true as a composite whole. But this retirement fund would no doubt assume large importance in the case of a gas distribution system before substantial amounts were withdrawn for the replacement of retired property, while in the case of an electric light distribution system the replacements occur sooner and the accumulations do not become so large a percentage of the total value of the property.

Structures pointed out as substantiating such a statement,

Main stone sewer, Rome		Built 600 B.C.
Aqueduct, at Tunis, built by Hadrian		120 A.D.
" , at Nimes, probably built by Agrissa in A.D.		18
Westminster Abbey, London, Oldstone portion	built	in 13th Century
Hatfield House, England (Marquis of Salisbury)	Stone "	1611
Saint Lawrence Church (Nuremburg) stone	"	1477
Cast Iron Pipe in Fountains at Versailles	Installed	1658
Howland House, Plymouth, Mass. (Frame)	built	1660
South Church, Boston, (Brick)	"	1750
Washington's home, Mt. Vernon, (Frame)	"	1784
Church, Alexandria, Va. (Brick)	"	1784
Aqueduct Bridge at Segovia, Spain Christian era	"	early in Christian Era
Aqueduct to Spolets in Central Italy	"	7th Century
Aqueduct, at Athens, built by Hadrian		104 A. D.

Those who argue against a depreciation, predicated on the service life for a piece of equipment, hold that a large part of the replacements are because of functional causes rather than because of the natural causes of wear and tear. L. R. Nash states such replacements were found on a number of railway properties to be 75% functional. A study of the charges to depreciation of a natural gas distribution system, by the author, indicated a large number of the replacements were due to the placing of larger pipe in the same location where small pipe had formerly served.

L. R. Nash in an objection to basing depreciation on useful or service life says,

(1) Actual experience of useful life of property elements in the past are not dependable as to the future, in view of rapid changes in the art.
(2) Useful life and salvage value are so indefinite that detailed calculations of depreciation are not justified.
(3) Straight line appropriations will amass a reserve not needed.
(4) Flexible provisions for reserve accounts should be permitted but there should be safeguards on these provisions that they do not exceed the needs or reasonable anticipated needs of the company.

DEPRECIATION ACCOUNTING:

The accounting methods used in the handling of depreciation reserves take different forms. There is the straight-line method

and the sinking fund method. The straight-line method requires larger annual contributions. There are objections raised to the straight-line method in connection with long lived property because from the taxpayer's standpoint it is his money left with the owner to pay for the owner's property when he, the user has by use worn it out, and that since it is his money it should not be considered as inactive, when it is well known no management would let it lie entirely inactive and not earning. It is immaterial what is done with it, it may be used in extensions and the public will pay a fair return on the property purchased with it; but as a depreciation reserve on long lived property the sinking fund idea does not seem at all unfair.

There are some properties so large, and made up of so many type of units, of such a diversity in service life, that the annual expense for replacements is practically uniform and in such a case there would be little reason for a large amount per year to be set aside for a reserve. This is more likely true of a railroad roadbed and its rolling stock than any other one type of utility. This is due to the number of the various units and the varied dates of expiration of service life, so that the annual requirements are practically uniform.

CONCLUSION:

The engineer arrives at an "impasse" after reading the many ideas, and finally it seems he will have to choose some course as a general program of procedure modified by the findings he may make which relate to a particular property. The program for procedure will include some or all of the following suggestions:

(1) The simplest method, to recommend to the owner of a utility, is to set up a replacement reserve or depreciation reserve, by a charge to operating expenses, based on the service or age life method, collected either by the straight line or sinking fund method. The service or age life to be the weighted composite for the depreciable units of property, and applied only thereto.

(2) The charges for depreciation be based upon the present reproduction cost of the depreciable items of the property.

(3) The actual accrued depreciation be measured by intelligent inspection, tempered by a knowledge of its service conditions, but certain items such as underground lines can be calculated on service life expectancy for they are not materially affected by maintenance and any reasonable inspection can only cover a small part of the property. The use of service life expectancy tables has to be carefully handled.

(4) Depreciation charges should be computed against that portion of the overheads effected by the wearing out of depreciable property.

