ALADDIN U.S.A.

By ERNEST GREENWOOD

With an Introduction by THOMAS A. EDISON

¶ A fascinating record of the wonderful accomplishments of electricity and of the way it has contributed to American prosperity and progress.

HARPER & BROTHERS ESTABLISHED 1817

Price
$2.50

...mploy your time in im-
...oving yourselves by other
...n's documents; so shall
...u come easily by what
...hers have labored hard
..."

SOCRATES

...s you grow ready for it,
...newhere or other you
...ll find what is needful for
...u in a book."

GEORGE MACDONALD

...he true University of these
...ys is a collection of
...oks."

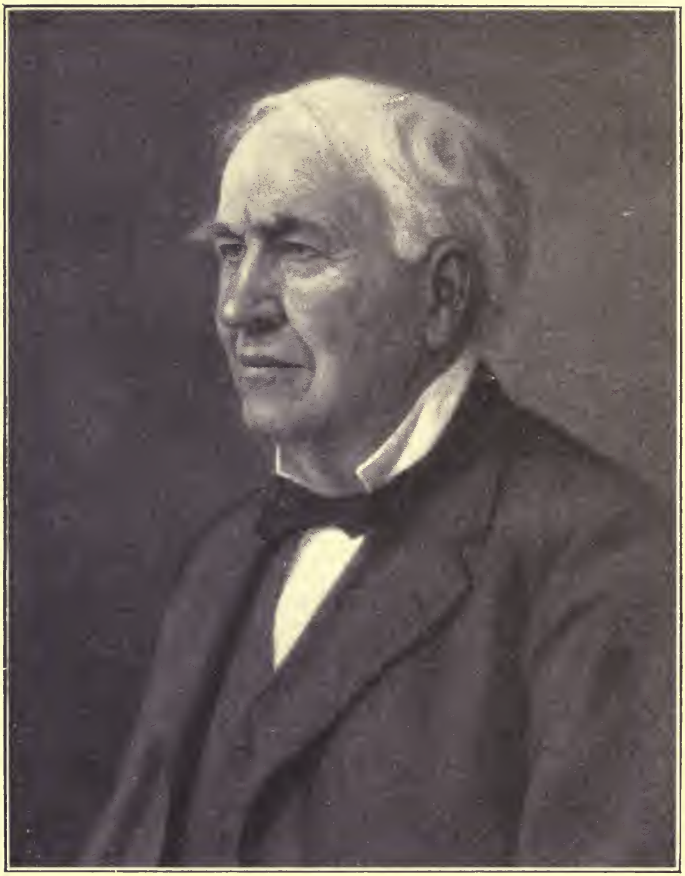
CARLYLE

...No man should think so
...ghly of himself as to
...ink he can receive but
...tle light from books."

JOHNSON

...). 1001

Aladdin, U.S.A.



Thos A Edison.

Aladdin, U.S. A.

By

ERNEST GREENWOOD

Author of
Grading Human Beings, Bootlegging in Humanity, The Little Read School Marm, Ellis Island Sob Stories, Ireland Laughs at Uncle Sam, Cornering the Eight Hour Day, What Price Safety, Labor Conditions in Soviet Russia, The Quota Law, etc., etc.

ILLUSTRATED

NEW YORK *and* LONDON
HARPER & BROTHERS PUBLISHERS
1928

ALADDIN, U. S. A.

Printed in U. S. A.
First Edition
A-C

TO

L. M. G.

WHOSE PATIENCE, UNDERSTANDING AND CONSTRUCTIVE CRITICISM ARE LARGELY RESPONSIBLE FOR ANY MERIT THIS BOOK MAY HAVE

Nobody can enjoy a sojourn of three or four months in Europe with its difficulties and its problems, its suspicions and its distrusts, its promises for the future and its threats, without coming back to the wholesome atmosphere of America pleased as never before that he was born an American and will be permitted to live and die an American.

Owen D. Young

CONTENTS

CONTENTS

ILLUSTRATIONS

A Word from Mr. Edison

IN the first chapter of this book Mr. Greenwood quotes the newspaper account of the opening of the Pearl Street station on the afternoon of September 4, 1882—the first station in the world for the production and distribution of electric power.

I remember well that afternoon.

The reporter from the *Evening Sun* who came to interview me at the station was an alert and agreeable young man, with an average degree of skepticism. It was obvious that the little station with its "thirty balloon-shaped globes, ranged at intervals on either side of the room" and glowing "with incandescent horseshoes," seemed hardly more than an amusing toy to him. He could not conceive that it meant the end of the candle and oil lamp and gas lamp, the end of the horse and carriage, the end of one epoch in civilized life and the beginning of another.

Some of us saw farther than he did, but even our imaginations fell short of visualizing all the changes that began that night. Many minds, working together, produce progress that outruns the imagination of even the most courageous.

That was forty-five years ago.

I was a young man then. I am an old man now. I have lived to see the street car, the elevator, the electrified railroad, the automobile, the phonograph, the motion picture, the radio, the airplane, and the beginnings of television. It seems to-day to many, as it seemed to most men and women in 1882, that no great forward steps remain to be taken which are comparable to those that have been taken.

It may be that the next forty years will not produce inventions of such revolutionary character. Progress has been so rapid that we may require a breathing spell in which to consolidate our gains and develop present inventions to their full capacity. But of one thing I am more positive than I was even forty years ago—the electrical development of America has only well begun.

So long as there remains a single task being done by men or women which electricity could do as well, so long will that development be incomplete. What this development will mean in comfort, in leisure, and in opportunity for the larger life of the spirit we have only begun to realize. Great days are ahead of this nation and the world. And electricity will have a great part to play, granted only that it can be unfettered, with full opportunity for the largest possible individual initiative and energy.

I look back with happiness to that eventful afternoon forty-five years ago. What will be happening in electricity forty-five years from *this* evening? I wish I might be here to see.

Thos A Edison

Author's Foreword

THE story of Aladdin and his accommodating lamp, the spirit of which was ever ready day and night to respond to his slightest wish, is one of the great classics which have been told to countless generations the world over since time immemorial. There is scarcely a man or woman living who has not at some time, in the days of youth, envied the hero of the Arabian Nights tale his ability to have whatever might be his heart's desire by the simple process of rubbing this precious lamp.

Yet within the past forty-five years science and human ingenuity have made it possible for almost every man, woman and child in the United States to play the rôle of Aladdin, differing from the original only in that an electric button or switch has been substituted for the obsolete lamp to bring instantly into service a great spirit bearing the gifts of light, power, innumerable comforts, education, amusement and a thousand and one conveniences. In the following pages the author has attempted to set forth as briefly as possible something of the history and development of this spirit of electricity, together with its social, industrial and political implications, and the tremendous change which it has brought about in our daily lives. It is to be hoped that the story will serve in some measure to stimulate an appreciation of what, because it has become commonplace, is little appreciated and little understood.

E. G.

Aladdin, U.S.A.

CHAPTER I

The Picture

SHORTLY before his death in 1923, Steinmetz, the electrical wizard, drew a sinister word picture of what would happen if the electric lines of the earth were suddenly withdrawn. It is hardly possible to picture the chaos if all public utilities supplying electric light and power should, because of some catastrophe, suddenly cease to function. If it were possible to visualize our complex daily life of today suddenly set down in the midst of conditions as they existed a hundred or even fifty years ago, totally lacking in modern resources which keep things moving, we could, perhaps, get some idea of the confusion and even hysteria which would be the inevitable result.

Let us suppose that some evening, about ten o'clock, every dynamo throughout the United States suddenly ceases to function and continues to remain idle for an indefinite period. What would happen in such cities as New York, Chicago, San Francisco or Boston and their environs or, in fact, in any city or town other than those communities located in territory served with natural gas?

First, absolute darkness. Not only darkness in the homes, but in the theaters, on the streets, in hotels—a total absence of all artificial light except gas and that cast by automobile lamps. Next, silence. All forms of transportation other than motor cars and motor busses are at a standstill. Subways, elevated, and surface lines have stopped, their cars and trains dark. Telephone bells are silent and efforts to get central and find out what it is all about are futile. Fires go unheeded by the fire departments until they have progressed beyond control, because of the failure of fire-alarm systems and pumping stations. Hospitals are immediately thrown into confusion, and unless they are so fortunate as to have a supply of candles or oil lamps stored away, are unable to give their patients any care whatsoever. Policemen on post or walking their beats, anticipating that criminals will be quick to take advantage of the unusual situation, are unable to communicate with their superiors or their station houses. Motor busses, upon completing their runs, remain at their terminals. Drivers of private cars and taxicabs, frightened, head for home.

In hotels and public buildings, elevators have stopped wherever they happened to be—often as not, between floors. Passengers in subways make their way as best they can in total darkness to the nearest stations. All steam trains are at standstill, owing to the failure of automatic signal control devices; and engineers, with the lives of hundreds of passengers in their hands, dare not proceed. All movement of foodstuffs, except supplies which happen to be on motor trucks or on horse-drawn vehicles, ends, and freight terminals are immediately in a hopeless tangle.

The next morning, the situation is little appreciated. The householder on arising finds that there is still gas, or coal, or wood with which to cook and, except for the absence of the telephone and the morning newspaper, life in the home seems normal. Having no other means of transportation, he uses his own automobile (if he is fortunate enough to have one) or picks up a motor bus or taxicab venturing forth in the daytime during this new order of things. The great mass of the people, however, dependent on the street car, the steam railroad, or the subway for transportation to and from business, must remain at or near their homes.

Arriving at his destination our householder finds that he might as well have remained at home. If he is a builder, or connected in some way with the building industry, there is little for him to do. All construction work has ceased owing to two very simple reasons—lack of transportation for the workers and lack of power to operate the devices now so necessary to building operations. If he is an office worker, he is unable to get to his office except by climbing interminable flights of stairs; and once having accomplished this, he finds that without staff, the telephone and in many instances artificial light, even a semblance of activity is made impossible. If a newspaper man, the linotypes and great presses are idle. Returning to the street he finds the banks, department stores, theaters, and all other establishments except small shops closed or in the process of closing.

Returning home, he finds the situation quite different from that which he left in the morning. The children have walked to school only to find it closed because there are no teachers, no janitor, no lights nor any one of a number of things which are necessary to the modern educational establishment.

Word has gone out from the gas company that as rapidly as possible all gas will be shut off everywhere except in hospitals, police stations and in certain public buildings. Owing to failure of transporation, the supply of coal so necessary to the manufacture of illuminating gas will soon be exhausted. The telephone and radio remain "dead." Local storekeepers and markets have warned that the supply of food is extremely limited and that additional supplies can only be had by means of motor transportation from nearby agricultural districts. There will probably be no milk the next morning.

All manufacturing enterprises, in fact all industry of every kind, mines, and shipping, have closed down, throwing literally millions of people out of work and on to the streets. Governments, local, state and federal, unable to function, martial law is declared. But even a combination of local police, state troopers, the National Guard and federal troops is so completely handicapped owing to the failure of transportation and communications that all law and order is rapidly replaced by rioting and looting. The anarchist, direct action communist, and the criminal, sensing the helplessness and fright of the people, are quick to seize the opportunity which they have long sought—free from the restraint of government and the conventions of civilized society. Within a very brief space of time, misery, suffering, confusion and terror have taken the place of well-being, prosperity, order and happiness. The sudden elimination of the kilowatt from the general scheme of things is indeed an indescribable catastrophe. Panic is dangerously near and with the exception of modern shelter and such clothing as may be on hand, a primitive state of existence looms, with the average citizen but poorly equipped to cope with its rigors.

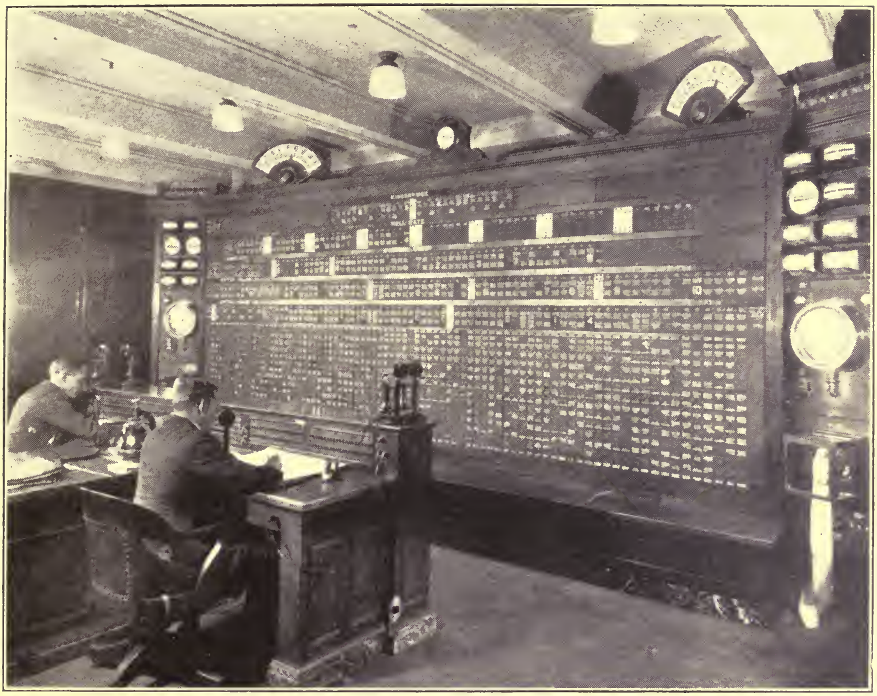
It is a picture which fortunately is only a phantasy designed to dramatize the part electricity plays in our daily lives.

Contrast this with the picture of things as they are. Let us pay a social call on the Power Dispatcher sitting at his keyboards in the center of a great network of transmission lines stretching out over hill and dale, spreading a beneficent mantle of light and life over city and on to farm, along the highway and into the home, bringing to all mankind those elemental things so necessary to existence; food, clothing and shelter.

The territory for which he is responsible may cover a small portion of a single state, an entire state, or even several states. Regardless of its extent, his duties are the same and his responsibilities are as great. Within that territory there may be a scant half dozen power generating stations or there may be a score or more of both steam and hydroelectric plants which, combined, are capable of producing more power than the mighty Niagara. As the day advances, he knows, almost from minute to minute, just what the power demands of his territory will be, whether for curling irons or giant manufacturing establishments, for the shaving light or the fifty-story office building. If it is a Monday morning, he knows that just so many washing machines will be in full operation taking care of the family wash, and if it is Saturday, he knows that toward noon he must take care of a rapid cessation of the demand for current. If it is a bright sunshiny day, he knows that the peak of the load for lighting will be much lower than it would be if the day were dark and stormy. He must know in advance the approach of a storm, for this means that everywhere electric lights will be snapped on, requiring an additional supply of current. He must know all about the movement of street cars, electric railroads, subways and elevated roads, and know just what hours of the day are their peak hours for the movement of great masses of people.

All of the generating plants under his control are what is called "interconnected." This means that they are hooked together in a power "pool." The territory, considered electrically, can be likened to a giant reservoir with twenty, or thirty, or fifty big intakes and hundreds of thousands of big and little outlets. The intakes supply the current from the generating plants and the outlets distribute it to the street, the home, the school, the store, the office, the manufacturer, and to transportation. At all times, there is a certain amount of current coming into the reservoir from one or more of the intakes and a certain amount dribbling out through the many smaller outlets. The volume in both depends entirely on the time of day and on the Power Dispatcher's knowledge of the consumption in his territory.

As the day progresses, the Power Dispatcher presses first one key, and then another and then another. One generating plant after another springs into life, pouring hundreds of thousands of kilo-



The Nerve Centre of the Electric System

The "Load Dispatcher" at his desk. Lights on the great board in front of him show the performance of every unit of the system; the telephones connect with the chief operator in each of the individual power-houses and the two-score of substations. Attached to this installation is also the electrostatic "storm-detector." This has supplanted the weather-watchman at the top of the plant, who was constantly on the alert for any accumulations of heavy clouds which would cause a sudden call for light.

watts through the great intakes into the reservoir. With another keyboard, this great cataract of power and light is released into the tens of thousands of outlets and the day's activities are under way. It may be the washing machine in the laundry, the electric stove in the kitchen, or toaster on the breakfast table, the electric crane hoisting building materials to incredible heights, the giant presses of the daily newspaper, elevators everywhere, all forms of transportation, the automatic traffic control devices handling the traffic on street and highway, the retail store, the wholesaler and the manufacturer, the telegraph, telephone and radio, the city worker and dweller or the farmer and his farm hands—all are dependent on the Power Dispatcher sitting quietly at his keyboards watching the clock, the weather and the delicate instruments which make it possible for him always to keep the electric energy in his reservoir constant and at the level which will supply the demand, together with his "stabilizers" which meet temporary "surges" in that demand.

This is not a fanciful picture—it is a daily occurrence which can be observed in almost any section of the country. The millions of men, women and children in the United States are quite as dependent on the Power Dispatcher for the safety and comfort of their daily lives as the passengers on a railroad train are dependent on the train dispatcher and the engineer for safety and comfort while traveling. The same man who is at the other end of the wire when you turn on an electric light is also at the end of the wire when a train moves out of the station, when an edition of a metropolitan newspaper goes to press, when the telephone bell rings, or when the radio sends forth the opening bars of the evening concert. His army of benevolent kilowatts moves backward and forward in well-ordered brigades on a never-ending march of service to humanity.

CHAPTER II

Mainly Historical

A LITTLE more than forty years ago—in 1885 to be exact—the electric industry held its first convention in Chicago. At that time there were approximately 600 lighting companies in the United States, of which only about 60 were making any attempt to furnish continuous electric service night and day. But, even though we measure them with the progress of the industry during the past fifteen years as a standard, these figures are stupendous. Lighting with electricity generated in a central station was in its infancy, being at that time but three years old—Mr. Edison established the world's first electric lighting plant in 1882, shortly after his invention of the carbon filament lamp.

Intimately associated with Mr. Edison in his early researches and experiments leading up to the practical application of his inventions in the central electric lighting and power field in 1882, were such men as Mr. Charles Batchelor, Mr. John Kruesi, Mr. F. R. Upton, Mr. E. H. Johnson, Mr. Charles L. Clark, and others, many of whom have continued in important relations with the industry ever since. With the inauguration of the pioneer central station in Pearl Street, New York, there came into the picture such men as Samuel Insull, S. Z. Mitchell, the late H. M. Byllesby, John W. Lieb, Charles L. Edgar, William S. Barstow, and many others. All of these men with the exception of Mr. Byllesby, who died late in 1926, are still active in the industry.

Mr. Insull, who was Mr. Edison's secretary, was destined to be the leader in appreciating and making available the many advantages of unified electric systems in the United States. Mr. Lieb, the electrician of the Pearl Street station, is now the Vice President of the New York Edison Company, one unit of which generates more electric power than the whole of Muscle Shoals. Mr. Mitchell, whose activities in the development of the industry have been nation-wide, is President of the Electric Bond and Share Company. So one might go through a long list of early pioneers whose abiding faith in the significance and importance of electrical applications has done so much to advance our national industrial progress. It has been largely through their broad vision, energy and engineering and commercial acumen that light and power service has been advanced from its very beginning in 1882 to the place it now holds as one of the most important factors in the sum of human happiness, comfort and achievement.

The history of the practical application of electricity prior to 1882 is largely confined to the history of the telegraph and telephone. Their story has been told in every known language and has no place in this volume. It must not be forgotten, however, that both owe their existence to electricity. In 1850, there was no electric industry, which means there were no telephones, no automobiles, no street railways, no airplanes, no submarines, no radios, little or nothing in the way of a power substitute for physical labor, and nothing in the way of devices to produce artificial light except those which did so by the burning of something such as gas, oil or tallow. The first telegraph line was established by Morse and Vail between Baltimore and Washington in 1844, when the historic message "What hath God wrought" was sent over the wire. The first telegraph cable of any consequence was laid between Dover and Ostend in the North Sea between 1850 and 1852, while Europe was not connected with this country by cable until 1866.

It was not until 1874 that Mr. Alexander Graham Bell started his experiments with the telephone which two years later he exhibited to the public at the Philadelphia Centennial Exposition. The first telephone exchange to be established in this country was installed in New Haven in 1878, and the first in any foreign country in London in 1879. Mr. Insull was the first telephone operator of this London exchange and it is interesting to note that Bernard Shaw, before he became famous, was employed by this telephone company in London.

In November, 1879, Mr. Edison applied for a patent on a "lamp with a high resistance filament." This was the beginning of our modern lighting system. Mr. Edison not only conceived, invented and perfected the incandescent lamp, but he also invented the electric generator to supply the electricity, the system of wiring by which one lamp could be turned out without affecting the others, switching mechanisms, an electric meter, and many other necessities required by an electric central station system. Mr.

Insull, who came to the United States in 1881 to become his secretary, gives an interesting description of Mr. Edison's appearance in a personal letter to an English friend:

> "With my strict English ideas as to the class of clothes to be worn by a prominent man, there was nothing in Edison's dress to impress me. He wore a rather seedy, black diagonal, Prince Albert coat and waistcoat, with trousers of a dark material, and a white silk handkerchief around his neck, tied in a careless knot falling over the stiff bosom of a white shirt somewhat the worse for wear. He had a large, wide-awake hat of the sombrero pattern then generally used in this country, and a rough brown overcoat, cut somewhat similarly to his Prince Albert coat. His hair was worn quite long, and hanging carelessly over his fine forehead. His face was at that time, as it is now, clean shaven. He was full in face and figure, although by no means as stout as he has grown in recent years. What struck me above everything else was the wonderful intelligence and magnetism of his expression, and the extreme brightness of his eyes. He was far more modest than in my youthful picture of him. I had expected to find a man of distinction. His appearance as a whole was not what you would call 'slovenly'; it is best expressed by the word 'careless.'"

Shortly after his arrival in this country, Mr. Insull wrote a letter to another friend which indicates the novelty of an electric light at that time. In this letter he said: "You ask me about electric light. Well, I have seen 700 lights burning, the current generated from the same electric dynamo machine for the whole lot, all of them getting their current from the same means (*i.e.,* street cables) of no less than eight miles in length."

The Pearl Street station, which was the grandfather of the New York Edison, started in business September 4th, 1882. The *New York Sun* the next day carried the following account:

"EDISON'S LIGHT TURNED ON

"Two engines in the Pearl Street station of the Edison Electric Illuminating Company were started last evening. Simultaneously thirty little balloon-shaped globes, ranged at intervals on either side of the long room containing the machinery, glowed with incandescent horseshoes. All customers of the company whose buildings have been inspected by the Board of Fire Underwriters were notified that the light was ready for use. The Drexel Building, containing 100 lights, the Times office, the Park Bank and the Herald office were among the places lighted last night by electric currents from the station in Pearl Street.

"Mr. Edison was seen by a reporter in the long, illuminated room. He wore a white, high-crowned derby hat and a collarless shirt. His face denoted that he was greatly pleased.

'I have accomplished all that I promised,' he said. 'It was not without some fear that I started the machinery this evening. I half expected that some new phenomena would interfere with the working of the light. But it has been entirely successful. You will see that we have only one engine running now. It supplies 800 globes with light. We have six engines, which will all be in successful operation before the end of the winter. We expect to have three running next week. We have a greater demand for the light than we can supply at present, owing to the insufficiency of men to put down the wires. We have to educate the men to the use and management of our machinery. We have only one experienced engineer here now. A man came down from our machine shop in Goerck Street the other day and put his oil can between two conductors. He was a badly frightened man a second later, for the can melted away as quickly as the oil that it contained. Another workman, while employed at a wire in Fulton Street, used a screwdriver. He was surprised to see his screwdriver burn away and returned to the station in great haste to know what was the matter.'

"Taking the reporter up to the second floor of the building, Mr. Edison pointed to two little boxes, each of which was surmounted by a blue globe between two red globes. There were bells attached to each box. Whenever a bell rang a blue or red globe would be illuminated. Mr. Edison explained that these were the indicators. When the globes were not illumined the electric pressure on the main wires was equal to 16 candles. A young man sat watching the lights on a high stool with his hands on a wheel. Whenever the bells rang and the globes were lighted up, he turned the wheel until the ringing ceased and the lights went out. What the young man handled was called the regulator.

" 'Have you ever noticed,' said Mr. Edison, 'that light contracts the pupil of the eye? I will demonstrate it.' He closed his eyes for a half minute. Opening them he called attention to the size of the pupils. He then exposed them to the light. When the reporter looked at the pupils they seemed to have decreased considerably in size. 'That illustrates,' continued the inventor, 'the desirability of a steady light. It prevents the dilation and contraction of the pupils of the eyes that the fluctuations of an ordinary electric light or gas light would cause.'

"The electrician said further that eighteen miles of pipe would be laid in the downtown district. Six miles are already laid."

Within fourteen months, the company had wired 508 customers' premises for 12,732 lamps. But the public was skeptical. The original capitalists who had supplied about one million dollars lost heart and refused to advance any more money. Banks and bankers in those days were pessimistic about new, strange, and untried things and little inclined to speculate. Mr. Edison risked his entire personal fortune in the development of manufacturing establishments to produce the apparatus necessary to the system and financed the operation to the extent of several hundred thousand dollars until the Pearl Street plant had progressed to a point where it was evident that it would be profitable. Then the original capitalists, their confidence miraculously restored, were willing and eager to supply additional funds. Almost before electrical engineers here and in Europe had recognized the success of the central station scheme, this first experiment was earning a return on the money invested.

We are inclined to think of hydro-electric power as a development of the past twenty years; yet within a short time after Mr. Edison's Pearl Street station was begun, a small central station driven by water power and with a capacity of 250 sixteen-candle-power lamps was started at Appleton, Wisconsin. This was the first hydro-electric plant and it was placed in operation a few weeks after the steam was turned on in the Pearl Street plant.

The next generating plant to be installed was that of the Western Edison Light Company in Chicago in 1882 and the third was the Chicago Edison Company at what is now 120 West Adams Street. In 1902, only twenty years later, there were 3,600 central lighting and power plants in the United States, which number, during the past twenty-five years, has increased to 4,885. The capital invested in 1902 was $504,000,000. Today it is over eight billions. The number of customers served by the electric light and power industry is estimated to be 19,-530,000.

But to return to the first convention of the industry, held in Chicago in 1885. Two other conventions were held during this same year and it was at this time that the National Electric Light Association was formed. Many of the things in the proceedings of this first meeting are highly amusing, yet one is startled at the vision and courage of these early pioneers. Carter Harrison was then mayor of Chicago and he had been accused of being unfriendly to electric street lighting. In his address of welcome, he denied this, but claimed that "as the father of over 600,000 people, all looking to me for protection, I say we want electricity, but we do not want death dashing like a horrid monster through our streets." Later on in his speech, however, he "hedged" a little and said: "What a startling thing it will be when bottled electricity will put a street car on the rails and send it whirling from the heart of Chicago to the outskirts."

This prophecy by the mayor provoked considerable discussion among the delegates. A Mr. Curtis claimed that cars were being run by electricity in Cleveland on a commercial basis "on a track a mile and a half in length." Still another delegate insisted that he had seen an electric railway running the whole length of a pier at Coney Island, a distance of about 700 feet. A majority of the delegates, however, were not satisfied as to the financial future of applied electricity and the question in their minds was summed up by Mr. George S. Bowen of Chicago who asked: "Can any man who has money to buy an electric light plant, put it in operation, run it successfully and declare a dividend?"

At this time—just forty-two years ago—no one could cite an example of a private residence in the United States lighted by electricity. Theaters, banks, newspaper offices, clubs and hotels were playing the rôle of pioneers. The Paris Opera House was named as the godmother of electric lights in the theater. The offices of the *New York Herald, World, Tribune* and *Sun,* the *Boston Herald* and *Detroit Free Press* were all lighted by electricity, as were the Palmer House in Chicago and the Murray Hill Hotel, the Hotel Dam, the Union Square Hotel and the Gilsey House in New York.

A Mr. W. H. Johnson was on the program with a paper on the application of electricity to motors. The presiding officer "begged the indulgence of the conference," saying that "it would do no harm to listen to what Mr. Johnson had to say." Mr. Johnson had vision and was not at all backward in making what undoubtedly were considered as wild predictions. He claimed that electric street cars were a certainty, electric railroads a probability and discussed electric power for balloons, submarines, and torpedoes. He also called attention to the fact that electric light plants were idle during the day, adding that he saw no reason why they should not be converted into power stations supplying electricity for motors in small shops.

This caused much speculation and a few brave spirits predicted that it might be possible some day to supply power for motors of from one to five horsepower. One delegate had the temerity to express the belief that there would be more money in selling power at $150 a horsepower than in selling light. He "actually had seen a 3-horsepower motor running 300 stock exchange tickers in New York for which the company obtained $400 a year per horsepower," and he challenged other delegates "to tell a better story than that."

It was also at this convention of 1885 that the first discussion over the relative merits and economies of the operation of steam generating versus hydro-electric plants arose. This subject is today of sufficient importance to entitle it to an entire chapter in this book. Some one suggested the appointment of a committee to investigate the matter, but the convention voted it down because, even at that time, just three years after electricity had been put on the market for lighting, the public was already complaining that the lighting companies were making too much money; this, in spite of the fact that the companies themselves hardly knew whether they were making or losing.

What has happened since those eventful days of forty-odd years ago—less than a lifetime? Electric street cars have for many years been a fact and they actually run in opposite directions; a possibility which was gravely doubted by the delegates at this convention. Urban and interurban electric lines operate 100,000 cars on 44,000 miles of track carrying no less than 15,400,000,000 passengers each year. Electrification of steam railroads has progressed more slowly, but the next five to ten years will see literally thousands of miles of railroad on which trains are moved by the central power station in place of the more cumbersome and expensive individual power plant, the steam locomotive.

To quote Mr. Robert F. Pack, "Electric lighting in factory, store, office and home has become almost universal in urban centers. In many cities and towns more than 90 per cent of the dwellings are lighted by electricity; but this tells only half the story, for the silent electric servant also washes, cleans, irons, cooks, refrigerates and performs countless other household tasks which win for it the blessings of the housewife.

"Great industries are taking their entire power requirements from the electric light and power companies, although many isolated plants still remain in industrial establishments. Nevertheless, electricity has become the great motivating power of industry and more and more industrial companies are discontinuing operation of their own individual plants in favor of power company service."

There are approximately 22,000,000 automobiles in daily use in the United States because of electricity. The airplane, the latest method of rapid transportation, is becoming more and more popular. Nearly 18,000,000 telephones handle no less than 75,000,000 messages a day, while 6,000,000 homes are provided with amusement and education by the radio. There is no single moment of the twenty-four hours of the day when the average citizen does not come in contact with electricity. Even though he may be sleeping, the spirit of electricity, through the medium of the fire-alarm system and the patrol box on the corner, is protecting him and his home.

The tense days of 1917-1919 saw the erection of another great milestone in the progress of the development of electrical service. So-called interconnection to provide an assured supply of reserve current and to accomplish certain economies of operation had been the subject of much discussion, but its progress had been largely confined to talk. During the war, there occurred from time to time serious shortages of power in important industrial areas. The development of interconnection became the chief concern of the electrical engineer until today we have great power pools of interconnected generating plants covering, in some instances, several states.

But interconnection is not the only thing stimulated by the war and the necessities of national defense. Nitrogen compounds in huge quantities are necessary for the manufacture of explosives as well as for innumerable other necessities for peace and war-time projects. Prior to the war, we were largely dependent on Chilean nitrates for these nitrogen compounds. In May, 1917, when Mr. Edison was president of the Naval Consulting Board and when a great search for a process for obtaining nitrogen for war purposes was being conducted, he recalled certain experiments which he had made twenty years before and during which he observed that a large quantity of ammonia was developed. Back he went to his experiments and the result was the Muscle Shoals project for the production of nitrogen for munitions in time of war and fertilizer in time of peace. Since that time other processes for the fixation of nitrogen, which are much more economical than the one calling for a large amount of electric power, have been invented and developed to such an extent that hydo-electric plants are no longer a factor either in national defense or in the agricultural industry. Had the war continued, however, it is applied electricity which would have produced munitions for the armies and navies of the United States.

It may be fairly said that the progress of civilization has been chiefly characterized by the untiring search of man for artificial light and for power devices to take the place of physical labor. Until the advent of electricity and the central generating station, the only form of light other than daylight that was known was produced by the destruction of something and the generation of heat. With the hydro-electric plant, light is produced without the use of fire or heat and without destruction of any kind. The same current which produces this light also supplies power for an indefinite variety of purposes until human labor has been reduced to the throwing of a switch or the pushing of a button. In fact, it has been predicted that electricity will bring about a maximum day for labor of four hours or even less. With the reduction of labor, standards of living have increased until life in the United States for the great mass of the people has become the marvel of all the world.

CHAPTER III

The Passing of the Backstairs Drudge

FORTY-FIVE years ago, when applied electricity was little more than a subject of popular ridicule, there was a saying to the effect that while man's work lasts only from sun to sun, woman's work is never done. It has a soothing jingle and harassed mothers of families in moderate circumstances sang it to their children in the cradle, repeated it when they had progressed to the traditional "Mother's knee" and used it most effectively on Father whenever he attempted to gain a little sympathy by explaining just how hard he had to work to earn a dollar, to keep a roof over their heads and the wolf from the door.

As a weapon of offense and defense in this day and age, it has been laid away, presumably with the lavender and old lace of the wedding dress of those days, along with the oil lamps, the broom, the washboard and the old-fashioned flatiron. No longer need the housewife, though her circumstances be too modest to permit her a servant, be the household drudge. Our spirit of electricity has made available a valiant host of mechanical servants, ready and willing any hour of the day or night to spring into life and service at the turn of a switch. They are everywhere in the house, from the laundry and furnace room in the basement, through the kitchen, dining room and living rooms, and on up the stairs into bedchambers, bathrooms and finally the attic. They do the cooking, housecleaning, washing and ironing, provide communication with the outside world, bring the markets to the door, turn the furnace on in the morning and off again at night, provide light anywhere and everywhere, bring education and amusement through the radio receiver, start the family flivver and announce the presence of visitors, provide unusual comforts for both sick and well and, in fact, do a multitude of things each day without fatigue, complaint or interruption.

There are today more than 16,000,000 homes in the United States which have electric service for lighting and for the hundred and one comforts brought to them by electricity. During the year 1926, the industry added 1,250,000 domestic customers to its lists. This means that a host of women joined the army of their sisters who have thrown off the yoke of monotonous drudgery and are younger, healthier and happier than their mothers and grandmothers were at the same age. The servant problem, has been at least partially solved while a score of other daily problems met in any well-ordered household, have been dissolved into thin air by the touch of Aladdin's button or switch.

Let us go into an American electrified home and spend a day. Many of the devices are so commonplace that the mistress forgets they are actually the products of the last few years; forgets, or perhaps never stops to think, as she slips through her routine duties without effort and without aching muscles, that at some place, anywhere from a mile to a hundred miles distant, there is a great waterfall or a gigantic steam turbine running ceaselessly, ready to do her bidding at any moment, or that the Power Dispatcher at his keyboard is supplying her electric iron while at the same time he is supplying the wheels of industry, transportation and a thousand other activities.

If we start in the basement, we find first the electric washing machine. It is Monday. The soiled clothes, including everything from heavy linen to the most delicate fabrics, together with soap and water, have been dumped into it. The housewife, or the laundress, has turned a switch and gone about other duties, secure in the knowledge that within a very short space of time these soiled clothes will be quite as clean or cleaner than they were on the day they came from the shops. Gone are the hours of arduous labor over the washboard; no more physical effort than that which is required to turn a little switch and, as far as heavy work is concerned, wash day is over. When the clothes are ready for the ironing board, there is the electric iron and the ironing machine for heavy pieces. Gone are the hot fire, and the heavy flat irons to be lifted back and forth from stove to board and board to stove.

Passing from the laundry, we find ourselves in the furnace room. Here is a furnace which uses oil for fuel. But this oil is sprayed into the fire box by an electrically driven motor. The oil burner would not be possible if it were not for this motor. There are no ashes, no clinkers, nor burnt-out grates, and no huge coal pile to be replenished periodically and to be tracked through the house daily. If the temperature of the house drops, an electrically operated thermostat calls on the Power Dispatcher for a little more power, the motor speeds up a little, the fire grows a little hotter, and—there you are. As the temperature rises, the motor slows down, the fire dies down, and, once more—there you are. Regardless of the weather, the time of day, or the season of the year, this automatic heating plant takes care of itself with the aid of electricity, scorning the attentions of family or servants. Its only requirement is an electric wire, a power plant at the other end, and a supply of fuel oil.

Passing up the cellar stairs, we come to a pantry equipped with an electric refrigerator. Here again we find an incomparable comfort. The iceman tracking in and out with his dripping chunks of ice and his general tendency to turn everything in the ice-box into a sort of Hungarian goulash belongs to the past. The pan beneath the ice-box, inspired to overflow at odd times, is gone. The temperature within never varies one degree, regardless of the seasons. Neat little cubes of ice are seen in orderly rows waiting for the table or for cooling drinks, to be replaced by water which in a brief space of time becomes more little cubes of ice. There is no drain pipe and at no time is there the accumulation of dirt so familiar in the old-fashioned ice-box. Desserts beyond the range of possibilities in the ordinary household are accomplished with ease by the electric refrigerator. And all because of a little motor, backed up by the power plant down the line.

From the pantry, we go into the kitchen, but it bears little resemblance to the kitchen of our grandmothers or even our mothers. At one side is the electric range. If the problem is one of baking, the oven can be brought quickly to any desired temperature and kept at exactly that temperature; a boon to harassed cooks which is almost priceless. With this electric range, the average housewife can accomplish things which ordinarily are possible only to the most skilful chef, with little or no more effort than the turning of a switch. Over on a table are electric beaters and stirrers which eliminate much of the physical labor of preparing the raw materials for the electric range. Alongside the white porcelain sink is an electric dishwasher. As the dishes come from the table, they are placed in it, a switch is turned and in a few moments they are thoroughly cleaned, ready for the drier. Truly electricity has replaced much physical labor in the kitchen, and the preparation of the most necessary three meals a day has become a matter so simple that the constant cry of anguish over food, food, food, so familiar to every householder, is no longer heard.

For the bride and groom who cannot stand even so slight a separation as that caused by the swinging door between the dining room and the kitchen, there is the electric toaster and a variety of other devices for cooking shirred eggs, crisp bacon or neat little sausages, or fluffy griddle cakes, right on the dining-room table if you please.

Finished with the breakfast, the housewife has the daily marketing to do, and if it happens to be routine marketing, a few minutes at the telephone and the gentle kilowatt is carrying the order to the grocer, the meat market, the milkman, or perhaps the truck farmer on the outskirts of the city. Except for special occasions, where personal inspection may be desirable, traipsing around each day from house to store and store to market belongs to the past.

If it happens to be cleaning day, there is the vacuum cleaner with its various attachments for rugs, furniture, curtains and cushions. It requires no more effort than that required by the school teacher using a pointer. The carpet sweeper, which never would get into the corners or do anything except to pick up some of the dirt in the center of the room, and the broom, which did nothing more than sweep the dust from the floor onto the furniture, the mantels, the pictures and the draperies, together with the labor required to operate them, have joined the old-fashioned ice-box, the washboard and the dish pan. Cleaning one room or many is a task only one removed from combing one's hair or brushing one's teeth.

It is indeed the home of a hundred comforts, and the physical, moral and spiritual effects upon the entire family have been so great that life in the home today no more resembles that of fifty years ago than the thatched hut of the South Sea Islander resembles the modern dwelling in a modern suburb. At night there is the steady glow of the most improved incandescent lamps. The importance of a light having a given and steady intensity cannot be overestimated. Whether in the home or in the school the children of today are fortunate, for literally millions of them are enjoying the boon of good eyes who would be wearing glasses if they had to do their studying by the candles, the oil lamps or the flickering gas jets of bygone days, now replaced by our Spirit of the electric switch. Continuous variations in the intensity of light cause the pupil of the eye to expand and contract, which inevitably results in strain and permanent impairment of the sight.