CHAPTER IX

FINANCING

GENERAL:

The financing of public utilities; particularly within the last ten years, has been a large undertaking. The realization of this comes more fully when one considers the fact, that the utility investment in this country amounts to over $100.00 per capita; and is equal in total to more than the recorded national wealth of the United States in 1860.

The need of capital has been constant because of the continued and rapid growth of the utilities.

The utilities have established their credit, better or equal to any other form of investment, except that of the larger governmental units. This condition is the outgrowth of a number of causes, one of principal of which is; that the issuance of the securities are subject to governmental supervision. It is customary now for the investment circular of a utility to show;

1. The information about the valuation of the utility property and the basis of the valuation.
2. A balance sheet of the utility company that is issuing the securities or a clear statement of the capitalization.
3. A statement of earnings, including operating rates, depreciation allowance practice, relation of net earnings to charges for service and a statement of the company's dividend record.

The utility credit has been so well established that ratio of bonds issued on the value of the property is a great deal higher than in any other line of investment. Bonds issued on industrials usually amount to twenty percent of their value, and on utilities to from 50 to 75 per cent. Very often utilities are financed on 50 to 60 percent in bonds; 15 to 20 per cent in preferred stock and 20 to 25 percent of common stock.

HOLDING COMPANIES:

In recent years there have been many holding companies formed that handle more particularly the financing of utilities, and also act as operating directors. The value of such holding companies is stated by their advocates to be very helpful, for in financing they,

(a) Standardize securities
(b) Average investment risks, and
(c) bring out larger issues reaching larger and more stable markets, and from the operating standpoint they

(a) Use joint purchasing
(b) Couple up plants to avoid excess investment in production equipment and to insure adequate service
(c) Secure the service of experts in the following several lines.

(1) Corporate officers	(7) Insurance Department
(2) Legal staff	(8) Valuation "
(3) Purchasing staff	(9) Statistical "
(4) Auditing Department	(10) Commercial "
(5) Security Bond "	(11) Engineering "
(6) Tax and Income report Dept.	

The holding companies have with their securities just about replaced the closed mortgage which cut down expansion, and they obtain money for extensions and betterments, and for the acquisition of property. The believer in the holding company says that twenty years ago the electric industry was provincial, limited in credit more than in vision, saddled with inadequate equipment, becoming rapidly obsolescent, and lacking in courage to convert the nation to the electrical concept, but today it has been able to reduce rates, give better service, conserve coal, and help decentralize population and industry and stabilize the transportation and mining industry.

FINANCIAL SECURITY:

An element that has contributed to the stability of securities issued by utilities is the fact that the utilities are little effected by hard times. This condition of stability has been aggravated some-

what by the more general use of electric power in the industries, but as regards domestic service it is true. The records show that for the period from 1882 to 1911 the following percent of the total securities of the respective types of investment were in the hands of receivers,

Gas and electric light properties	0.37 of one percent
National banks	0.32 " " "
Railroads	1.67 " " "
Industrials	2.07 " " "

In this same period no electric light or power company was in receivership when 1/10 of the railroad mileage of the United States was in receivership.

FORMS OF SECURITIES:

The forms of securities, which consist of bonds, coupon notes, and stock have already been mentioned. There are different forms of bonds which include first mortgage, consolidated, general and refunding. Recent bonds are usually of the type known as the open end mortgages, in which the number issued shall not exceed in value a certain percent of the capital requirements; these bonds do not necessarily have a definite date for payment. Bonds usually are protected by provisions that there shall be certain amounts allowed for depreciation and retirements and at times a sinking fund to increase the bondholders security. Bonds at one time were issued almost universally in $500 and $1,000 denominations, but to increase the number of investors "baby bonds" in denominations of $100 are now issued. Stock is also issued in small denominations.