The radio has been made possible only by research in the field of electricity. Already it has progressed far beyond a device to provide amusement and entertainment. Great universities are giving extension courses by broadcasting, and education is brought into the home to those who, for physical or other reasons, are unable to go to education. Even the modern public school is installing the radio that the pupils may have the benefit of instruction in music, in the arts, in science, by teachers of world-wide reputation whose services could not be procured in any other way. By means of such concerts as those broadcast by the great networks of stations, the best in music is being brought into hundreds of thousands of homes where good music has been heretofore unknown. The influence on American culture of these radio programs cannot be measured in words and phrases. On the other hand, a great responsibility has been placed on the broadcasters in the selection of their programs. No newspaper, no great chain of newspapers, have such opportunity for influencing the life and thought of a nation.

The use of electricity in the home is increasing with even greater rapidity than its use in industry, and the cost is at least 15 per cent less than before the war. It is not only the smallest item in the family budget, but it is the only commodity which has shown a steady decrease in cost. The cost of living has gone steadily upward during the past fifteen years, while the price of electricity, the burden bearer of the home which has emancipated women from the deadening drudgery of housekeeping, has steadily declined.

In spite of the rapid progress of the electric industry and the increase in the number of homes served —a million and a quarter added in 1926—there is apparently much to be done. In June last year, Mrs. John D. Sherman, president of the General Federation of Women's Clubs, hurled the following questions at the industry:

"When electric power at a few cents an hour is within easy reach of the homes in 97 per cent of all of the communities, why are 65 American homemakers out of every 100 still sweeping the floors with the backbreaking, dust-raising, germ-cultivating broom?

"Why are over 78 women out of every 100, even in places too small to have steam laundries, rubbing the family wash on the old washboard and straining at the old-fashioned wringer when the mechanical washing machine will do the work better and release the home-maker to the care and companionship of her children?

"Why should 98 in every hundred women in towns that have no gas works be fumbling in the wood box or fussing with the coal scuttle to get the family meal when the wire that brings the light to the home could also furnish a fuel available at the turn of a switch and cook more efficiently than coal or wood?"

To which Mrs. Sherman replies: "I am convinced that in the great majority of cases, the answer is not to be found in economic conditions, but rather in the habit of drudgery; in a chronic failure to set up against the cost of labor-reducing devices, the saving, the increased efficiency, the protection to health and the contribution to the general well-being of the family, all of which accrue from the elimination of drudgery by the installation of efficient labor saving devices."

There are no economic reasons, no legitimate reasons of any kind why the average American home should not be equipped with these electric devices. Even the first cost is no longer a burden, for they may be purchased on the modern deferred-payment plan almost anywhere. In fact, in many cities the local public utility company will furnish them and add the payments to the monthly light bill. This simplifies matters for those who, because of modest circumstances, may not have established credit. These payments are a real investment in health, comfort, happiness and the prolongation of the youth and even the life of the home-maker; they are as important as the monthly addition to the savings account.

Modern civilization is founded on the home. In an infinite variety of ways, electricity has contributed to the increased standards of living in the American home, and it is a gift from American science and American ingenuity which should be seized and conserved. As Bruce Barton has well said, "the home of the future will lay all of its tiresome, routine burden on the shoulders of electric machines, freeing mothers for their real work, which is motherhood. The mothers of the future will live to a good old age and keep their youth and good looks to the end."

CHAPTER IV

Industry Goes to the Country

ONE of the pet words which has come into much favor during the past ten years is "decentralization." When the candidate for public office is in need of a subject for a political speech, he can always talk about the decentralization of the government. It is "states rights" in a new dress, does no harm, and always has a popular appeal. The city planner, seeking for some new device to solve traffic problems or problems of congestion, talks learnedly about "decentralization." Committees of experts sitting in solemn judgment on some national issue turn vaguely to "decentralization" when they find themselves in a fog of doubt as to what to put in their reports to indicate intelligent consideration.

As a matter of fact, decentralization has been going on quietly in many of our larger cities for some time; it has been paralleling, in fact, the development of the electric lines. New sub-centers of business are being constantly created to relieve concentration in districts already overcrowded. Banks and department stores everywhere are establishing new branches in outlying districts. Small shops are moving or opening additional places. Brokers, real estate firms, newspapers and attorneys are either moving their offices or establishing branches. New theaters and motion picture houses are being built outside the traditional theatrical district. Transportation is making it possible for people to live further and further away from their daily tasks. Everywhere there is a constantly growing tendency to "spread out" instead of to go further up into the air or deeper down into the ground. Much of this tendency is due to electrical power and the new facilities which it has created.

Until comparatively recent years industry has concentrated in the larger cities because of the availability of (1) labor, (2) power, and (3) markets. As the power lines have been extended into more rural territory new industries, as well as old industries expanding their operations, have shown a tendency to avoid congested cities and "get out into the country" where improved living conditions might be attractive to labor and where power, in addition to serving industry, has improved transportation facilities for the movement of their products to more distant markets. This tendency is sometimes described inaccurately as the "decentralization of industry." Decentralization might very easily mean the closing down of existing industrial plants, or their shifting from one section of the country to another, or their disintegration into a large number of small units. This of course sometimes happens. But to say that any such futile scattering of industry as a whole is going on or ever will go on is absurd. Industry going into the country is not decentralization; it simply means that while present industrialized sections keep their industries, much future expansion will permeate rural sections bringing about a better dilution of agriculture and industry. What does this mean to the over-agriculturized, under-industrialized areas?

Some years ago, the University of Tennessee started a study of the economic status of Tennessee. But before it had progressed very far it was found that an analysis of Tennessee conditions was applicable to almost every other state. Thereupon, the scope of the study was extended to forty states which were arranged in seven groups. These were: the Pacific Coast group, the grazing area, the wheat belt, the corn and livestock area, a group of such states as Michigan, Ohio, Pennsylvania and New York, where industry and agriculture are more equally balanced, the New England group, in which was included New Jersey, and the Southern group. Some of the conclusions reached as to the effect on the values and welfare of communities by a lack of balance in the distribution of industry and agriculture are intensely interesting.

For example, Washington is the nineteenth state in size, while Oregon ranks ninth. But although Washington is much the smaller, the estimated true value of its property is over five billion dollars, while Oregon, with 50 per cent more area, has a value of little less than three and one-half billions. Turning to statistics with regard to industry in the two states, we find that manufacturing in Washington adds about one hundred and eighty-eight million dollars to its wealth, while in Oregon it adds only about ninety-one millions. Curiously enough we also find that the agricultural value of Washington is higher than that of Oregon—in fact, it is 29 per cent higher. The first conclusion is that this is due, in part at least, to the fact that Washington is more fertile than Oregon. Fertility may be the controlling factor but it is this very fertility that helps to bring about decentralization of industry. Barren states may have water power but the flexibility of power makes it possible to carry it to the fertile state and thereby increase agricultural values. In any event there can be little doubt that by the extension of power lines industry does get out into the country, and in agricultural states this means heavy increases in agricultural values.

Somewhat similar conclusions may be reached by comparing Colorado with Wyoming. Colorado is only slightly larger than Wyoming in point of area, but it is actually worth about three and one-half times as much. The value added by industry is two and one-quarter times as much in Colorado as Wyoming, while agricultural values are about five times as great. Here again we find as factors irrigation in Colorado, as well as its great mining interests which add to its value. But certainly power has helped in its irrigation projects and in the development of its mines, and these combined have certainly contributed to its agricultural values. The conclusion is that manufacturing prosperity connotes agricultural prosperity, while power, by bringing about a better diffusion of both, adds to the value of both; and this is certainly sound.

An even more striking demonstration is obtained by comparing conditions which obtain in the fifteen Tennessee counties that show highest assessed valuations with the group of fifteen counties showing the lowest values. The first group has 59 per cent of the total wealth of the state, while the second group has but 2.4 per cent. The first group produces 52 per cent of the county revenue, the second, but 3.1 per cent. The first group is the childbearing group having 34.6 per cent of the school children of the state, while the second group has but 4.9 per cent. Of the urban population of Tennessee, 77.1 per cent reside within the first group of fifteen counties while practically none reside in the second group. The tax rate in the first group is on the average eighty-four cents per one hundred dollars while in the second it is one dollar and twenty-seven cents per one hundred dollars. But one conclusion is possible. Add industry to agricultural sections and assessed values go up, tax rates come down, and revenues increase. The number of children of school age increases; illiteracy disappears. Seventy-five per cent of the people of Tennessee live in the country with no industrial life and consequently with but a small buying power.

Turning to the state of Georgia, we find that a single county out of the 161 in the state possesses 20 per cent of the assessable values of the entire state. There has been such a concentration in Fulton County that it has a greater assessable value than the total value of 85 other counties. An examination of conditions in Georgia leads to identically the same conclusions as were reached in the case of comparisons of one state with another or the two groups of fifteen counties in Tennessee. Comparisons of groups of counties in South Carolina, Arkansas, Mississippi, Louisiana, and Alabama all tell identically the same story.

What has electricity to do with this question of increased values, increased revenues, and lower tax rates? Everything. Take the single instance of Blount County, Tennessee. A few years ago Blount County was not a rich county and even today is surrounded by poor counties. Now Blount County enjoys three or four times its former income. There has been no increase in the tax rate. There has been a heavy increase in population. The farms are more prosperous because of the addition of immediate markets. The county has more money to spend on educational facilities and on good roads, and the standard of living conditions is rising higher and higher. Why? The extension of electric power into Blount County made it possible for the Aluminum Company of America to build a great plant there. The building of this plant did not mean that the Aluminum Company of America was subtracting from the industrial developments of other sections. It simply means that in the course of normal expansion of its business, it found it possible to go out into the country instead of adding to the congestion of some already overcrowded city.

Comparing the state of Mississippi with Ohio presents an even more striking picture. Mississippi has no water power of its own and no coal. It has a population of 38.6 to the square mile, of which 13 per cent is urban. In Ohio, which is considerably smaller than Mississippi, 63.8 per cent of the population is urban, and through the availability of power industry is well distributed and the dilution of the rural population is the best of any state in the Union. But the value of the agricultural products of Mississippi with its greater area and its larger proportion of rural population is $965,000,000, while the value of the agricultural products of the smaller Ohio is $3,096,000,000, or three and a third times as much. This is what the extension of power into the rural districts does for agriculture by bringing about a better distribution of industry.

What is the effect of this distribution of industry on future generations? Mississippi has exactly $12,000,000 invested in school property, while Ohio has $170,000,000. But Mississippi has an assessable value of but two billion dollars, while Ohio has an assessable value of eighteen billions. Mississippi has only been able to spend $7.84 per child per year for education, while Ohio, because of its greater values and consequent greater income, has been spending $41.77. And it is not necessary to particularize on Mississippi.

Compare South Carolina with Massachusetts, or Tennessee with Indiana, or make any one of a dozen other comparisons and it will be found that wherever industry has been distributed throughout the rural sections, public revenue increases, tax rates are lowered, the value of agricultural products and property has increased, the children have improved educational advantages, and life is in every way better worth the living. It is electricity and the development of interconnection of power plants scattered throughout large areas which has helped to bring this about. It is electricity and the interconnected system throughout the Southeastern power area which will make it possible to develop such states as Mississippi so that it will compare favorably with such states as Ohio.

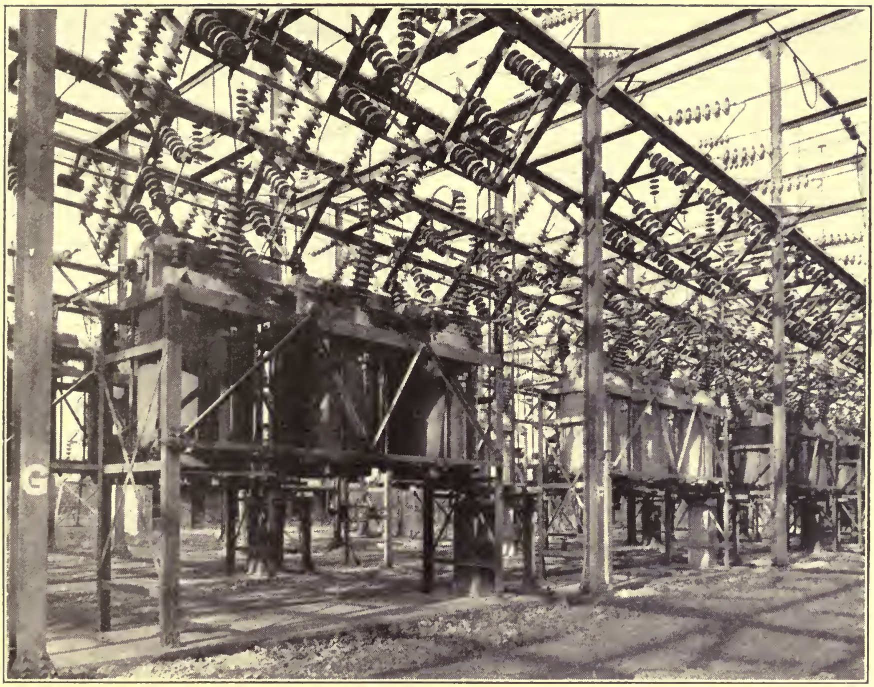
This relationship between industry and agriculture is not sectional; it applies to the whole United States. For example, the same ratio of assessable values in rich and poor counties as was found in Tennessee persists everywhere. For the entire country, it is 93.6 to 6.4; for the eleven Southern states, 95 to 5; for the eight Central Western states, 95.5 to 4.5. If, finally, we tabulate by states the assessed values of the richest and poorest counties in that state and the amount of value added to each of these counties by manufacturing industry, we have unimpeachable evidence of the relationship between wealth and industry.

Suppose we take that vast area extending from the southern border of Pennsylvania, West Virginia, Ohio, Illinois, Iowa and Kansas to the Gulf of Mexico and from the Atlantic Ocean to the western border of Texas. This territory contains about 31 per cent of all the land area in the United States and has a population of nearly 40,000,000 people. The South is becoming an agricultural empire and for but one reason; it is also becoming an industrial empire—an industrial empire based on a network of power lines. Regardless of its great fertility the development of the riches of the South began when industry began to go to the country and add to its agricultural domains those great values always brought about by the advent of markets and manufacturing prosperity. In the South this has been accomplished by the development of water powers and the wide distribution of electrical energy. The assessed value of the taxable property in the South has increased from $6,500,000,000 in 1900 to $30,000,000,000 in 1922.

It has been said that the geographical center of the textile industry is moving from New England to the Piedmont sector of the South. The facts are that cotton-spinning has followed the development of hydro-electric power. In North and South Carolina there has been created a great power system resulting in the establishment of 497 textile plants, which in 1923 were consuming more cotton than was produced in those states. In fact more than one-half of all the cotton spindles in the country are in the cotton states of the South which now consume more than 64 per cent of the cotton used in American mills. Power plus the cotton fields has moved the textile industry from its traditional location in the crowded New England towns and out into the country, and the three together are creating the Southern agricultural empire. It must not be inferred that the availability of power has been the sole cause of this movement. It could not have taken place however without the existence of cheap power.

The value of manufactured articles produced in the South increased from 1½ billion dollars in 1900 to nearly 7 billion dollars in 1923. While this was going on the value of Southern farm lands increased from 3¼ billions to nearly 15 billions and the value of farm products from a little less than 1½ billions to over 6 billions. Railroad mileage increased from 61,701 miles to 90,323 miles; expenditures for improved highways from 12½ million dollars annually to nearly 300 million dollars; expenditures for education from 35 million dollars to 316 million dollars a year. One could quote enough figures of this kind to fill a good-sized volume, all to prove just one thing. The South is becoming saturated with industrial enterprises made possible by its great development and expansion of power and power-transmission lines; and because of this saturation it is rapidly becoming the great agricultural empire of which it is so justly proud, an empire which sends its products to every corner of the country and the world. With this has come an era of unparalleled prosperity bringing with it good roads, unlimited educational facilities for the children of the South, and a standard of living which is second to none.

In addition to a better and more equable distribution of wealth and increased values brought about by the extension of power lines, the social effects of this movement of industry toward the country are of great importance to the progress of the nation. Until ten years ago, it was almost necessary for industry to concentrate in and around large cities because of the availability of labor, power, and transportation. As industry expanded normally, it added to the crowded conditions of these cities until in many instances living conditions became almost unbearable, particularly in the congested districts. But industry has found that by following the slender copper highway, it can "get out in the country," taking its labor with it, and that transportation will follow power and industry. This means infinitely better living conditions for the worker and his family. It means better educational facilities, better food, better air and, in fact, better everything of every kind for the rearing of children. And since the



In the Switch Yard

This picture shows the multitude of branches and switches necessary to subdivide the high-tension power for further distribution among the lesser transmission lines. The spool-like objects are the strings of insulators.

children of today are the nation of tomorrow, the healthier the children, both mentally and physically, the healthier the nation. It is the condition of the mass of the people that makes or breaks nations.

Leaving the crowded city and the workers, we will see in the next chapter how this distribution of industry adds to the prosperity of the farmer, giving him greater opportunity for himself and his family, and making life on the farm not only more bearable but even preferable to life in the cities. His markets are at his back door and he finds he can diversify his crops, raising more perishable foodstuffs. The small community or village finds itself a miniature industrial center, with all the advantages of the larger city. An army of benevolent kilowatts has sent its brigades throughout the country, and, by making the decentralization of industry possible, has added to the benefits of industry itself and brought the comforts of urban life into the rural districts, together with vast economic benefits.

CHAPTER V

The Farm as an Industrial Enterprise

SCARCELY a generation has passed since the average American farm was, at best, an isolated unit possessed of few of the ordinary comforts and conveniences of modern civilization. Practically cut off from the rest of the world in the winter, it was a lonely place, even in summer. To the farmer and his wife, it meant nothing more than a living, obtained at a price of everlasting and back-breaking drudgery, under conditions almost identical with those of their grandfathers and great-grandfathers. To the children, it meant only the most elementary education and endless chores. There were few amusements and practically no social life, except an occasional call on a neighbor. A trip to the nearest town was an event to be talked about for weeks. To summon the doctor might mean a drive of miles, as telephones in farm houses were few and far between. Bathing was confined to a Saturday-night dip in a washtub by the kitchen stove. In the evenings, the family sat around a single oil lamp and went to bed by candlelight or in the dark. The farm itself was worked by sheer human and animal labor, differing but little from farming in ancient Egypt.

Today, there are literally millions of miles of fine roads throughout the country, and hundreds of thousands of farmers and their families make almost daily trips to town to shop, to go to the movies, or to visit. To the farmer of today, a ride to town means nothing more than the trip of the average commuter going back and forth from suburb to city. There are but few farms without a telephone. The radio brings into his living room market reports and prices for his products, the latest jazz or symphonic music, lectures in the extension courses of the state university, crop reports, political speeches, the church service and everything else which is available to the city dweller. Our electric switch responds to the call of Aladdin, U. S. A., whether he be rich or poor, live in a farm house or city mansion, regardless of his creed or cast. It responds as readily to the touch of the button in the farmer's house or barn as it does to the touch of the button in the banker's residence or in the great factory. The modern farmer is quite as successful in the rôle of Aladdin as the city worker or the capitalist. In this one thing, at least, all may be equal.

What is applied electricity, and particularly that phase of it which we know as "interconnection," doing for the farmer of today? Let us look ahead a little and go with Waldemar Kaempffert writing in the *New York Times* to the farm of one John Sanderson in Pennsylvania in 1938. The electric power for this farm comes from the Susquehanna River.

> "Here are Sanderson's chicken houses, at the back of his farm, somewhat to the right. Note the electric lights. They are egg producers. In autumn and winter, Sanderson turns them on before sunrise and after sunset for an hour or two and switches them off when

it is full daylight. Rather, he sets a clock, which automatically turns the lights on and off for him, while he is in the living room listening to a radio symphony concert that comes from New York. Scientists discovered long ago that more light means more eggs, and this without speeding up the hen. So Sanderson gathers a third more eggs in winter than he would if he let nature take her course—gathers them in the very season when eggs are scarce and prices high. To the left of the huge coop is a small house—the hatchery. Inside there is an electric incubator which automatically controls the temperature with such nicety that it never fluctuates more than half a degree. And there is an electric brooder—an artificial mother that keeps chicks warm under artificial wings.

"Sanderson has not worked a pump handle or carried a drop of water for years. The Susquehanna does his pumping for him through the medium of an electric motor. Much water is used on Sanderson's farm and in Mrs. Sanderson's kitchen. But the Susquehanna fills a huge tank on a hill back of Sanderson's house, and from the tank the water flows into every farm building. There are six hydrants in the big farmyard alone, so that Sanderson can water his cattle easily when he drives them in from pasture. In the cow barn there is running water the year round—kept at the proper temperature in winter so that the cows will drink more of it.

"Sanderson used to buy ground feed and run the risk of losing some of it when mold rotted it in his bins. Now he pulls a lever. Grain drops from a bin above into a hopper. He snaps a switch. You hear the purring of a motor and grain cracking in the grinder. The Susquehanna is working for the animals. Sanderson pays no attention to the grinder. He knows that the motor will stop automatically when the allotted amount of grain has been crushed, and so he goes into the cow barn. Here he adjusts two milking machines to swollen udders. Back he goes to the grinder, which has finished its task. He switches the belt from the grinder to the suction gear that runs along the stalls in the cow barn. Presently you hear the swishing of milk in pails. The Susquehanna, seventy miles away, is milking Sanderson's cows for him—milking them better than he could milk them by hand.

"Like millions before him, Sanderson used to dry hay in the sun and sometimes lose tons of it because he and his men could not stack it quickly enough when thunderstorms swept down the valley. Sanderson has not dried hay in the open since 1930. It matters little to him now whether the sun is shining or not. The Susquehanna dries his hay for him. He distributes the grass in a long tunnel, into which a motor and a fan blow hot air. And it is better hay, richer in food value, than any he ever fed to his cattle in the days of sweat. The herd of pedigreed Holstein cows is three times as large as it was before the Susquehanna did most of the heavy work. An electrical grooming machine keeps them clean. Of course, there is an electrical cream separator and a machine that sterilizes pails and cans with electrically generated steam.

"Sanderson used to hoist hay into his barn with a block and tackle by sheer muscular power. Now an electric motor, driven by the Susquehanna, does the work for him. Farmers call it the 'chore motor' because it performs so many different tasks.

"Walk into the farm house where Mrs. Sanderson reigns. It is a step-saving house. Time was when she not only pumped every drop of water she used for washing and cooking, but carried it by the pailful from a well twelve feet from the kitchen. Then she had to stoke the stove by hand with wood carried from a pile on the back porch. Every Monday was a blue Monday, spent in bending over steaming washtubs and rubbing overalls on washboards. A bath was an event in those days of fetching and carrying. What a difference now! Mrs. Sanderson does her washing and ironing on the same day. The Susquehanna sees to that; for it drives a huge washing machine in a bright cellar, and a mangle which is electrically heated. Hot water is always on tap. Sanderson takes a shower every evening before he sits down at table.

"Cooking has been miraculously transformed. At harvest time Mrs. Sanderson and her two daughters find no difficulty in preparing meals for twenty men on an electric range. Even the dishes are washed and dried electrically. Electric toasters and coffee percolators? You will find them on the sideboard. Ice comes to the Sanderson household by wire, which means that there is an electrical refrigerator in the pantry. That there is a vacuum cleaner goes without saying.

"Sanderson and his wife are the directors of machinery and not the old-time slaves of human misery. Farming, once the most grueling and the worst paid calling in the United States, dependent largely on increased land values for profits, is transformed by 1938 into a highly capitalized technical business in which able managers make money by raising and selling cattle and produce. On the whole, Sanderson is at least ten times as efficient as was his father. It took forty-one minutes to produce a bushel of corn in 1894. Turn to Sanderson's charts and records. Five minutes in 1938. And Sanderson and his wife have leisure to read, leisure to spend a day or two in town during the winter and to see good plays and hear good music."

It sounds like a fairy tale but it is a real one; quite as real in fact as the real Aladdin's lamp in the guise of an electric button. On January 1st, 1927, there were more than 227,442 farms in 27 states receiving electric light and power service and it is estimated that 350,000 are now being operated by some distant waterfall or steam turbine. Once the connection is made with the distributing line, and there are exactly 140 uses for electricity on the farm and 190 uses for rural industries. The spirit of the switch will milk cows, hatch chickens, grind feed, pump water, shell corn, saw wood, light and heat both house and farm buildings, make butter, mix fertilizer, clip the cows, cultivate, dehydrate, candle eggs, grade fruit, cook, produce ice, shear sheep, spray fruit, pull stumps and so on *ad infinitum*. Not the least important of these operations are the things which electricity has brought to the farmer's wife; her housekeeping problems today are no greater than the problems of her city sister. Electricity can make life on the farm as pleasant and attractive as life in a metropolitan suburb. Many phases of farming are being reduced to the pulling of switches and the pushing of buttons. While the farmer is leaning over the fence watching one corporal's guard of kilowatts tame the bull or prod the cattle, his wife is taking a bridge lesson over the radio operated by another brigade.

But the elimination of the drudgery of farm life and the provision of modern conveniences are by no means the only things which electricity can do for the farmer. There are social benefits which tend to make farm life worth living. Accompanying them are economic benefits which are almost, if not quite, as important. Through the movement of industry out into the country as described in the last chapter, new markets are brought to his door—particularly for that portion of his product known as perishable foodstuffs. There has been a tendency to over-industrialize the larger communities and to over-agriculturalize the rural districts. With the help of electric power and interconnection, a better balance between industry and agriculture is being gradually established which benefits both. Just as power has a tendency in industry to maintain wages at a high level and at the same time reduce the cost of manufactured articles, so in agriculture it has a tendency to reduce the cost of farm products and at the same time give the farmer a larger margin of profit. It sounds like an economic paradox; nevertheless it is true. It is no longer a matter of speculation or experiment. There is a great mass of evidence today and the rapidity with which the farms of the United States are being electrified is ample proof of the soundness of the thesis.

Another great economic benefit to be derived from power on the farm is in the elimination of waste of both time and products. The farmer of today who has electric power can, for example, turn his corn stalks or wheat straw into pulp for the manufacture of paper, cardboard and paper containers. This not only turns his waste into a marketable product but provides occupations during the winter and rainy weather. Recently a chemist has discovered a simple and inexpensive process by which the cellulose in wheat straw can be extracted to the amount of 37 per cent of the weight of the dry straw. This process requires such a small plant that it can be set up anywhere in the vicinity of the straw. If it is profitable it may well be, as Dr. Edwin Slosson says, that we may soon be eating our bread or breakfast food while wearing neckties and stockings and reading a morning paper all made from the straw that is left in the field after harvesting the grain from which our bread or breakfast food is made. A by-product of this process is oxalic acid, useful in dyeing.

It is not difficult to visualize the farm of today as an open-air crop factory—rather than just a farm—with the farmer in the capacity of an industrialist quite as much as the manufacturer of automobiles is an industrialist. Perhaps the biggest problem with which the electric industry is faced is the problem of speed in rural electrification. For, after all, there are still about 27,000,000 people living on 6,000,000 farms, still reading by obsolete oil lamps, washing clothes in old-fashioned tubs, carrying water from the well, and cooking in kitchens differing but little from the kitchens of a hundred years ago. Over 90 per cent of the labor on farms is still done by animal or man power. There are many problems to solve before all of these farms will be receiving electric service. These are problems involving the expenditure of untold sums in additional generating facilities, transmission lines, transformers, etc. There is also the grave question of the small demand per farm in relation to the heavy expense of distribution. That these problems will be solved is proven by the manner in which even bigger problems have been solved in the past.

The question is frequently raised as to whether this tremendous project of electrifying all of the farms in the United States "will pay." Whether it does or not is hardly the question; we have the much larger question of American civilization. We must not forget that, regardless of how irritated we may be at times over the continual cry of "farm relief" and "help for the farmer," we are certainly dependent on him for our very existence, and we must find some way to keep him on the farm. We can, if we have to, get along without automobiles, without artificial light, without modern shelter and even without clothes. The ladies have proved conclusively that in this twentieth century, we can get along with but few clothes without doing serious damage to morals or health. But no one ever got along for any great length of time without food. Food we must have and, if we are to continue to eat, we must make conditions on the farm livable. We should also remember at this point that back in 1882 the bankers abandoned Mr. Edison as a visionary and a dreamer whose project for furnishing light from a central generating station was neither practical nor economically sound.

And why not? We have raised the standards of living in industrial centers and in cities and towns not only by constantly increasing wages but by providing comforts which royalty would have considered the greatest of luxuries a century ago. Louis XVI refused to accept forks, saying they were a device of the devil. Only the farmer has been forced to maintain the standards of his grandfather and he has rebelled. If he cannot get some of the good things of life on the farm, he is going to abandon it and add to the concentration of population in our already overcrowded cities. By becoming a nation of abandoned farms, we may solve the problem of the three meals a day for the housewife, but it will be because there won't be three meals a day, or even one.

There is much general misunderstanding with regard to the relation of electric power to the cost of manufacture of fertilizer. For this, Muscle Shoals and the publicity which has always attended that much press-agented enterprise is largely responsible. The facts of the matter are that if hydro-electric power in some way could produce fixed nitrogen for fertilizer at absolutely no cost at all, it would not reduce the cost of a ton of fertilizer to the farmer to the extent of one thin dime. Fixed nitrogen is nothing more or less than nitrogen in the form of one of its many compounds, such as nitrates or nitrites. Unfortunately it has been mixed up with the Muscle Shoals project and is responsible for a ten-year-old controversy which has been one long campaign of slogans. Many people still believe that it is the only hope for the American farmer.

Turning back to the records of the hearings before the Senate Committee on Agriculture and Forestry on the Ford offer for these properties, we find it said that it would save the American farmer $200,000,000 a year on his fertilizer bill. At that particular time the American farmer was using about 6,647,300 tons of fertilizer a year which, at an average price of $35 a ton, brought his annual bill to $232,655,780. In other words it was claimed that the proposed contract would reduce the cost of fertilizer from $35 a ton to considerably less than

$5 a ton. When one considers that there are ingredients in a ton of fertilizer which cost many times more than the cost of the fixed nitrogen, one can appreciate the wonderful statistical ability of some of those who testified before this committee.

CHAPTER VI

Power and the Worker

FOR many years it has been a part of the creed of those opposed to organized labor that one of the fundamental principles of the labor movement is "restricted production." From time to time it is charged that bricklayers do not lay as many bricks as they did in the "old days"; that inefficient workers are protected in their jobs by union rules which forbid the efficient worker doing any more than a specific maximum amount of work each day; that there is a continual cry for shorter hours in order that a given production in any industry shall require more workers than are reasonably needed; all of which, combined with the constant demand for high wages and resistance to labor-saving machinery, has advanced the cost of living until it has become almost unbearable for the average citizen.

The complete answer to this fallacious theory—the proof that it is nonsense—can be found in the report of the Executive Council of the American Federation of Labor, adopted by the forty-sixth annual convention of the Federation in Detroit, October, 1926, which contains the following declaration:

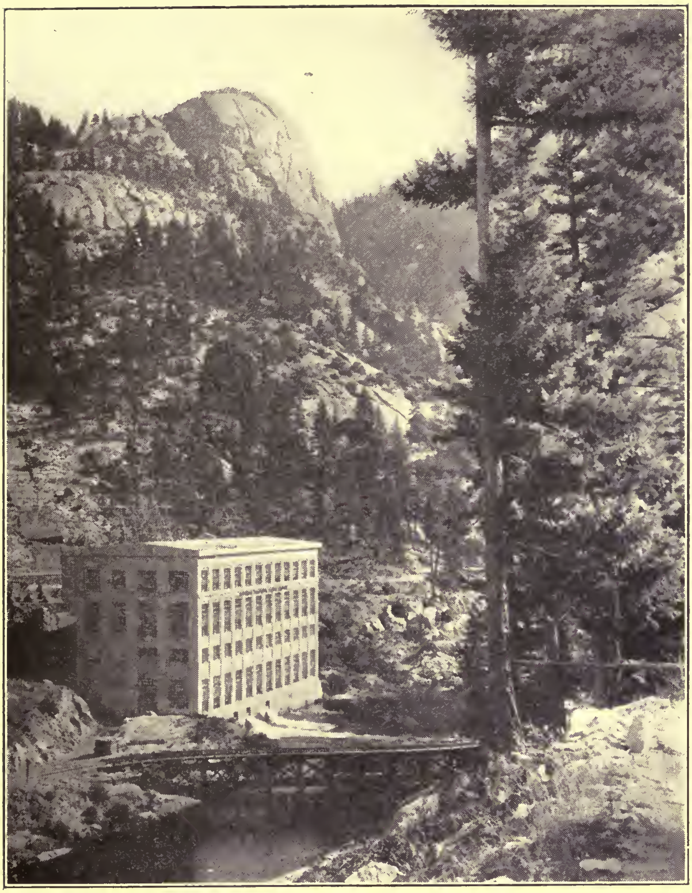
> "American wage earners are the highest paid workers in the world. A number of factors have contributed to wage increases for our workers: our wealth of natural resources, *our*

use of power and machinery, our high productivity per worker, a trade union movement that has steadfastly insisted that economic benefits were its immediate concern.

"American methods of production and efficiency are the subject of study by employers, technicians and wage earners of many countries. The American Labor Movement has been foremost in recognizing the interdependence of all concerned with production and in declaring that *increased productivity is essential* to permanent increases in the standards of living. On the other hand, American labor has pointed out that workers must have wage increases if there is to be a sale for the increased output of industries and agriculture."

Late in 1926, the government of Great Britain sent an industrial mission to the United States to uncover, if possible, the reasons for our industrial prosperity. One of the members of this mission, in summing up his conclusions, said: "If we had your power machinery and your management, we could hold our own with the best in the world." The final conclusions of this mission, as well as of a trade union mission sent on a similar errand by the *London Daily Mail,* were that the increasing horsepower placed behind our industrial machinery, making available (as there is available today) four horsepower or the equivalent of 40 man-power for every industrial worker in the country as compared with barely one horsepower for the workers of our industrial neighbors, is responsible for the prosperity of American industry and American workers, increasing wages and a lowering real cost of living. In this connection great stress was laid on electrical development as providing this vast amount of cheap power. It is mass production made possible by labor-saving machinery and the hearty cooperation of organized labor that enables our great manufacturing enterprises to accomplish that seeming paradox—increased wages and reduced cost to the consumer. At the same time, the increased wages mean increased buying power, which in turn makes possible the absorption of this increased production: a benevolent circle around which travels our army of benevolent kilowatts, organized and drilled, and furnished with transportation by means of interconnection.

To say that organized labor has resisted the development of labor-saving machinery because it increases production without increasing the number of workers required, is to say what is not true, and is also to accuse the American labor movement of a total lack of intelligent leadership. In fact, there is a close relationship between the light and power industry which furnishes the power to operate these labor-saving devices and labor. It is a relationship which affects wages, productivity and efficiency. The lives and welfare of the great mass of working people associated with industry have been vitally affected through the introduction and use of electricity in industry. It has proved that the wages of wage earners can be substantially increased while the cost of manufactured articles is materially reduced. The effect of this economic development has been



On Big Creek, Fresno County, California

One of the first developments of the Southern California Edison Company on its Big Creek-San Joaquin River project. From this river the power now runs to Los Angeles, 275 miles away.

so far-reaching that it has made an appreciable difference in the real wage received by the workers.

Whose words are these? The author's? The electric industry? Not at all. They are the words of Mr. William Green, president of the American Federation of Labor, and they were spoken at the Fiftieth Annual Convention of the National Electric Light Association held at Atlantic City in June, 1927. Mr. Green also said other things, among which was: "We hold that the best interests of wage earners, as well as the whole social group, are served by increasing production in quality as well as quantity." He recognizes, just as every other intelligent labor leader recognizes, that the spirit of the electric switch has relieved the American worker of the drudgery of back-breaking physical labor and at the same time increased his buying power to such an extent that he himself can absorb for himself and his family the thousand and one comforts and luxuries that formerly have seemed to be peculiarly the appurtenances of the wealthy. It would almost seem that one can have one's cake and eat it, too.

While the dollar wage today is more than double that of 1913, the general cost of living has advanced only about 65 per cent. In other words, the margin between earnings and expenditures is constantly widening. This is due in part at least to the introduction of electrically-driven labor-saving machinery and to the skill with which the American worker gets the most out of it: a combination which keeps him constantly in advance of his European brother. Electrical and mechanical development will continue to raise the standard of living and at the same time continue to eliminate drudgery and hazards of work.

We have seen how electric power tends to stimulate the expansion of industry in rural territory. When every section of the country is supplied with this electric power—and that time is rapidly approaching—industry can be carried on in almost any location. Manufacturing plants are already showing a tendency to move into localities where they can be closer to supplies of raw material, where there is plenty of room and where rents are comparatively cheap. The tide which has been flowing cityward is changing, and people who have been crowding more closely together are spreading out into the suburbs and the country where electricity brings them the same recreational and educational advantages and the same ease of housekeeping as in the cities. About the only effect this has on our cities as they are at present is to wipe out the slums, take the children from the tenement and the street, and give them grass, trees, flowers, fresh air, good food, education—in fact, mental and physical health. It is power traveling along the copper highway, which makes this possible.

While we take it for granted that all these improvements in living conditions for the mass of the people are being made, few people realize how extensive they are or just exactly how they have been brought about. The factors seem to be labor-saving devices, increased productivity, increased efficiency and the decentralization of industry. But what has the formula made up of these factors actually produced?

Turning to the statistics of the U. S. Department of Labor, we find that the average increase in productivity for eleven great industries is 68 per cent. The cost of living is 64 per cent higher than before the war, but wages are 134 per cent higher. In other words, while the worker has to pay $1.64 for that which cost $1.00 in 1914, he is receiving 2.34 times as much as he received before the war, with which to buy it. This is not the whole story, however. As pointed out by a writer for the Alexander Hamilton Institute, "in the past fifteen years, working hours have shown a decline ranging in some cases up to 35 per cent. In a number of branches of the iron and steel industry, working time for employees has been cut from a 12-hour to an 8-hour day, a reduction of 33 1/3 per cent. This decline in the number of hours per week which the wage earner has to work represents a direct increase in the standard of living, since the worker has more time to enjoy the additional things which his wages permit him to buy, more time is available for rest, and more time is given the worker for education and to better his condition by making and doing things for himself. In fact, it has been freely predicted that electric power will eventually bring about a four-hour working day."

The contribution of the electric industry to the well-being of the workers of America has been summed up by John Spargo, the noted economist and writer on political and social subjects, in a striking manner. He says:

> "Today there is probably mechanical energy amounting to not less than 4½ horsepower be-

hind every industrial worker in America. Behind these facts, there is the most inspiring chapter in the whole history of man's increasing mastery over his environment. They explain that greatest of all phenomena, increasing productivity with lighter toil and better living. Taken as a whole, no workers anywhere in the world work under conditions equal to those prevailing in this country, or enjoy anything like such a high standard of living. And there is no country in which inventive genius has brought into the homes of the masses so many agencies alleviating the toil of the housekeepers. It is no longer true to say, as John Stuart Mill did in his day, 'that it is doubtful whether all the mechanical inventions have lightened the day's toil of a single human being.' One has only to watch operations on any construction job for half an hour to realize that electric energy is saving human energy to a most extraordinary degree. And every time electric horsepower takes the place of human muscle, the cause of progress is served.

"Such are the results which have been obtained under a system based upon private enterprises subject to social regulation. Where Government ownership has been tried, it has achieved no results comparable to those which have been attained under the system that has prevailed in this country."