There are issued at times, short term coupon notes, with the general credit of the company back of the notes. Stock is usually issued as preferred or common. The preferred stock has a priority in dividends and this is usually cumulative, and has equal voting power

common stock except as relates to its own retirement. Very often preferred stock is exchangeable for common. Common stock is usually issued in larger amounts than preferred and controls the policy of the company. It has the power to call bonds and retire preferred stock, thereby owning the company. It has usually been required that stocks and bonds be sold at par, and to avoid this there has been developed the stock of no par value; this overcomes the legal requirement and results in a market price of the actual value of the stock. The form of no par value stock was recommended by the Railroad Securities Commission to Congress in 1911, and was authorized in 1912 in New York State. Such form of common stock is now authorized in three quarters of the states and preferred stock of the same form in one-half of the states.

There are a number of factors which affect the class of securities to be issued. Some of the more important items are the amount of outstanding debt, money rates, current profitableness, terms of the franchise, and the maturity of the enterprise.

There are times when bonds should be issued and other times when stock is the more favorable form of financing.

Bonds are issued when the existing issue is not over 60 per cent of the total capital, money rates are normal, business is not particularly profitable and general long range of prices are up.

Preferred stock is issued when business is stable, money rates are low, the company is prosperous, and the general trend of prices is downward.

ACCOUNTING METHODS:

Standardization in accounting methods, so that reports are comparable

has materially effected the financing of utilities. The first attempt to standardize utility accounting was in Massachusetts in 1876; in 1900 one large holding company installed a uniform system of accounts; in 1907 the uniform system of accounts was prescribed in Wisconsin; and in 1922 a uniform form of accounts was adopted by the American Gas Association, the National Electric Light Association and the National Association of Railways and Utilities. Such accounting must reflect current and cumulative data.

In a commercial investment analysis it is customary to inquire into whether the bonds exceed 75 per cent of the value, whether the property is being kept at full value either by proper maintenance or depreciation charges; and whether the total bonds and preferred stock do not exceed, by more than a nominal amount the reproduction value. There is also a study of the ratio of gross earnings to bonded debt. This latter ratio varies as to type of utilities with an average of about five to one for all types of service. Hydro electric properties with large consumers may have a debt equal to 6 or 7 times the gross earnings, the more conservative companies show about 3 to 1.

SALES OF SECURITIES:

When utilities were first started there was some difficulty in financing them, but as they grew and showed satisfactory earnings, financing became easier. The growth of these utilities was so rapid however that it took high sums to keep pace, and more sources of capital had to be tapped.

The sale of securities of a utility to the customer has become quite the practice in recent years, and the writer feels this practice was actuated for two particular reasons, one was to get the money with-

out having to go to the large centers for disposal of stocks and bonds and to tap new sources of supply and the second was to improve public relations, that is make the customer feel he had an interest in the business. This latter idea assumes that each customer owner will be a friend of the company. This plan of customer ownership is not a new one but was suggested by one of the early English economists. It has grown to the extent that one large utility company in Kansas has over two thousand salesmen licensed.

The amount of securities that have been sold and the basis of their sale, indicates that the financing of public utilities in in a very healthy condition at the present time.

CHAPTER X

OBSERVATIONS

OTHER UTILITIES:

There are a number of municipal utilities which have not been mentioned in this thesis; utilities which could have been included under this subject. The reason for this omission is that the subject is such a big one that it was found necessary to limit this thesis to a discussion of those utilities that have a direct charge for service rendered, and that are subject to regulation. The sewers and highways treated herein, will immediately come to mind as not falling in this class, but sewers are gradually being brought into the class, and the gasoline tax has indirectly resulted in making a charge for use of highways at least for motor traffic.

It is true that practically every municipal activity is a utility designed for the service of the people of the community and worthy of careful and efficiency operation, in order that it may measure up to the general standard of utility service; namely, the maximum of service at the minimum of cost.

The municipal services not included in this treatise include playgrounds, street cleaning, parks, policing, etc, but they do not fall in the same classification as those discussed, for such services have many indirect benefits that can best be paid for by the city as a whole. The measure of these services is social rather than individual.

TRENDS OF THOUGHT:

In the development of the utilities serving municipalities there have arisen many problems, which have as yet not been straightened out

and which may continue to be subjects of controversy and debate for years to come. Many of these problems arise out of the honest difference of opinion, which may later be straightened out, some are due to the newness of the arts, and some revert to the fundamental idea of the rights of property. As the utilities become more important the differences are being pushed to the fore and are becoming a part of political discussions. This however, is politics of the higher order for it involves theories of goverment and public welfare and economic consideration.