Some of the figures showing the increase in production per man per day since 1800—the real reason why the American workers' pay envelope has increased with greater rapidity than the cost of living—are interesting. In iron it has grown from 500 to 5,000 pounds. In lumber, from 100 feet to 750 feet; in nails from 5 to 500 pounds; in shoes, from 1/4 of a pair to 10 pairs; in coal from 1/2 a ton to 10 tons; in paper, from 20 square feet to 200 square feet. Much of this increase is due to cheap power.

An even more striking example is the electric brick-laying machine which lays 1200 bricks an hour as compared with the 500 a day for the average bricklayer. Three men can operate this bricklayer and with it do the work of perhaps 20 masons. If this is true, then certainly the construction industry can afford to pay these three men laying 1200 bricks an hour a better wage than it could afford to pay 20 men doing the same work by hand.

But the facts that the worker is earning real wages far in excess of his real wages of fifteen or twenty years ago and that his home life and the home life of his family have been improved immeasurably by the development of cheap power, are not quite the whole story. There are the many improvements in the conditions surrounding his actual work. The development of the individual electric motor, making it possible for every machine in industry to have its own individual power plant, under the control of the worker operating it, has added greatly to the safety and comfort of his daily tasks. It has made great headway in eliminating the long overhead shafts, pulleys, cog wheels, belts and the like, all of which provided a fertile source of painful, and many times fatal, accidents. One of the lessons which electricity has taught modern American industry is that the conservation of the worker by surrounding him with as much comfort and safety as possible, adds to productivity and lessens the overhead cost. It has taught this lesson by a practical demonstration—the simple process of doing away with the source of accidents by the installation of a type of machinery which is practically foolproof.

The attitude of the American worker toward the electric industry itself is interesting and indicative of his appreciation of what it has done for the mass of the people. We find Mr. Green, speaking of the pioneers in the industry, saying that "the initiative of those who ventured in the field of industry has been rewarded by the success of their endeavors. They have been fortunate in that they have been permitted to carry on their business in a land which guaranteed to them the right to own and possess property and to enjoy all the benefits which come from private undertaking and private enterprise." Speaking of the cooperation which exists between the power industry and labor he said:

> "It is my opinion that cooperation, understanding and a spirit of mutual interest can be exemplified in the electric power industry to as great or a greater degree than in any other industry. In the transportation lines, where electric power is being used more and more, and in public utilities companies, men and management come in close contact with each, and

> together with the general public and the public interest. Many problems of public character arise which seriously affect the economic interests of all concerned and the social interests of the great mass of working people."

In spite of these statements, however, and in spite of such declarations as "let us hope that our nation will always remain free from governmental, autocratic and dictatorial control of its industries and its workers," we find that organized labor has declared for "government ownership and operation of public utilities in principle." To many, this is thought to be little more than a "paper declaration": something of a sop to the more radical groups within their ranks. Evidence of the existence of some truth in this theory may be found in the fact that such outstanding leaders as John P. Frey, who has helped as much as any living man to shape and interpret the policies of the labor movement, can openly oppose government ownership and operation both in principle and in practice without losing caste.

After all, the fact remains that combinations of business enterprises, whether the combination be corporate, physical or simply by trade agreements, have been largely responsible for so-called mass production resulting in higher wages for the workers and lower costs to the consumers. The British delegation to study industrial conditions in the United States found that "the conditions in the United States permit of mass production for a wide domestic market. Where these big units are well-organized, they are able to distribute their risks over a variety and number of products, to develop wide domestic and foreign markets, and so to reach a higher standard of efficiency in production and distribution than is possible in small businesses. They also permit of great reductions in costs by the adoption of standardized materials, up-to-date machinery, and labor-saving devices.

"The large establishments are the most outstanding examples of the intensive use of machinery and the subdivision of processes. During the last few years, mechanical processes have been introduced to such an extent as to make possible a marked increase in production with no increase in the number of wage earners, while on the other hand there has been a considerable reduction in the average length of the working day." To this should be added—for the sake of emphasis—wages have increased much more rapidly than the cost of living.

The members of this British delegation are not the only Englishmen to reach definite conclusions from comparison of conditions in Great Britain with conditions in the United States. Two others, in a work entitled *Eclipse or Empire,* have warned England against industrial eclipse "(1) if she didn't use more power; (2) if she didn't do more research; (3) if she didn't hire more chemists; (4) if their business men didn't believe what their engineers told them, and, (5) if British labor didn't produce to its utmost capacity." To prove their point number 1, these authors made an intensive study of some 24 American industries and compared them with similar industries in England. They found that the amount of horsepower per 1,000 workers in an English boot and shoe factory was 172 while in the United States it is 486. The output of the English worker per year they valued at 171 pounds sterling while the value of the yearly output of the American worker they placed at 516 pounds sterling.

In the manufacture of cardboard boxes they found the amount of power in use in English factories to be 114 horsepower per thousand workers, as against 590 horsepower in the United States, with the output of the American worker almost double that of the English worker. Averaging the whole 24 industries, they found the horsepower per American worker to be three times that of the average British worker in corresponding industries, and that the value of a year's output in America is three times the value of a year's output in Great Britain, saying: "Everybody knows that America's wages are almost three times British wages." This has suggested a new but extremely simple law in political economy. *High wages depend on big horsepower.*

Large combinations in the United States have been made possible because of two reasons: First, the policy of the American people of leaving to individual and corporate initiative and enterprise any and all things which can be done by private enterprise; and second, due to this policy, the rapid development of the power industry. It is power plus our national principle which has caused the industrial United States to forge ahead of its European sisters so rapidly that nations are sending official delegations to study us and find out what it is all about. We *are* more prosperous than any other country in the world, and these other countries have found out why even more quickly than we have found out for ourselves.

But most important of all—electricity is turning the muscle worker into a brain worker; a director of power.

CHAPTER VII

Interconnection and the "Super-Power" Bogey

It is a common American trait—sometimes an extremely useful one—to seize upon words or phrases and bring them into common use with special meanings remote from the intent of those who coined them. Such phrases are "super-power," and "giant-power" as distinct from super-power. These two hyphenated words have only recently joined the American vocabulary, but they have been subject to more misuse and more general misunderstanding than almost any one of the newer phrases of modern times. To the average person they mean generating plants of a Gargantuan size, flashing high voltage current which spreads death and disaster to all who come within its radius, along cables "thick as a man's wrist," for incredible distances. Nothing could be further from the truth.

Sometimes it is easier to define a word or phrase by describing what it does not mean. "Super-power" does *not* mean that the amount of power generated within a given territory has been increased above a normal amount to meet the power demands. It does *not* mean that somewhere within the territory served a giant power plant has been built, taking over all of the duties and services of a score or more of small local plants. It does not necessarily mean high tension transmission lines carrying high voltage current over long distances. As used by the electrical engineer it does not mean any of the things usually associated with the term "super." Nor does it mean a "super-trust" controlled by men having some sort of super-power over those who buy their wares.

What, then, is "super-power?" The best definition to be found is in the answer given by the late Mr. Guy E. Tripp, chairman of the Board of the Westinghouse Electric and Manufacturing Company, to the question, "How can rivers be utilized?" to which he replied: "By connecting several water powers together into a single system, and by feeding into this system power from one or more supplementary steam plants." By way of explanation he added. "The variations in the flow of the water powers tend to counteract each other, especially if the water powers belong to different drainage systems; while the steam plants, which are operated only when needed to make good deficiencies in the water power, assure a definite maximum amount of power at all times with the minimum consumption of fuel. Such a composite system, which must necessarily be of large dimensions, is known as a super-power system. It not only forms the most efficient method of utilizing water power, but also possesses certain additional advantages." By "large dimensions" he meant covering a large amount of territory.

And that is the answer: It is a system of hydro-electric and steam generating plants within a given territory hooked together by "interconnection" into a power pool, as described in the first chapter, so as to make the utmost use of the water power resources within that territory and conserve our fuel and oil as far as possible. More than 65,000,000 horsepower is available from water in North America, of which only about 10,000,000 horsepower is being utilized at present. The development of this water power not only will conserve our national resources of coal and oil, but will also conserve human labor. To produce a given amount of power by steam requires many times as many men as are required to produce it by water; at least a half a million men would be released for other occupations if it were possible entirely to replace steam power with water power. Of course this will never be accomplished, as we will presently see.

But rivers, unlike steam plants, are by no means under human control. One of their characteristics is that the flow varies according to the season. A river may be capable of generating 500,000 horsepower in flood and only produce 20,000 during a period of drought. The so-called primary or "all-year-round" power at Muscle Shoals is only about 85,000 horsepower; a trivial amount as power plants and power demands go these days. If the Southeastern power area, or even a portion of the state of Alabama, should be solely dependent upon Muscle Shoals for its electric current, many of its industries would be idle a large portion of the time. It is only when it is "interconnected" with other water powers and auxiliary steam plants that the Muscle Shoals project becomes a sound economic power unit. In other words, it is but one of the sources of supply for the intake of the Southeastern power pool or power reservoir.

If we stick to the analogy of a pool or reservoir, we can recognize at once the fallacy of considering a super-power system as a device for transmitting the same power or electric current over long distances. For example, it was often said, during the controversy over the Ford offer for Muscle Shoals, that power generated at the Wilson Dam would be felt as far south as New Orleans and as far east as northeastern North Carolina. This is literally true, but not in the sense that most people understand it. In fact, power generated in Alabama had had its effect on neighboring states through interconnection for a number of years; but this does not mean that the power produced in Alabama is actually transported to North Carolina or Mississippi. It is better described by saying that it is "bucket-brigaded." In other words, if there is a shortage of power in North Carolina, as there was in 1921, North Carolina borrows a little power from South Carolina. But South Carolina may not have enough power for its own needs and the needs of North Carolina as well, so it, in turn, borrows a little power from Georgia. Georgia, being in a somewhat similar position to that of South Carolina, turns to Alabama, which may have a surplus of power. And so shortages and surpluses are balanced one against the other, and the level in our power pool maintained by interconnection with each locality and territory always assured of an abundance of power, regardless of the season or the vagaries of rivers.

As a matter of fact, the maximum distance which power can be transmitted economically at the present time is about 250 miles. At this distance there is so much loss due to leakage in transmission and distribution that not more than 70 per cent of the power generated at the central plant registers on the domestic customers' meters at the other end of the line. The power plant must, therefore, be equipped with facilities for the generation of considerably more power than it can market. This, of course, increases the overhead and eventually the price to the consumer. If, however, a considerable number of generating plants within a given territory are interconnected so that they all contribute to a general fund, so to speak, the power generated by each one of them will be "felt" throughout the territory even though it be hundreds or even thousands of square miles in extent.

This being true, there is actually no such thing as the transmission of power across two or more states, and little actual interstate transmission of power except what is called fringe distribution; that is, the furnishing of power to communities along the border of one state by a plant just across the state line and in a neighboring state. As a matter of fact, probably not more than 8 per cent of all of the electric current generated in the United States ever crosses state lines, and when it does the crossing is often "temporary." If two plants on opposite sides of a state border are interconnected, the bulk of the power may flow in one direction during certain seasons of the year or even during certain periods of the day, and in the opposite direction at other seasons of the year or other periods of the day. It is simply a process of borrowing and returning.

If interconnection does not necessarily mean the interstate transmission of power, even though the interconnected, or super-power, system covers a territory comprising several states, it is obvious that these systems cannot be considered as being engaged in interstate business in the same sense that a transcontinental railroad is engaged in interstate business. The local or single plant does not lose its purely local characteristics simply because it is "hooked up" in a system and is pouring its power into a pool rather than directly into the establishments of its customers. It has simply joined forces with other plants serving other territories, thus obtaining for its own territory the same benefits of co-operative action as it contributes to the territories of its brother plants. When a number of farmers join together in a co-operative market association, this does not mean that each farm loses its individuality or that each individual farmer has lost any of his control over his farm and its products. It simply means that he has joined in a wholesale distributing enterprise by means of which the cost of marketing is reduced, thereby benefiting both himself and the consumer.

Nor does it necessarily mean corporate consolidation into some great super-financial structure. Interconnection is accomplished just as easily between power generating companies that are absolutely independent of one another as the interconnection of the rails of two railroad companies in order to furnish facilities for the continuous journey of the trains of both companies. A contract for interchange of electric power and connection of transmission lines is all that is necessary.

Many advantages and economies accrue by this development of interconnection. The first, perhaps, is the marked reduction of reserve equipment which is necessary to take care of power demands every hour of the day and night and every day of the year. This reserve, so necessary to the isolated plant, is responsible for a big item in the cost of producing and distributing power. Naturally, a certain amount is necessary even for the largest of interconnected systems. Steam plants used to supplement hydro-electric supply at seasons when the water is low, may be idle other portions of the year. But the amount of reserve equipment per kilowatt of power generated is very much less with large scale production and interconnected distribution than with a number of small unconnected concerns.

Second, the transmission lines of an interconnected system must form a network covering a considerable amount of territory. Thus electric service is made available to many people, especially in the rural districts, who otherwise could not get it. This also makes possible the "decentralization" of industry, bringing new markets to the farmer and turning small communities into thriving miniature industrial centers. The rapid industrial development of the South during recent years and the general improvement of the condition of the Southern farmer has been due, in a very large measure, to the increase in interconnection of Southern power plants.

Third, when an interconnected system covers a considerable area and comprises both hydro-electric and steam plants, the use of the various plants can be staggered, and "seasonal" or "secondary" water power changed into "primary" or "firm" power.

Take, again, the illustration of Muscle Shoals. The Muscle Shoals plant as an isolated enterprise cannot be considered as anything more than a 85,000 horsepower plant, in so far as the power requirements of its possible territory are concerned. As part of an interconnected system which contains other supply for use during the dry season, however, it becomes a source of 210,000 horsepower which is the installed capacity.

Fourth, an interconnected system provides absolute security to every consumer against interruption of service by storms, water shortage, failure of transportation, or failure of equipment. This alone is worth all of the time and the money and the ingenuity which has been spent in its development. We have seen what it would mean if all power plants throughout the United States should suddenly become idle. The same result, in a lesser degree, accompanies the shutting down of an isolated plant on which even a single community is dependent. With interconnection, the failure of a local power means no more interruption to the service than that caused by the blowing of a fuse which is repaired in a few minutes.

Fifth, an interconnected system can use power from any economical source generated within its area. Take the case of a steel plant. Gases driven off from coke ovens and blast furnaces make excellent fuel. If the transmission lines of the interconnected system pass near the plant, power can be produced by these gases and fed into the system, thereby reducing the amount of power which must be supplied by the system's supplementary steam plant, and the heart of Secretary of Commerce Hoover cheered by the addition of another item to his "elimination of waste" program.

Sixth, the single or isolated plant is built to take care of the peak load, and a considerable portion of it is necessarily idle a part of the time. This is not so in an interconnected system, which means the release of a considerable amount of capital to be used for other purposes, as, for example, the extension of distribution into rural districts and small communities.

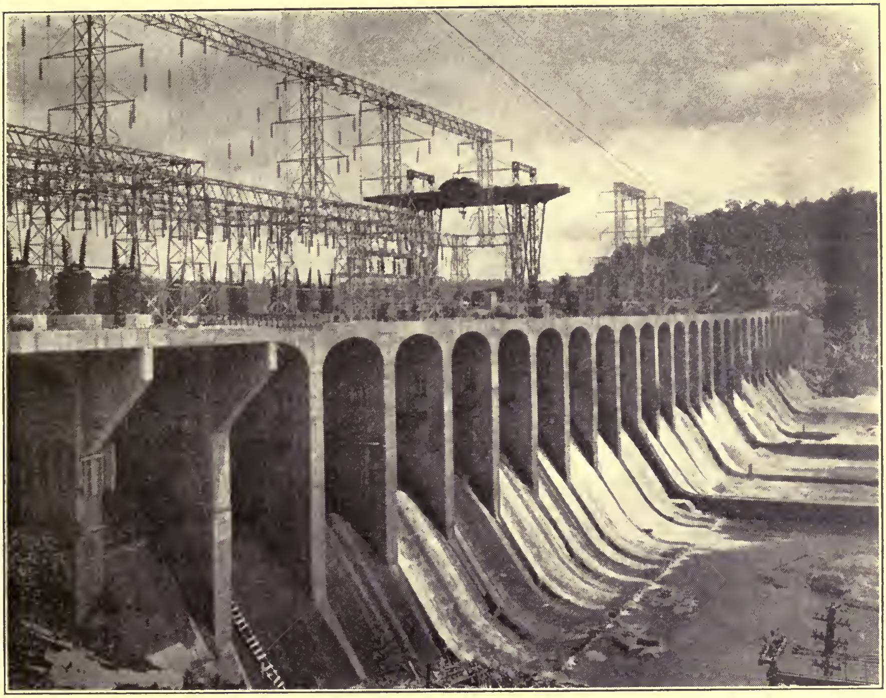
There are already many conspicuous examples of interconnection throughout the United States. One of the most striking in extent, character, and effect on the territory involved, is what is known as the Southeastern Power Area. This includes the states of North and South Carolina, Georgia, Alabama, Tennessee and Mississippi. To quote Mr. Paul S. Clapp, managing director of the National Electric Light Association:

> "The Southeast, as represented by the states in this geographic division, has made unparalleled advances in the application of electricity. No section of the country has made greater progress in development of interconnected electrical systems and in the provision of adequate and reliable power supplies which will further the growth of the whole South. In no section has there been such stimulation of industrial activity. In none is there a keener appreciation of the benefits of electric power in attracting industry and in effecting the gains in produc-

tivity which characterize our national progress since the war.

"The generation of electricity in the Southeast in the last four years has increased by 78 per cent, as compared with an increase of 32 per cent in the nation as a whole. The utilities of this division have been engaged in stupendous building programs to provide the power houses, transmission lines and distributing systems to supply this service. In five years, the electric power generating capacity available to the people has been doubled. Over 800,000 homes in these states are now reached. In ten years, Southeastern industries have added 683,000 horsepower in electric motors supplied from the interconnected system. The power utilized in these industries has steadily increased until now each worker in the Southeast has 4.08 horsepower as against an average of 3.77 horsepower for the workers of the country." (These were the figures for the year 1923. In 1925 the average for the workers of the United States was 4.2 horsepower.)

Another important interconnected system is in the Central Northwest, comprising the states of Minnesota, Wisconsin, North Dakota, South Dakota, Iowa and Illinois, a conspicuous example of the success of interconnection in supplying the electrical requirements of a large territory. It serves a population of 1,400,000 people in 505 communities in six states and is operated by the Northern States Power Company. It consists of 27 hydro-electric plants and



Unique Among Power Developments: The Mitchell Dam on the Coosa River, Alabama, During Construction

Beside the switching and transforming equipment, the super-structure of this dam of the Alabama Power Company carries a standard-gauge railroad.

25 steam electric plants, with a total capacity of 447,562 horsepower, distributed by a vast network of 3,178 miles of high voltage transmission lines interconnecting these power sources. In 1921, the public utilities in this territory were serving 299,247 customers. In 1927, this great interconnected system was serving 313,343 customers. In 1921, the kilowatt-hour output was 510,331,587, which was increased during the past six years to 805,380,692 kilowatt-hours. The gross earnings had increased to $23,155,955. This, of course, means that interconnection has brought about a great industrial expansion and has also extended the use of electricity to large territories where it has never before been available.

Perhaps the most conspicuous and most recent example of interconnection in the East is the agreement entered into by the Philadelphia Electric Company, the Pennsylvania Light and Power Company, and the Public Service Gas and Electric Company of New Jersey. At the present time this forms the world's largest power pool and the total cost of the transmission lines and transforming stations will exceed 26 million dollars. It will mean great economies in operation, an interchange of power at peak hours which differ in the three companies, and eventually lower rates to all classes of consumers.