There are two district schools of thought on this subject and there is even a third holding a middle ground which enters into the situation. There are those who feel that the public utility enterprises and activities should be free from public authority and be allowed to develop freely and there are those who feel that the public utility development is challenging the exercise of a function which is reserved by the National Government; that of protecting the people from political or economic oppression. This latter school feels that any great monopoly controlling an essential commodity fails to act in the public interest; that it is too great to be in any but governmental hands; because such power can be protected in the courts beyond the reach of political consideration. This school also feels that since a great many utilities derive their mechanical power from national or natural resources they should not be subjects of private, but rather of public control.

Some of the men who are members of the first school feel that property and wealth is attributable ninety-five percent to brains and five percent to nature, and should be made the exclusive function

of the individual. Men of this type fail to recognize that a large part of this so called brain power is the use merely of common knowledge and in the case of utilities exercised freely only because of a grant given to them by the State, which in fact is from the people served. This type of men very often feel that all taxation is confiscation. The members of this school of thought are sincere and their reasoning appears to be well expressed by Marshall in the "Principles of Economics", as follows,

"The tendency of careful economic study is to base the rights of private property not on any abstract principle, but on the observation that in the past they have been inseperable from solid progress, and that, therefor it is the part of responsible men to proceed cautiously and tentatively in abrogating or modifying even such rights as may seem to be inappropriate to the ideal conditions of social life".

The members of the second school feel that all men are not actuated by personal gain, but even if they were they should contribute their ability to movements for the common good; they find that public service puts no damper on personal incentive , and if such a condition did occur they feel it would be due to an unhealthy condition of society and should be corrected.

There is still a third school that occupies a middle ground; their opinions are well expressed in this extract from an address by President Hoover, then Secretary of Commerce, on September 29, 1924, in which he said,

"I am convinced, not only from the experience of our own country, but from the attempts made abroad, that government operation is a step backward in every one of these propositions. It is the negation of progress. America has found the true road of advancement in these enterprises through sustained initiative and equality of opportunity to our people, with public control to prevent abuse. Our salvation consists in following this line with increasing intelligence and devotion".

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"There is scarcely a single utility today that is not under public control through some governmental commission, local or national.

These commissions today fix the rates, the issues of stock, the time tables, the car service, the profits. Our great national water powers are reserved to the government through fifty-year leases, under public control. And our commissions are not alone preventing abuse; they are maintaining initiative, enterprise, and progress in our railway and other utilities, as witness their enormous growth and constantly improving efficiency and service.

"Regulation has, through stabilizing rates, reduced the cost of capital by increasing the security for the savings of our people. From the security, and within our generations there has come a new tide, and that is toward popular ownership as distinguished from government ownership. These enterprises are no longer owned or controlled by a few. One of our great service corporations has nearly 400,000 stockholders, another over 200,000. The power companies have over 700,000; their bonds are directly or indirectly, through our mutual insurance companies and savings banks, in the hands of literally millions of owners. A silent revolution is transferring ownership to the public.

"Moreover, the new generation of administrators of these enterprises has firmly grasped its responsibility to the public. Indeed, there are deep and promising currents originating in our economic life driving toward a mutualization of public and private interests, employer and employee interest, with promise of a new period in industrial development. There has been a genuine growth of business conscience and service, and this growth is far more precious than any amount of legislation. Of those occasional individuals who fail to manifest this sense of public responsibility I could speak with bitterness, for they are the real stimulators of socialism. Such men give the cause for the despair that government ownership is the only relief from their actions. But we do not put the whole people in jail because of occasional murders".

It is a few strong men of the first school lacking tact and broad human vision that cause the activity of those who believe the ideas of the second school. The abuse of power by members of the first school, and the lack of equity in the statements and acts of the members of the second school result in final action according to the idea of the third school, except for occasional instances.

This expression of opinion is not intended as an argument against municipal ownership, because there is no question but that such ownership has been very successful in many, many instances and there would be many millions fewer people enjoying the comforts of service by these utilities today, if there had been no municipal ownership.

The placing of these services in the smaller cities is largely the result of municipal ownership, which proved that such services could be sold in small communities and be made to pay. Much of the pioneering was done by the cities themselves. Since the pioneering days large companies, particularly in the electrical field have come in, purchased many of these smaller plants merged them into large operating companies and effected added economies and improved service. The laws governing municipalities would not permit this merging of interests of cities with each other to effect these economies.

There have been a great many people, who have felt that these wonderful developments in utility services were ruining our people, and upsetting our great basic institution, the home; because it resulted in too much idleness and individuals have not developed to the stage where they can make wise use of leisure time. There have been further arguments that it has resulted in the increase of a mercenary attitude on the part of our people, who direct the great enterprises. An answer to this last charge against the American business man is contained in an article in the Saturday Evening Post, November 16, 1929, entitled "Freedom of the Air", and written by Owen D. Young, his comment is as follows,

"The physical sciences and the vast powers they release are developing fast; but no faster, I hope, than the moral fiber of the individual and his capacity to deal with them. In the last analysis, all crises must be met by men of character. Of course it is the fashion to call this machine age of ours an age of materialism. The American business man, they say, is just a money grubber. Well, I have known many of them, and I say I don't believe it. Every age has its materialists, and so has ours. By and large, however, I think the American business man cares less for money than the business man of any other country. He works less for luxury than for power. His aim is primarily achievement. He will give away his money to universities and hospitals, but the power to embark on great enterprises he will not give away. And so I say to his critics, if this be materialism make the most of it."

The charge, that the utility services are ruining the home, cannot be answered with finality for only time will tell, but it can not be accepted as a fact today. An appraisal of utility service indicates it has raised the standards of living, improved the conveniences for all members of the family, and contributed to the health and welfare of society as a whole.

The statement which has sometimes been made that the housewife has been relieved of so much of the drudgery of the home, that she has too much time on her hands, and as a consequence is not willing to keep up the institution of the home, but instead has ventured into the field of business, is not entirely true. In the first place while it is true that modern conveniences have lightened the load in homes of greater affluence, in such cases it has given the women time to go into civic and cultural fields, thus bringing back into the home a mother better fitted to help her children find their rightful place in the world. Miss Campbell of the homemaking department of the University of Missouri says, "Homemaking is assuming the dimensions of a profession.

> The type of homemaking which means only cooking, cleaning, etc. will never teach our boys and girls to meet their life problems".

Any means which the future can devise to extend these luxuries to the poorer classes, giving these housewives an opportunity to help in civic projects, and broadening their vision of life, should redound to the glory of the home rather than to detract from it as some critics of labor saving devices believe.

BUSINESS CONDITIONS:

In cases where the management carefully invests its funds and operates economically, the utilities create one of the soundest forms of investment, for then there will be a fair return for the owners. The fact that the market price of stock of municipal utilities dropped

last fall in the market crash, is not a reflection of adverse business conditions in this industry, but rather an evidence of market inflation.

Utilities furnishing municipal service secure the larger amount of their capital from sales of stock and the following extract entitled "Auditing the New Era" by Glenn Frank, President of Wisconsin University, is instructive as to Business Conditions and would indicate that the utilities need have no serious concern as to the market for its securities when issued upon a sound financial basis.