A striking example of a giant power pool constructed to guard against any interruption of service is illustrated by the completion of a 132,000 volt transmission line between Kingsport, Tennessee, and Saltville, Virginia. When this line was put into operation, it connected the great hydro-electric resources of the South and the steam generating plants of the North. Mr. George N. Tidd, President of the American Gas and Electric Company and the Appalachian Electric Power Company has given a graphic description of the big double circuit hook-up by the completion of the Kingsport line. He says:

> "The completion of the line gives loop, or double circuit, facilities for the transmission of electric power as needed between systems covering the Southeastern states from Tennessee and the Carolinas to the Gulf and the extensive interconnected transmission lines reaching through the Virginias, Ohio and Indiana into Illinois and Michigan and to the Northeast through and beyond Pennsylvania. In the contingency of an accident affecting a line, service can now be looped around the trouble by way of the other line, and even the line in trouble can be fed from both ends to the vicinity of the interruption. The importance of this new interconnection in the need of industries for reliable electric power is very evident."

Interconnection is rapidly progressing in the Northeast. This power area will eventually include the states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, New Jersey, Delaware, Maryland and the District of Columbia. It will include such great sources of water power as the Niagara River, the St. Lawrence River, the Delaware River, the Susquehanna River, the tributaries of the upper

Ohio, the Adirondack powers, the Potomac River and the state of Maine rivers. The report of the Northeast Super-power Committee, of which Secretary of Commerce Hoover was chairman, and which made an exhaustive study of power development in this area reached the following conclusions:

> "The economical and adequate power supplies for this area require
>
> "(a) Extension of interconnection between different systems.
>
> "(b) The building of large, centralized, steam-electric plants located at strategic points.
>
> "(c) The development of the large hydro-electric projects."

It also stated that the economic values of such development would be:

> "1. An estimated reduction of our coal consumption by over 50,000,000 tons annually.
>
> "2. More economical production of power.
>
> "3. Security in power supplies against interruption with its losses through disturbed production and unemployment.
>
> "4. Larger reserves of power through which other industrial development need not lag, awaiting power construction.
>
> "5. Electrification of transportation with increase in its efficiency.
>
> "6. Extension of power uses to the farm.
>
> "7. Decrease in human labor."

New York State is itself already one vast interconnected system. Ninety-five per cent of the state has been connected up, benefiting 11 million people with the prospects of cheaper rates and better service. Much of this work has been done within the past two years.

There is no apparent reason why these present existing and projected interconnected systems should not eventually be themselves interconnected, until the entire United States and Canada is served by only such a number of systems as economic conditions dictate. When this is accomplished, there will not be a single village so small, and few cottages or farms which will not have electric service. There is nothing visionary about this scheme, for its construction is entirely feasible with modern electrical apparatus.

But such colossal projects directly concern the public; and already there are murmurings over the suggestion that enterprises of this size should be placed entirely in the hands of private interests, no matter how drastic the regulatory laws. On the other hand, there is little difference between even a single interconnected system serving the entire nation and the telephone which has been accepted as a natural monopoly. Certainly no one would wish to return to the old days of thousands of independent telephone companies, with their lack of long distance facilities, meager financial resources, and cumbersome and crude equipment. Yet the difference between those telephone days and the present-day system of the American Telephone and Telegraph Company is no greater than the difference between pre-war electric-power days and the modern interconnected power system. The improvement in the telephone service has been no greater than the improvement in electric light and power service, and in both cases improvement in services and reductions of costs to the ultimate consumer have been brought about by interconnection. When a public service is a natural monopoly, it is a natural monopoly which cannot be escaped any more than humanity can escape the inevitable workings of natural laws. To resist this fact and attempt to change it means only one thing: retrogression.

CHAPTER VIII

Organizing the Streams

THE closing paragraphs of the last chapter raise at once the whole question of governmental policy with regard to power development throughout the United States—a question which is making an effort to become an outstanding national issue. It is not the intention of the author to discuss power and politics at this time—that is reserved for a chapter all its own. It seems advisable at this point, however, to outline the facts of the so-called public versus private ownership controversy, and the various creeds of government ownership and operation; or, rather, the various levels of the groups advocating some form of government ownership and operation.

There is a great variety of shades of public ownership opinion, ranging all the way from those groups advocating a paternalistic form of government which abandons its traditional duties of governing to assume the operation and management of vast business enterprises, to groups which go no further than to advocate the retention of title to certain important power sites, leaving it to individual initiative to develop and operate those resources under some form of government regulation.

It is needless to say that with one or two brilliant and outstanding exceptions, there are no men prominent in public life who belong to the extremely radical group which advocates the nationalization of everything from mines to shipping, from the manufacture of boots and shoes to the manufacture of electrical energy, from life insurance to religion, from transportation and communications to the manufacture of clothes for the newborn infant and coffins for the citizen who has succumbed to the unbearable burden of too much government and too little freedom. This of course is the basic principle of the present government of Soviet Russia. It may be admirably suited to a country where the great mass of the people are almost totally lacking in modern education and where transportation and communications are, at best, in a most elementary stage of development. But for an enlightened nation such as ours it just won't work. The radical European socialist finds cold comfort in America, regardless of what circle may engage his attention. The American worker, with his superior education and high standards of living, is no more receptive to his arguments than the bank president or managing director of a large industrial establishment.

The next group, only a little less radical than the one just described, argues that only those things which have a definite public interest should be owned and operated by the government. This includes the railroads, telephone and telegraph, electric light, power, gas and water utilities, and insurance. It would leave the manufacturing of automobiles, clothing, and the like to individual initiative, as well as all retail business. In this group we find many men prominent in public life who sincerely believe that government operation of these public services would result in greater benefits to the people as a whole.

Narrowing the discussion down to the electric light and power service, we find a third group which believes in what is called government ownership and private operation of hydro-electric plants. The members of this group advocate the retention of ownership of all facilities for the utilization of water power, but the leasing of them to private companies which would operate the plants and distribute the light and power under the provisions of the lease. Between the second and this third group is a small group advocating government ownership and operation of hydro-electric generating plants, but selling the power to private distributing companies, controlling their activities and the rates charged by the terms of the contract under which they purchase the power wholesale for purposes of selling it at retail.

To this group belong those who advocate government ownership and operation of certain so-called "key" power sites such as Muscle Shoals, the St. Lawrence River Power project, Potomac Falls near Washington, Boulder Canyon Dam and the Columbia River Basin project. They argue that by holding these key positions the federal government can always control the power situation.

Finally, there is the group to which a majority of the people of the United States seem to belong, and which believes in the development, ownership and operation of all public utility projects by private initiative under the present scheme of state commission regulation. It is under this system that the electric service has reached its present high state of efficiency; and the questions naturally arise: Is this the time and are conditions such that a drastic change in our national policy is wise? Is there a necessity or a definite public demand for such a change? Will a change from a policy of leaving business to private enterprise and individual initiative to a policy of government ownership and operation, or, to use a popular phrase, "government in business," mean progress or retrogression? The author does not propose to attempt to answer these questions—his self-imposed duty is only to present a few of the facts as he sees them.

The most popular scheme of the many which have been proposed for the purpose of accomplishing some sort of a change in policy is the one which provides for government ownership and operation of certain "key" power projects, such as Muscle Shoals, Boulder Canyon Dam, the St. Lawrence River and the Potomac River hydro-electric developments. A majority of the advocates of this idea do not propose that the government shall necessarily distribute the power generated at these plants—they simply propose that the government shall own and operate the plants selling the electricity generated to private distributing companies which may be either already in existence or which may come into existence because of the opportunity of acting in the capacity of middle man between the government manufacturer and the citizen consumer.

In considering this proposal two things must be kept constantly in mind: First, the tremendous development of electric light and power service and its extension into the highways and byways as well as in the larger cities have been due to interconnection of the power resources scattered throughout a considerable area. Second, the isolated plant operated independently of the interconnected system is antiquated, costly, unreliable and inefficient. If the government is to own and operate these individual plants, it must be prepared to do one of two things: it must make a deal with the present interconnected systems so that the power generated may be poured into the power pool or reservoir, or it must parallel the present existing transmission lines belonging to private companies and enter into competition with its own citizens within a radius of some hundreds of miles. Even a most casual examination of the past history and experience of the industry will clearly demonstrate that even the federal government cannot manufacture electricity in these isolated plants as cheaply as can the great interconnected system by reason of its large scale operations. In order to compete, it must therefore sell power at a loss, which can only be covered up by charging such items as interest on the money invested, amortization and depreciation to the taxpayers as a whole instead of to the consumers of the power and light.

On the other hand, if the government proposes to keep out of the field of competition, it must either lease the plant itself or operate it, selling the power to private distributors. But the present distributors in interconnected areas already have ample power facilities, as well as potential resources which they can develop rapidly and easily as the consumption in their territories may demand. They can hardly be expected to purchase power at a greater cost than they can generate it themselves—if they do, this additional cost will ultimately be passed on to the consumer. It has been argued that if the government builds the power plants, it will release an equal amount of private capital for other purposes and thus place the government in a position of lending a helping hand to the electric industry. But money is money and demands its interest, regardless of whether it is the government's money or money obtained from private bankers. It may be that the federal government can borrow money more cheaply than the private individual. But here again we find the ultimate consumer paying the bill as a taxpayer, for what the government saves in interest it loses in taxes; government-owned utilities pay none.

What will be the effect of such a scheme on the orderly development of hydro-electric power resources on a national scale, such as has been suggested in the preceding chapter? It is doubtful if anyone knows the answer. None of these "key" locations are of great importance to existing and proposed interconnected systems, in spite of the nation-wide publicity which has been given them. True, as individual units in the system, they will contribute to the general pool and thereby increase the scale of the operation and contribute to the movement to reduce costs. As independent operations under an ownership separate and distinct from the ownership of the distributing lines, they lose in importance and represent a step backward instead of forward. Even the advocates of government ownership and operation admit that interconnection is not only important but absolutely necessary to continued progress.

Muscle Shoals, as an independent power project, is only an 85,000 horsepower plant. It is doubtful if the Wilson Dam would ever have been built had it not been for the war. The site was owned by the Alabama Power Company which, although it paid approximately half a million for it, gave it to the government for $1.00 cash money. At that time, Muscle Shoals was not considered as a power plant; it was a project to manufacture nitrogen compounds for national defense in time of war and fertilizer in time of peace. But during the past three years, processes for the fixation of nitrogen have been developed which have caused Muscle Shoals to become entirely out of fashion in both the munitions and the fertilizer industry. It no longer has anything to contribute to the armies and navies of the United States or to the American farmer. The government already has invested a very much larger sum in the dam and generating plants than would have been needed had it been developed as a part of the Southeastern interconnected system. As a power project, Muscle Shoals is almost as much of an orphan as it is when essaying the rôle of first aid to the farmer or a unit in national defense. The only part that seems to be left for it is in the character of a national issue, and as such it has been a most satisfactory football for various groups and Congressional committees for ten years.

The proposed hydro-electric power development on the Colorado River at Boulder Canyon, which has been the subject of so much controversy in Congress and in the various states which presumably will be affected by it, is a similar case. The ostensible purpose of spending $125,000,000 in Boulder Canyon is for flood control in the Imperial Valley and for irrigation. The proposed hydro-electric plant is thrown in for good measure and to provide a means whereby the government theoretically can make a sufficient profit eventually to pay back into the Treasury the entire cost of construction. Incidentally, this is the first time it has been proposed that the government go into business for profit in order to pay for government enterprises designed for the welfare of the people as a whole.

Boulder Canyon Dam as a project for flood control or to provide water for irrigation purposes, thereby creating more farms, is one thing; but Boulder Canyon Dam as a hydro-electric power project is quite another. Will it fit in with the interconnected systems of either the Pacific Coast or the Middle West? If it is to become a part of either system, it must transport current over two to three hundred miles of line; and it has been said that the cost of the power delivered at the end of those lines would be prohibitive, far in excess of the cost of electricity generated by steam plants local in character. It has no immediate local market to help reduce these costs, and probably never will have. The eastward and the Middle states development is extending its lines westward, and both have indicated that they can get along very well without a giant hydro-electric power plant in the desert wastes surrounding the Colorado River at Boulder Canyon.

Here again we have the question: What would the government do with Boulder Canyon Dam should it get it? Will it go into competition with existing distributing systems or will it attempt to sell the power generated to these systems? What will it do if the companies prefer to market their own product which they can manufacture more cheaply than they can buy it from Boulder Canyon Dam? What will be the effect of this power plant on the orderly development of interconnection in the West as part of a great national scheme? Again the people of the United States should consider these matters thoughtfully. The author does not pretend to give the answers: he simply raises the questions for discussion.

The great hydro-electric plant proposed in connection with the development of the St. Lawrence waterway from the Great Lakes to the sea is presumed to give impetus to the extension of power and light facilities throughout the Northeast, but will it? Interconnection is progressing rapidly in the New England states, and in New York and Pennsylvania as well. Within this area there still remains many potential water powers which can be brought into the system as fast as the demand for electric current justifies the investment. They are already a part of a carefully coordinated scheme of extension and development; if it does nothing else the injection of a large unit of power from the St. Lawrence will necessitate the readjustment of many local ideas. It can be seen that the St. Lawrence power project as part of a continental scheme embracing not only all of the United States but Canada as well, might take on great importance; but its value to the New England states, New York and Pennsylvania is at least open to discussion.

Considered as a scheme to earn money for the government, the St. Lawrence power project is quite different from the Boulder Canyon project. At Boulder Canyon at least two-thirds of the dam would be useless except for power—otherwise it is unnecessary. On the St. Lawrence, however, the very structure necessary for navigation purposes would also provide the power. No additional construction is necessary and therefore its utilization for power purposes becomes purely incidental.

If we can agree that the electric light and power systems of the nation are natural regulated monopolies and that their future development in the interests of the most people depends on an extension of the principle of interconnection, it seems logical that there is only one scheme of government ownership and operation which might succeed from a practical operating standpoint. This is the scheme of our second group, which would have the government take over all generating plants and transmission lines throughout the country and operate them as a government business. Divided ownership and responsibilities between private companies and the federal government might easily open the door to endless confusion, expensive controversies, interrupted service and a species of political blackmail which can be contemplated by American business only with a feeling akin to terror.

What is implied in government ownership and operation of the electric industry? This is a question which is answered more easily than the question: How will the American people benefit by such a radical change? If government ownership is sound for electrical and other utilities, it is sound for the railroads. In fact, it is almost necessary to include at least the railroads, for we can today look forward to the time when many of the larger railroads will have abandoned much of their motive machinery and will be buying the power to move their trains from the great power systems.

If we consider therefore that the railroads, street railways, power and light companies should all be taken over by the government, we find that it would be faced with an initial investment of about 40 billions of dollars; for this is the value placed on these properties by official commissions. This is so staggering a sum that it cannot be visualized, except perhaps by an international banker.

But this is only the beginning of the story. It would also mean the government taking over no less than 2,700,000 employees, thereby creating at once a political hierarchy undreamed of even by the most dictatorial of bureaucratic governments. True, a lot of folks would get jobs in the utility industry who are unable to get them now, but the benefits to the public of this result is problematical. The interest on the investment alone would amount to at least two billion dollars each year; the operating budget would exceed ten billion dollars, while the government would have to dig up somewhere at least two billion dollars annually to take care of extensions and improvement. As Secretary of Commerce Herbert Hoover said in 1924: "Surely before we embark on such a voyage, we should look into the possibility of profit, examine the chart of the place where we are going, and consider the capacity of our vessel to carry the cargo."

The question seems to resolve itself somewhat in the following fashion: "Shall the development of the power resources of the United States be permitted to continue its progression of the last few years under government regulation as to service, rates and security issues, or shall we dodge off into an unknown path and consider light and power as something which belongs to all of the people and which should be developed, owned and operated by the people's government?"

We know exactly by past experience what private initiative will do with the business, but do we know what the government will do with it? Can executive departments, bureaus, commissions, division heads, and members of Congress take the place of the veterans who started out in 1882 on an unknown sea and brought their ship, with its strange unheard-of cargo, into the port of present day electric service? Again, the author would like to turn to Mr. Herbert Hoover, because he appears to have a broader vision of this whole subject than any other man in the United States, and because, by no stretch of the imagination, can he be identified with the electric industry. He says:

> "Neither our National nor our state governments are planned or equipped for the task of government operation of utilities. Nobody ever tried it on our stupendous scale of a continent. Nevertheless, there are governments

which, in their smaller scope, do operate in some fashion some of their utilities. Since it is always in worse fashion than ours, their example is no temptation to imitate, but it does illustrate that some governments, on some scale, in some fashion, can operate some of them. But none of them has ever attempted to operate all the utilities, nor does any one of them possess 15 per cent of our railway mileage, or 6 per cent of our power, or 15 per cent of our telephones.

"I would also have you observe that these governments all have much more concentrated power and responsibility than we have ever been willing to grant to our government. The fathers purposely made our government to a different model, for a different task. They divided power and responsibility, where business must concentrate them. They thought liberty and individual rights worth safeguarding even at some cost in efficiency. But this very fact necessarily leaves to private enterprise many things which other nations can, if they prefer, do through government—after a fashion. On the governmental side, the result has been one of which we are as proud as other peoples are envious. On the business side, the accomplishment far surpassses anything they know. Through the one, we have liberty; through the other, enterprise and decisiveness.

"Our form of government, which we have developed over 150 years, has assured us a measure of freedom and progress hitherto unparalleled in political history. The more we cherish it the less ready we should be to load it with a burden for which it was not built. To bear this load, the Constitution would need to be rewritten in a score of places, until it was no longer our democracy. Above all, it would change the major thought and purpose of our government into the making of money instead of devotion to the preservation of basic human liberties—a big enough job in these times.

"The very first fundamental obstacle to government ownership that our form of government presents is the relation of the states to the federal government. For in our plan, we conceive that liberty requires a great measure of decentralization in authority. If these public utilities are to be operated by the federal government, we at once deprive the states of their measure of authority and control over railway, power, light and communication companies—we make the service in these states dependent upon the will of Washington, thousands of miles away. Are we to give the states the power to regulate the business of the federal government as they now regulate these services? Or are we going to divide the railways and power and communications into 48 systems, each ending at the boundary of its own state? Whichever we do will crack the timbers of our government.

"If we pile these forty billions of business and two million, seven hundred thousand employees upon the government, one of two things happens. Either the 530 members of Congress or the hundreds of members of state legislatures become their real boards of directors, or, as it has been claimed, these great businesses could be placed in the hands of non-partisan commissions or government corporations, somehow free from politics and the dead hand of bureaucracy. Neither alternative will work. If we were to set up such agencies, so free from restraint of the Congress and legislatures as to accomplish these objects, we would have created gigantic despotisms controlling the well-being of our whole people—and incidentally controlling the very election of our officials.

"As a matter of fact, we can do nothing of the kind if we are to maintain a democracy. We cannot have a democracy and deprive our elected representatives of their control of government investment, their power to fix salaries and wages, their independence in the investigation of the conduct of public officials. The reservation of any or all of these powers renders any kind of a commission subservient to the members of the legislative bodies, no matter what the theory is. When they are subservient to elected officials, politics will be their daily meat. Above all, the members of our legislative bodies represent districts, states, parties and groups of opinion. Each member is expected by his constituents to look out for their local or group interests first. They have to be elected upon the results they obtain. Under government ownership, partisanship, 'log-rolling,' and politics would be the inseparable accompaniments of administration. No great business can be efficiently administered by such a board or such a basis of choice. *We shall convert business into politics, and surrender efficiency for spoils. If we distribute railway extensions as we distribute public buildings; if we locate electric power plants as we locate reclamation projects; if we divide up public industries generally as we share river and harbor improvements and army and navy stations—then, as surely as night follows the day, facilities will be wastefully provided for those districts or groups which are politically strong, and they will not be adequately provided for the districts or groups which are politically weak.*

"Also, under a régime of government ownership, these legislative bodies would have to deal with group pressures striving for favors in rates. The relative rates will affect the prosperity of every city and every section, every group and every industry. States, counties, farmers, town dwellers, every group of manufacturers, will press their representatives to secure an advantage, and legislators will inevitably honestly favor their constituents. Every experience to date indicates that the taxpayer will pay for the resulting concessions. Because the government had not the courage to increase railway rates during the war, *the taxpayer made up a $1,600,000,000 operation* *deficit.* A neighboring government yielded last year to the demand for lower rates on the government railways; it is paying the deficit from taxes today.