> "Before the stock market crash of last autumn, we heard much of the "new era" into which business had moved.
>
> The man in the street never had a very clear idea of what was meant by this "new era" and today he has a general impression that this "new era" came to an end with the market crash.
>
> J. George Frederick has written a very sensible book on Common Stocks and the Average Man, which might very well have been called Auditing the New Era, for in it he pulls together more clearly than I have seen elsewhere the principles that underlay the "new era" and seeks to see which of the principles have stood the test and which have failed. Of the ten principles that went into the philosophy of the "new era" he thinks six have stood the test and four have failed, viz:
>
> The following six standards of the "new era" have proved sound:
>
> 1. The high wage and low price principle, making the increase of the average man's purchasing power a basic industrial policy.
> 2. The awakening of the average man to a fundamental interest in investment-speculation and his widespread ownership of common stocks.
> 3. The federal reserve machinery as a check on speculation, fluctuation and credit inflation.
> 4. The greater stability and smaller investment risk of the sound corporation through modernized management and research.
> 5. The principle that bonds are also partly speculative and in many respects inferior to common stocks as investments, for the average man, if invested in exclusively.
> 6. The principle that investment and speculation are not two different things is essence, but the same process at heart.
>
> The following four standards of the "new era" have been proved unsound:
>
> 1. That a ratio of twenty or more times earnings is not almost always an inflated valuation for most stocks.
> 2. That the market does not act according to a law of up and down swings, and that cycles of inflation and deflation are a delusion and no longer can occur.
> 3. That fiduciary institutions should carry most of their investments in common stocks.

4. That high pressure selling and promotion in finance is sound, and, in particular, that investment trusts cannot be oversold.

Here, in ten sentences, is more about the business situation than can be found in many ponderous volumes."

The six standards that have proved sound are those most helpful to the utility because such standards add to the market for utility service, add to the source of capital, strengthens regulated securities and return, and are a commendation of the method of operation used by utilities.

The business reports certainly indicate no decline in the standing of public utilities in the money market, in fact a great number of the new projects announced for this year are extensions of utility service particularly in the natural gas field.

The popularity of municipal utility investment immediately creates in the mind of the men who fight private utility on general principles the idea that there is something wrong and that the companies must be making too much money. Some of the causes of this popular wave towards utilities is the uniformity of return year in and year out; the opportunity for growth and the safety of the investment due to the regulation. This is not intended as a brief for private ownership, for well operated municipal plants do equally as well when operated by the same aaliber of men. Municipal plants however do not go out into the market and sell stock and consequently are not subjected to market fluctuations, nor are their operations reviewed and checked up by business. The showing of municipal plants as sound business concerns are not given wide publicity and their securities guarantee a specific return with no possibility of greater earnings to the holder.

UTILITY OPERATION:

The successful utility operator and the one who builds his property and business on a sound foundation looking to the future is the one who treats his position much as a stewardship. He is trustee with obligations both to the owner and to the consumer. He recognizes that the public has granted a privilege when it has given his company the exclusive right to a natural monopoly, which is essential to modern living and that the public has done more for his company than anyone else. Such an operator recognizes that in lieu of this grant the public is justified in establishing, standards of service, of rates, and of capitalization, which will result in a safe and adequate service at reasonable rates, and that the company owes the public a safe and unfailing technical service of high order founded on economical operation, square dealing, broad vision and designed to share the benefits of developments in the art with the customer by better service and lowered rates. This is not only an ideal but is good business, and there are more operators each year who are realizing their position of stewardship.

SCIENTIFIC PROGRESS:

There have been periods in the World's history when there has been real progress in the betterment of mankind, and from all appearances the present is one of those periods which in the centuries to come will appear as a high spot in man's progress. The development of this period is scientific, and the utilities serving municipalities are an expression in practical form of this development. It is imperative that society absorb this development sanely and continue to grow with no subsequent dark ages.

A book written one hundred and fifty years ago on a scientific subject would have a small part allocated to the exposition of the scientific fact, and the larger part would be taken up in the discussion of the influence of this scientific fact upon religion. The sonservative attitude of the organized Church made scientific men draw away from it for a period and they became known as opposed to religion, which is very probably untrue although it may be true as to their attitude toward the organized Church as it then existed. Scientific men cannot but marvel at the wonders of the universe and at the forces at their command which when harnessed properly are beneficial to mankind.

A fine attitude of approach in scientific development is that expressed by Henry Van Dyke when he says that science is the study of God's works as compared to religion which is a study of God's words. If this thought actuates mankind's scientific investigation and the idea of service also an idea basicly religious and now uppermost in the utility operator's mind, influences its application, no prediction as to the future can be made too optimistic, and the utilities mentioned in this thesis and other allied ones will grow in usefulness and increasing service to mankind.

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