"If we embark on this vast venture, we shall at once increase the total of national and local office holders up to about six millions. The rightful interest of this group is in higher pay, constantly better conditions of service, and better standards of living. The rightful public interest will be to hold down rates and taxes. These interests will clash, and their clash must fight itself out, not on grounds of economic bargaining between labor and employer, but in the political arena. The voting strength of this mass of office holders, their wives and dependents, will be over 25 per cent of the whole. It is the balance of political power between parties in every district. Either every member of the legislative bodies will be elected to do the bidding of this bureaucracy or will be elected by a public in rebellion against it.

"No commission or any body of administrators can carry on these vast operations efficiently in this political maelstrom. We shall lose most of our democracy in the storm.

"Unless the federal or local governments can give the public lower rates, there is no use undertaking the gamble.

"If the government is to reduce rates, it must do so either by the saving of private profits or by reducing operating expenses or lumping them on the taxpayer. During the past four years, the railways have on an average earned less than 4 per cent on the Interstate Commerce Commission valuation. Even if this value were reduced by 25 per cent, they would have earned only 5 per cent. Our electrical utilities are regulated at earnings between 6 and 8 per cent upon their invested capital. The government could not borrow the huge sums necessary at less than 5 per cent.

"In a sale to the government, the constitutional requirements would, for various legal reasons, probably result in a much larger sum than the forty billion dollars of present valuations by commissions and others.

"Moreover, the wasteful distribution of the hundred and fifty million of capital invested annually in the Post Office, Reclamation Service, Shipping Board, rivers and harbors and roads, would not be a patch on the waste in appropriations when our legislative bodies get a chance to handle two billions per annum of new capital outlay. For all these reasons, I am convinced that interest charges alone to the government would be larger than the present utility profits, and no economy lies there. Rather the way of the prodigal.

"Nor can the government operate as economically as private enterprise. If we take over nearly three million new employees into public service, we must put them under an airtight civil service, to be hired by a separate commission and promoted by seniority. At once we have created a bureaucracy. Otherwise, we would have nearly three million jobs to be given out and a political debauchery unparalleled in all history. There are certain inherent qualities of bureaucracy in its deliberative action, the necessity to maintain joint responsibility, its enlargement of 'red tape' designed to prevent error in judgment and conduct, all of which are perhaps an advantage in purely governing functions, but they become disaster when applied to the rapidity of movement vital to business and service. Numbers increase for every task. The alternative is political favoritism. And at the top where exceptional talent and genius must be had, neither seniority, nor competitive examination, nor politics will secure or find it. It is one thing to choose a postmaster but another to choose a railway president. These things are the actual and daily experiences of our public life; and if a hundred years of this experience is not proof that the efficiency of government operation must always be below the efficiency of private enterprise, then the public is incapable of conviction.

"We can get some direct experience from government operated railways in foreign countries during the last ten years as the results of these forces in this loading of employees. For instance, the number of employees of Italian railways had increased 50 per cent against an increase in traffic of 18 per cent. German employees increased 20 per cent against 5 per cent increase in traffic. Danish employees increased 48 per cent with 20 per cent increase in traffic. Swedish employees increased 10 per cent with a 25 per cent decrease in traffic. Norwegian employees increased 62 per cent with an increase in traffic of 37 per cent. Compare these figures with American railways, where the number of employees is about the same today as ten years ago, against a 10 per cent increase in traffic. American railways are the only railways on earth showing increased efficiency in the last ten years. Incidentally, ours are the most efficient railway men, employees and managers on earth. If we had increased our employees by such percentages, it would cost $600,000,000 per annum or an increase of 10 per cent in rates. For the rates today are, in the long view, based upon costs.

"With all these forces in action, our cost of operation would increase. If we make rates to equal costs, our rates will rise—not fall. Unless, of course, the taxpayer pays the deficit."

There we have this whole question of the coordinated development of our power resources in a nutshell. Shall we continue as we have during the past few years, or are there some unknown, undiscovered benefits in government ownership and operation which can persuade us to face the picture drawn so graphically by Mr. Hoover? The answer, of course, lies in the social, political, and industrial implications of applied electricity; the modern Aladdin of the electric switch.

CHAPTER IX

White Coal vs. Black Coal

THERE is a popular fancy that since water costs nothing and runs down hill, its metamorphosis into power is a simple and inexpensive matter which anyone can undertake regardless of previous experience or financial standing. One has only to turn to the records of the Federal Water Power Commission and examine the applications filed with it to understand the prevalence of this point of view. During the past seven years, the Commission has received hundreds of these applications from individuals, corporations and municipalities, many of whom have no apparent ability to finance the proposed undertaking, no training or experience in hydro-electric development, and no adequate conception of the problems involved.

If one should suggest to a manufacturer that the total cost of his product is raw materials plus the labor involved in fabricating it, and that therefore the difference between these costs and the retail price of the article is his profit, he would either laugh or else become indignant over such abysmal ignorance. In most instances, these are the smallest items on his cost sheet. To them must be added interest on investment, reserve for depreciation, advertising, distribution, sales, accounting, collections, losses from bad accounts, and an infinite variety of other charges. The amount of raw material in a pair of woolen blankets may cost the manufacturer not more than a dollar; yet the price of those same blankets to the ultimate consumer may be $25.00. At the same time, the manufacturer may be lucky if his net profit is fifty cents. In many instances, the mere cost of selling an article is many times the cost of the raw material plus the cost of making it.

The fact that water, which is the raw material for the manufacture of electricity in a hydro-electric plant, costs nothing, and coal, which is the raw material for the manufacturer of electricity in a steam generating plant, costs something, does not necessarily mean that the hydro-electric plant is cheaper either to build or operate than the steam plant. In fact, the contrary is frequently the case. It may not sound reasonable but it is so. If it were only necessary to stick a water wheel down into a stream, hook it up with a generator, turn on the switch and have electricity for all the world, it might be so. But there are many other things to be done before power and light service from water power becomes a fact, and all of these things cost money; sometimes a lot more money than to give the same service from a steam generating plant, burning up dollars and cents in the form of coal or oil.

Let us look over some of the items involved in the installation of a hydro-electric power. In the first place, a dam must be erected, and dams cost real money. One cannot measure this cost in sacks of cement and pounds of steel. Camps must be established, roads or railways built, construction equipment installed, foundations excavated or drained, reservoirs cleared, debris removed, and a general overhead organization maintained. These costs are not visible when a water power project is in operation, but they are there and require a permanent investment of capital on which interest must be earned for ever and ever.

In addition to the cost of the dam there is the cost of the generating plant. In the case of a steam plant, it is necessary to install only enough generating equipment to take care of the existing demand. Steam plants are built in units and as the demand for power and light increases, more units can be added. In other words, there is a minimum initial investment. With the hydro-electric plant, the situation is quite different; maximum investment in the dam is required at the outset. Conditions may be such that the storage dam will be two, or three, or even four times as large as the market requires. This means vast sums of capital tied up, demanding its wages each day, but on which no return can be expected for many years. Hydro-electric power cannot be stored or provided for in units as the market for power warrants. Once installed, fixed charges on the dam have been assumed which, in many cases, more than offset the difference in the cost of coal and the cost of water.

Having installed the generating plant, both hydro-electric and steam generating projects must have a system of transmission and distribution. These are far in excess of the cost of generating. In fact, the capital expenditure for transmission and distribution is greater than all other costs combined. In the case of one large and typical utility using water power, the average cost of power at the switchboard is 4.25 mills per kilowatt hour. But in order to guarantee continuous service and furnish part of the power requirements of the territory during periods of low water, this company has to have a reserve steam plant, carrying with it operation, depreciation and interest charges, which bring the cost up to 6.28 mills. Transmission losses and costs, taxes and general expenses bring the cost of this power to one cent at the point of delivery to the distribution system. Distribution costs from this point to the industrial consumer practically double this cost, bringing it up to two cents. With the domestic consumer, there is the cost of local distribution, interest, depreciation and maintenance on the distributing system and meters, handling the accounts, and other general expense items. The cost of delivery to the average residence may run as high as seven or even eight cents, of which only about 15 per cent is chargeable to generation.

A good example of the lack of popular understanding of the relation between the cost of generating electricity and the cost of distributing it, is in the case of the proposed water power development at Great Falls in the Potomac River. Citizens of the District of Columbia think this will cut their electric light bills in two. As a matter of fact, it would make no appreciable difference in the cost of furnishing light and power on the monthly bill of the average Washington residence. It would, however, conserve coal at certain seasons of the year which is an economic benefit to the nation.

A good example of the major costs in a typical modern hydro-electric plant can be found in a certain California project. This plant, which has a 45,000 horsepower capacity, consists of a diverting dam, a tunnel 3½ miles in length, a concrete power house with generating equipment, 180 miles of transmission lines and four substations. The power house with all of its hydraulic and electrical equipment costs only $29 per horsepower; less than one-fifth of the total. The dam, conduits, and tail-race together cost $89, and the transmission lines and substations, $34. Transportation facilities alone cost nearly $5 per horsepower. If this plant had not been an addition to an existing interconnected system, it would have been necessary to add from $40 to $60 a horsepower for steam reserve and probably as much more for distribution lines and equipment.

Returning to a consideration of the relative costs and merits of hydro *vs.* steam generation, there are many other factors which must be taken into account. Not the least of these is the question of location. In many instances, the distance of the hydro-electric plant from its principal market makes it impossible for it to compete with a steam plant located in the heart of the territory to be served. Take the case of the proposed power development at Boulder Canyon. According to a study made by engineers, the estimated cost of the dam, power house, generating equipment and step-up transformers would be about $83,000,000 without interest to develop 550,000 horsepower of firm power, or $151.00 per horsepower. But the market for this power is from 200 to 300 miles from the power plant. The cost of transmission, including six substations, has been estimated to be $60,000,000, or $109 per horsepower, making a total of $260 per horsepower. Furthermore, these estimates assume that the power will be delivered to distributing systems already in existence and that nothing need be included for distributing lines and equipment or for steam auxiliaries. It is significant to note that in this case the capital costs of transmission are greater than all other costs combined.

Muscle Shoals is another excellent example of the lack of economic soundness in a great hydro-electric plant as an isolated project. This enterprise has already cost the government at least something more than $100,000,000. No one seems to know at this time just exactly how much money the Treasury has been called upon to pay out. We have seen that during periods of low water, it will only generate 85,000 horsepower. This, therefore, is the capacity of the plant which gives us a cost of at least $117.50 per horsepower. Muscle Shoals, however, has an installed capacity of 215,000 horsepower for several months of the year. As part of an interconnected system, with plenty of steam reserve to fill in during the dry season, it becomes a 215,000-horsepower plant and economically sound. Again we are faced with the fact that many of our water-power resources are almost, if not entirely, useless unless they are supplemented with steam reserve plants. They cannot supply the demand.

Other important factors must not be overlooked if we are to avoid the error of laying too much stress on the development of water powers and neglect the part which must always be played by steam. If all the potential water resources in the United States should be fully developed by 1935, they would only meet about 35 per cent of the demand for power. This fact alone demonstrates that we cannot depend upon water as our raw material for the production of our light and power needs. Furthermore, over 70 per cent of all water power in the United States is west of the Mississippi, while the big industrial demand for power is in the East. We cannot move the bulk of our industrial enterprises west, away from important coal and oil supplies, merely to utilize another source of power which will only supply a small portion of the demand, and which is not only no cheaper but in many instances more expensive.

Again, the art or industry of generating electricity by water power has apparently reached its maximum efficiency—we cannot expect any great reduction in costs in the future. On the other hand, the improvements in the generation of electricity by steam during the past ten years has been spectacular. In 1919 the average use of fuel in all the power and light plants of the United States was 3.1 pounds of coal per kilowatt-hour. Last year it had dropped to 1.9 pounds, with the newest individual plants operating on as little as 0.9 pounds.

The result has been that water power is now seriously menaced by the competition of steam. In Southern California today, with fuel costing what it now costs, steam power generated at the cities is cheaper than water power delivered over a transmission line from distant sources. Colorado River power from Boulder Canyon is more expensive than power delivered from a new steam plant at Los Angeles.

Another popular fallacy is that all steam generating plants should be located at the mine mouth—that it is much cheaper to transport the power in the form of current on electric wires than in the form of coal by rail. This may be fine in theory, provided that other raw materials are available at the mines. The steam generating plant requires a vast quantity of water for condensing purposes, as well as coal to turn water into steam and finally into electric energy; and if the water is not available, all the coal in the world is of no more use than so much granite. The New York Edison Company, which generates six times as much current as Muscle Shoals, pumps no less than 58,000,000 gallons of water a day for condensing purposes alone. The seven million people living in New York City only require 50,000,000 gallons of water a day for all other purposes.

Summing up, the steam generating plant will never be supplanted by the hydro-electric plant. In any interconnected system, the steam plant is an imperative necessity. In many areas, the steam plant is, and always will be, more economical than water power. In many instances water power should be considered as an auxiliary to the steam plant, rather than as the primary source of power with the steam plant as the auxiliary. Water as raw material is cheap only when it can be used as a substitute for fuel, with the coal pile always in reserve to guarantee stability and continuous service under

One of the reasons why the auxiliary steam plant is necessary in the light and power industry.

any and all conditions. We must avoid the error of attaching too much importance to it in our national consideration of the whole power question.

This does not mean that we should in any way minimize the importance of water power and water power development. Its contributions to light and power, to the downward trend of rates, to the extension of distributing lines into small communities and rural districts, and its additions to the amount of horsepower available to the workers of the United States, are largely responsible for many of the things which have been brought to us by electricity. But in any broad view of the question water power must not be considered as a cheap substitute for coal. Each has its individual part to play, and the two together as part of a coordinated system serving as comrades rather than rivals mean continued improvement and extension of service and a steady lowering of costs to the consumer.

CHAPTER X

Power and the Steam Railroads

WHILE applied electricity was busy speeding up industrial production and making it possible for the American people to absorb additional products by bringing about high wages and great prosperity, it was unwittingly creating a new and complex problem for which, however, it has, itself, provided the solution. This is the problem of transportation. If this great industrial development is to be of any use, the facilities for the transportation of masses of people and for products must keep pace with the times. The burden of mass transportation of people has fallen largely on the street railways, the high speed interurban lines, and the suburban services of the railroads; because of electricity they have been able to carry the burden. But the moving of the enormous quantities of raw materials, manufactured goods, and foodstuffs demanded by the people in these stirring times of the twentieth century has fallen on the railroads, and largely because of physical obstacles they have often met the demand only with the greatest difficulty. Were it not for the fact that power, which created the problem, has in electricity the key to solve it, the railroads today would be in a state of almost hopeless congestion.

The history of the railroads is bound up with the industrial, economic and social development of the United States. It may be fairly said that our commercial prosperity depends upon their ability to render efficient and adequate service. It is therefore apparent that the expansion of railroad facilities must keep pace with the expansion of industrial facilities. What have the railroads been doing these past few years?

The improvement of railroad transportation since the World War has been phenomenal and is equaled only by the improvement of public utility service generally. There is a better understanding between the railroads and the public; cooperation between shippers and managements; better cooperation on the part of employees; and, finally, the many improvements to the physical properties. Since 1920 when federal control of railroads ended, the railroad companies have spent approximately $5,000,000,000 for new facilities giving them a total property investment of twenty-four billion dollars, one-fifth of which is in properties they did not have during the war. As a result, the roads handled in 1926 over 40 per cent more traffic than they handled in 1921. Yet the road mileage has only been increased by 2,300 miles, the number of freight cars by 27,800, the number of passenger cars by 1,300, while the number of locomotives has been actually decreased by 2,000. How, then, have the railroads been able to handle this enormous increase in their business?

Largely by the improvement of terminal facilities. The expansion of transportation ability depends very largely upon the expansion of terminals, particularly in the larger cities. The terminals are the bottlenecks. It is here that congestion is first felt; and the addition of all the tracks, locomotives and cars in the world is of no avail if the terminals cannot accommodate the trains, the people and the goods which the railroads are moving. And it was not until electricity as applied to steam railroads became a fact that it was considered possible to increase the capacity of many of these terminals.

The relief of congestion was one of the principal reasons for the electrification of the terminals of the Pennsylvania Railroad in New York and Philadelphia, the Grand Central Terminal of the New York Central and the New York, New Haven and Hartford roads in New York; the Victorian Railways in Melbourne, Australia; the several English roads in London and the French lines in Paris. Although traffic was steadily increasing, all of these terminals had reached their maximum capacity, and there seemed to be insurmountable obstacles to any further increase of railroad transportation facilities. Located in the busy sections of the cities, expansion in the form of additional tracks was impracticable, if not impossible, and hence the only solution was to operate more trains over existing tracks. Electricity made this possible, for it increased speeds, eliminated turning movements, reduced switching, and made possible the operation of trains on different levels.

The greatest demand which is made on city terminals is the suburban passenger traffic during the morning and evening rush hours, to which must be added the through passenger and freight train service. The rate of the suburban growth is usually larger than that of the city itself and this means a parallel increase in the volume of traffic and suburban train movement. By the use of multiple unit electric trains—that is, trains that have their own electric motive plants and do not require locomotives—there is accomplished at once a flexibility in terminal operation which is impossible with the steam train and its cumbersome steam locomotive. These electric trains can be operated more rapidly in and out of the terminal and the number of cars in a train is limited only by the length of the station platforms.

The application of electricity to the movement of trains in and out of terminals has also accelerated the movement of through trains by substituting the electric locomotive for the steam locomotive. Electric locomotives, although their weight is much less than that of their steam brothers, have almost unlimited power. They are not power plants like the steam locomotive, but are converters of power generated at some central station which may be a hundred or more miles away. There is a story told of a tug of war between a great steam locomotive and one of the smaller electric locomotives. The little electric pulled the steam locomotive backward with the greatest ease and after the test the motorman was laughing at the steam engineer. "You know perfectly well," said the latter, "that I could pull a whole train of contraptions like yours, but I cannot pull that d—d power house down the line."

Railroads operating through long tunnels have adopted electrification, adding to the comfort of passengers by eliminating smoke and gases. The New York Central and the New York, New Haven and Hartford, in order to get into New York City, have to use the Park Avenue tunnel. Operation in this tunnel with steam locomotives continued for many years until the growth of the traffic caused the state legislature to force a change to electricity. The Pennsylvania also enters New York underground. The elimination of smoke and gas was the main reason for the electrification of the Baltimore and Ohio tunnel under the city of Baltimore, which is 7,350 feet long; and also of the Great Northern in the Cascade Mountains, the Grand Trunk Railway through its St. Clair tunnel, 13,873 feet long, and the Hoosac tunnel of the Boston and Maine, 25,031 feet long. Previous to the construction of the tunnel under the Detroit river, the trains of the Michigan Central were ferried across, involving expense, hazard and loss of time. This tunnel has been operated by electricity since 1910.

The abatement of the smoke and gas nuisance, particularly in tunnels under the hearts of great cities, has greatly enhanced property values. Anyone walking along Park Avenue, New York, from 42nd Street north, who can remember the Park Avenue of the old days, will appreciate what this has meant. The same thing is true around the Pennsylvania Station, New York; the Illinois Central, Chicago; Riverside Drive, and in a score of other places. All subways and elevated lines in the big cities are operated by electricity—in fact, many of them would be impracticable, if not impossible, were it not for this gasless, smokeless, silent power. Many can remember when the elevated trains in New York were drawn by puffing steam locomotives pouring black smoke into the windows along their routes, destroying property values and adding immeasurably to the discomforts of city life.

But it is not only increased capacity, improved service, additional comfort and economy that the Spirit of Electricity has brought to the traveling public and the shippers. Where heavy grades are encountered, the necessity of additional horsepower per locomotive has demanded electrification. This is true on several of the lines in Austria, Switzerland, Italy, France, Japan and South America, and largely of the Norfolk and Western, the St. Paul and the Virginian Railroads of the United States. There is a practical limit to the horsepower which can be developed in a single steam unit, while the capacity of the electric locomotive is the capacity of the power house and the strength of car couplings. Electric locomotives weigh much less per horsepower and can handle trains up grades which required two steam locomotives, at almost twice their speed.

On the long down-grades, power saving and economic braking are accomplished by the use of what is known as "regenerative" equipment. When going down hill the electric locomotive ceases to be a motor and becomes, instead, a moving power house pumping back electricity into the line. The effect involved in this return of energy into the electric system not only produces a braking effect which does away with the wear and tear of mechanical brakes, but also delivers to the power lines a large quantity of electricity which can be used to move trains going *up* other hills somewhere else.

Most of the progress in the electrification of steam railroads has been made during the last 20 years. The first electrified railroad in the United States was that of the Nantasket Beach line of the New Haven Railroad, which began operation in 1895. During that same year, electrification of the Baltimore and Ohio tunnel under Baltimore was commenced and during the following five years, three short sections of the New Haven Railroad were electrified. From 1900 to 1910, several notable projects were completed in the United States, among them some of the suburban routes of the Long Island Railroad, the New York terminals of the Pennsylvania, New York Central, and New York, New Haven and Hartford; the St. Clair tunnel of the Grand Trunk; the Cascade tunnel of the Great Northern and the Detroit River tunnel. At the same time electrification was adopted to a considerable extent in Italy, England, Austria, Switzerland, Holland, France and Japan.

Between 1911 and 1920, more than thirty separate installations in the United States and foreign countries were completed and during the past seven years many others have been added. At the present time, 5,376½ miles of steam railroad lines throughout the world are being operated electrically. Many new projects are under construction, among them the Great Northern's electrification from Appleyard to Skykomish, the section of the Pennsylvania from Philadelphia to Wilmington, the New York Connecting Railroad, the Long Island between Port Morris and Bay Ridge, the trunk line railways of Switzerland, Sweden and Italy, and a number in England, France, Australia, Russia, Japan and the South American countries.

The advantages and beneficial results of electrification are many. Summed up, they are: reduction in the number of engine crews; release of locomotives for use elsewhere; release of some types of coal-bearing cars for other traffic; greater horsepower per pound of coal consumed; increased revenue through greater traffic; reduction in maintenance costs; reduction in locomotive terminal facilities; reduction in switching costs; elimination of smoke; lengthening of engine divisions; reduction of standby losses and of consumption of coal; benefits of regenerative braking; greater availability of electric locomotives, and many others. To these must be added the many public benefits, such as greater comfort to the traveling public, improved and speedier service, and the great increase in property values around terminals. In the early history of our large cities, property adjacent to railroad property was chiefly used for industrial purposes. With the advent of electrification, it is now available for hotels, office buildings and apartment houses.

What of the future? The time may come when most of the big railroads will have dispensed with their motive machinery, and their trains will be moved by central generating plants selling them power on meter, just as to the housewife for her vacuum cleaner. Of course, where the traffic density is light, the expense of electrification will not be justified for some time to come. But where traffic is heavy, where there are a large number of trains per day, and where there may be tunnels, underground entrances to large cities, and heavy grades, then the electric locomotive will sooner or later displace its steam rival.

Owing to the development of the modern large central generating station and the pooling or interconnection of electric supply over large areas, the power companies can usually sell electric energy cheaper than the railroads can generate current in their own stations. Interconnection makes possible the reserve power so important in railroad operation, for any interruptions to service must be obviated. In the case of the Illinois Central Railroad in Chicago which purchases power from the Commonwealth Edison Company, even the substations and the conversion equipment are owned by the electric company. The railroad has at its disposal not only the facilities of the Edison Company, but also those of several other central stations with which the Edison Company is interconnected, aggregating more than 1,200,000 kilowatts capacity, while the railroad's maximum demand is slightly under 23,000. On the other hand there are a number of large railroad systems generating their own power.

Here again the great value of interconnection or the pooling of power resources is brought forcibly to our attention. It has made possible railroad electrification. Without it, the railroads in many cases would be compelled to build their own power plants and would have to construct not only for their actual demands but for a great supply of reserve power to insure uninterrupted service, requiring an initial investment which, added to the cost of electrification of the roads themselves, would produce an almost prohibitive total. It is the power and light companies which have solved many of the transportation problems of the country quite as much as the railroads themselves.

CHAPTER XI

Power and National Defense

According to pacifist propaganda which from time to time is distributed so plentifully about the United States by those who, before the war, insisted that there never could be a world war, any form of preparedness indicates an aggressive state of mind and is provocative of war. To these people the word "preparedness" means nothing more than the maintenance of a large professional standing army, thereby forcing other nations to arm for their own security. The World War, the situation throughout the world today which is anything but peaceful, the attitude of suspicion with which almost every nation is regarding this or that other nation, the failure of disarmament conferences, teaches them nothing. "Create a condition of absolute unpreparedness," they say, and we can never be dragged into a war again. Naturally not. The nation which is totally unprepared—so unprepared, in fact, that it cannot defend its own self-respect—cannot even take a licking gracefully; it just takes a licking, or avoids it by apologizing and paying everyone in sight. It is at best an unpleasant part to play in world affairs, and little to the liking of any American citizen even though he may not be a professional patrioteer.

"On the other hand," says Secretary of War Davis, "the defensive preparation of a peaceful nation looks only to the safeguarding of its own soil by a small permanent force, backed by a citizen soldiery which prepares for active military service only when danger is imminent. Defensive preparedness is unsuited to aggression and hence is not, in any sense, a threat against any other nation, while it is at the same time a warning that the nation is prepared to defend itself against invasion with all the resources at its command. Such a defensive preparedness is preparation against war and is an assurance of peace. American preparedness under the National Defense Act is entirely defensive in character and our best insurance against war. If we had had a reasonable defense preparedness in the past, it would unquestionably have saved us thousands of valuable lives and billions of dollars. We must not make this unnecessary sacrifice again."

The National Defense Act, in addition to dealing with purely military problems, provides first of all for the mobilization of the industries of the country. A war such as the World War involves the supplying of 35,000 articles made up of some 700,000 different items, of every conceivable kind, and in quantities running into millions. These in the future will be handled by seven supply branches, each with its own problems. Never again will government departments bid against each other as they have in the past. Never again will orders be placed with certain manufacturers by four or five different government agents, each demanding priority for his work. In a future emergency, all facilities will have been carefully surveyed and scheduled and allocated to the proper agencies, thus avoiding much of the confusion of the last war.

The power question caused the government considerable worry during the war; and measures taken then are largely responsible for the rapid development of interconnection since the war. Troubles were due almost entirely to power shortages; with interconnection there can be no such thing as a power shortage.

Almost as soon as the government began to place orders for supplies in 1917, a threatened shortage of power occurred in the Niagara district, to be followed by shortages in other districts. A power committee, which eventually became the Power Section of the War Industries Board, was formed by the Council of National Defense to investigate the situation. Power capacity had to be increased, the distribution made more equable, and certain nonessential uses had to be curtailed in order to meet the requirements of essential war industries. Such a situation can never arise again. The Power Dispatcher, whose work was described in the first chapter, can run his fingers over his keyboard, bringing into his power reservoir the full force of all of the current capacity of every hydro-electric and steam plant in his territory and redistribute it to all industry as it may be demanded. He will see to it that the reservoir is always full, so that all of his outlets are carrying power to their fullest capacity.

There were other power lessons learned because of the war. We find Secretary Davis says: "In time of war, the national energies must not be taken out of the hands of the private agencies, experienced in their use, and put into the hands of a gigantic official machine. Such a machine could not manage them as effectively. Private initiative, energy, and resourcefulness must not be thrown aside and the vital and complicated processes of production and transportation lowered. Yet the energies of all must be directed to their effective use for the good of the government. Certain controls are essential to accomplish that purpose." In other words, the war taught that the production of power must be left in the hands of skilled and experienced management and not subjected to governmental red tape and political addling.

The lessons taught by the war were severe and, fortunately, lasting. Since the passage of the National Defense Act, the Chief of Engineers of the army, with the hearty cooperation of the electrical industry itself, has made and is keeping an up-to-date survey of the power facilities and resources of the United States, until now the War Department is in possession of invaluable information which would enable a war-time director to act promptly and efficiently. Every kilowatt of available power has been charted, and the exact location of surpluses, as well as the locations where there may be danger of shortages, are known; and it will always be possible to distribute any emergency load in such a way that it will never exceed the productive capacity.

This survey, together with interconnection, is a matter of supreme importance to national defense. The organization and training of vast armies is an almost useless operation without prompt and efficient industrial mobilization. As all industry today is dependent for continuous operation on power, it cannot be mobilized unless it can be assured of an ample and continuous power supply. It has been argued that this is a source of danger; that with the destruction of a few transmission lines and an important generating unit here and there, the interconnected system will be interrupted and rendered useless—at least temporarily. There is of course a certain amount of truth in this, but on the other hand, one might as well say that the destruction of a fleet renders the navy useless or the destruction of large munitions plants will put the army on the rocks. We have the experience of a great national catastrophe which serves to illustrate how the power industry meets an emergency; namely, the Mississippi flood.

Had the Mississippi flood of 1927 occurred in say, 1907, or even in 1917, almost the first thing which would have happened would have been a total failure of the power and light supply. We can readily appreciate exactly what this would have meant to the flooded area. If we take the chaos created by a complete failure of power and light and add to it conditions created by a great flood, we can form some vague idea of the terror, loss of life, and misery which might have occurred. What actually happened? According to the Edenton (N.C.) *News:* "The recent Mississippi Valley flood furnished a striking illustration of the value of interconnected electrical service. Many communities were flooded so that local plants were helpless; but the big power plants, located in safe districts near or far away, were able to run without interruption, giving light and power to the communities so sorely stricken. Hundreds, if not thousands, of people owe their lives to the light service furnished by far-away plants that were able to make night rescues possible because they themselves were not flooded out.

"The little town with its own little, inefficient public plant faces every possible menace—overcharge, underservice, breakdowns without reserve supply, high taxes, fear to invest where paternalism is rampant, political jobbery that disgusts and alarms. The big interconnected plants that are so rapidly developing the South, were life-savers during the flood; they will be life-builders forever after."

Had it not been for the interconnected network of transmission lines, a majority of the towns in the flooded areas would have been without electric service of any kind, as the high water made the operation of many small local plants impossible. To quote Mr. R. Linsley Shepherd, writing in the *Electrical World:* "As always in emergencies, officers and employees of the power companies in the affected areas worked heroically to maintain service. Rowboats were used to reach spots where it was necessary to raise transformers or to repair broken wires. In some instances the boats were overturned, subjecting the occupants to the risk of drowning in the muddy waters. Automobiles were frequently marooned, and men went on horseback with water up to their knees. These men put all they had into the task, keeping no hours and going wherever they were sent both day or night."

In Oklahoma the Gas and Electric Company was able to maintain service throughout the state, although its generating plant in the coal mining regions was struck by lightning and burned down. In Arkansas, where the Arkansas Light and Power serves the territory through which the St. Francis, White and Arkansas Rivers flow to join the Mississippi, the company maintained continuous service except in two small towns. The splendid work of this company was given public recognition by the mayor of Little Rock. In the Greenville, Mississippi, territory where the worst flood conditions in the whole southern district were experienced, had it not been for the tie line between the Arkansas Power and Light Company and the Mississippi Power and Light Company the city would have had no service; in fact, although it was virtually evacuated, electric service continued without a break. Both of these companies, together with the New Orleans Public Service and the Louisiana Ice and Utilities, were able to give constant service in that state.

Here we find those who are responsible for the power service of the country ready to meet an emergency totally unexpected and covering an immense territory; an almost unparalleled example of just what the industry can do by marshaling resources through interconnection. It is safe to say that at no time in the future can any mere man-made catastrophe occur which will seriously hamper or interrupt the continuous generation and distribution of electric power and light for any and all needs, whether emergency or otherwise. This, in itself, is a contribution to our national defense program which makes the successful defense of the country assured.

The plans of the War Department for the mobilization of power in time of war are based on five general principles, set forth by the Secretary of War as follows:

> "(1) The government should not take over any plant or power system unless necessary to insure the efficient prosecution of the war.
>
> "(2) No additional control should be exercised in regions where power is adequate for present and immediate future needs, both civil and military.
>
> "(3) When shortage of power for essential needs exists or is threatened, the government should take over the entire output of the plant or plants in the locality and apportion the power output to users in the best interests of the United States. This action should set aside all existing contracts for the supply of power with which such action conflicts.
>
> "(4) If the preceding methods fail to obtain sufficient amounts of power, the government should undertake actual operation of such plant or plants.
>
> "(5) The existing organizations of any companies taken over should be utilized in their operation, in order to make full use of the experience, training and skill of their personnel.
>
> "With these principles in mind, the plan calls for the selection by the President of an Executive Assistant, to be known as 'The Emergency Power Director,' who would be responsible for the effective utilization of the power facili-

ties of the country. The Emergency Power Director would be assisted by an Executive Committee, the majority of the members of which would be nominated by the National Electric Light Association, and approved by the Emergency Power Director. These men would serve in a civilian or military capacity. The Committee would serve under the direction of the Emergency Power Director and would be the medium through which the mobilization and coordination of the power systems would be carried out and effective cooperation secured.

"The functions of the Emergency Power Director would be carried out through the Executive Committee and a small field force in the several power zones into which the country would be divided. At present the country, for the purposes of carrying on the power survey which I mentioned above, has been divided into eleven power zones. These zones might be used as the basis for the power control zones in case of an emergency. Each zone director, under the direction of the Emergency Power Director, would be responsible within his zone for the better utilization of existing sources of electrical and mechanical power, the interconnection of existing systems, and the development of new sources of power, particularly for shipyards, munition plants and industrial facilities engaged in the manufacture of commodities necessary and essential in the prosecution of the war, and for the ascertaining by inspections that priority policies formulated by proper authority were obeyed.

"The plan further provides that the Emergency Power Director, or his duly authorized representative, would normally leave the management of the plants in the hands of the Executive Staff or organizations of the companies, even in case the output has been taken over. In this case, the compensation to the companies will be at rates established for similar services by the Utility Commission of the state or district in which the plant is located, or in the absence of such fixed rates, at the same rate as paid by private consumers for similar services.

"The plan further states that no physical property of the power companies will be taken over unless absolutely necessary. In these rare cases where this action is taken, the property will be all property used in the generation, transmission and distribution of power, the materials and supplies on hand at the time possession is assumed, all balances in the account or accounts representing the total or accounts receivable as of that time, and a working fund, if in the treasury of the company, not in excess of an amount necessary ordinarily to cover one month's operating expenses. All these would be credited to the company. The United States would pay out of the funds coming into its hands from the operation of the plants, or otherwise, the expenses of operation of the company unpaid at the time the possession was assumed, and charge same to the company. It would likewise pay just compensation for the use of the property during Federal control, as provided later, and would also pay all taxes accruing during Federal control, except such additional war taxes as might be levied in connection with the then existing war. All revenues from operation during Federal control would belong to the United States, and all expenses of operation during Federal control would be paid by the United States.

"Compensation to be paid the company would be a sum equivalent to the average net operating income of that particular company during the preceding three fiscal years, except that if exceptional or abnormal conditions were found by the President to exist during all or a substantial portion of such period of three years, which would justify a larger or smaller compensation, provision would be made for such larger or smaller compensation as might be found to be just and equitable. Due allowance in the compensation would be made for the use of additions, improvements, or equipment, the use of which was not fully reflected in the operating income of the said three years, or a substantial portion thereof. Compensation would be paid to each company in quarter-annual payments. In taking over the company, a contract would be entered into, stating and defining the rights and obligations of the parties."

There is much confusion of thought with regard to power and national defense. So much has been said during the last few years about Muscle Shoals with the catch phrase "munitions in time of war and fertilizer in times of peace," that the average citizen thinks of "power and national defense" as meaning the utilization of hydro-electric power for the fixation of nitrogen drawn from the air to produce nitrogen compounds for use in the manufacture of munitions.

Now, when the Muscle Shoals plant was first projected at the beginning of the war, it undoubtedly was a sound war-emergency measure. We were at that time largely dependent on Chilean nitrates for our supply of fixed nitrogen, as was every other nation. Had the war continued, Muscle Shoals would have become one of our great bulwarks of national safety, supplying a large portion of the ingredients so necessary to the manufacture of munitions for our armies and navies. Since the war, however, the art of fixation of nitrogen has undergone a tremendous development and methods have been devised which have made the Muscle Shoals process antiquated and expensive. Muscle Shoals today is simply one small unit in the southeastern interconnected system and cannot be considered as anything more than a very small detail in the plans for national defense. As a power generating station, it would of course contribute to the power supplies of those industries furnishing materials of a great variety; but as a manufacturer of the actual ingredients for explosives, it has permanently passed from the picture.

Only recently the Allied Chemical and Dye Corporation announced that it proposed to erect at Hopewell, Virginia, a $5,000,000 plant for the purpose of manufacturing commercial fertilizer by this new process. This is the first of a chain of similar factories throughout the United States. It is stated that this will yield much cheaper fertilizer than the old-fashioned methods depending on electricity for the fixation of the necessary nitrogen.

Electricity as the motivating power of all industry is the rôle of the industry in the national defense. And the Secretary of War has said that the mobilization of all industry in time of war "is the greatest and most complex business problem that can ever confront a country."

CHAPTER XII

Who Owns the Light and Power Companies?

In the occasional showers of criticism of public utilities, their real owners seem to be entirely overlooked. There is a general impression that a few electrical manufacturers, investment bankers and individual leaders in the industry control it, holding in their hands the power of giving as much or as little service as they please at any price which suits their individual notions. If this were true, it would be cause for serious concern. It is difficult to contemplate with equanimity such a tremendous force in our daily lives in the hands of a few men, regardless of their integrity or sincerity of purpose.

But the facts are that the diffusion of ownership of public utilities is nine times that of the railroads, that one person out of every 59 in the United States is a stockholder in some utility, and that one customer out of every fifteen of the light and power companies owns a share of the plant which serves him. In short, over three millions of security holders in the United States own stocks or bonds, or both, in companies occupied in the public service.

Turning to the financial reports of the companies themselves, we find that in 1926 some 228 companies serving an aggregate population of about 85,000,000 people raised more than $236,000,000 of new capital from 248,800 new stockholders. Somewhere in a previous chapter, the author said that in his opinion a majority of the people of the United

States believe in the development, ownership and operation of public utilities by private enterprise and individual initiative. It would seem that here we have some concrete evidence of the truth of this statement. In one year, more than a quarter of a million people joined the two and one-half millions who already had invested their savings in public service companies, owned and operated by private management. By so doing, they have expressed their confidence and belief in what has always been an outstanding American business principle. Otherwise this money most certainly would not have poured into their treasuries from the savings accounts of the rank and file of men and women. The public has been too well educated by the press of the country to risk its earnings with anyone who has not demonstrated some degree of trustworthiness.

Years ago farseeing managers of railroads, telephones, light and power and other public service companies, recognized the benefits to be derived from what is now called customer ownership—that is, ownership of the public service enterprise by those who are its customers. Thereupon they began a deliberate campaign to spread their securities among their customers and the users of their services, until now ownership of a majority of the shares is actually lodged in this great multitude of individuals. There are even organizations of security holders of this kind, and it is interesting to note that in no single instance do we find any suggestion on their part that a change to government ownership and operation should be made. By following the fortunes of the companies which they own and of which they are a part, they are on the inside, so to speak, where they can see the wheels go round, and there seems to be no indication of any desire for a change of this sort. If we turn to the report of the Federal Trade Commission we will find that in the case of one of the greatest electrical equipment manufacturing companies, only one single entity owns more than one per cent of its stock, and that is its own employees' organization.

In approaching the question of popular or customer ownership, the light and power industry has laid down ten cardinal principles. They are interesting as indicative of a trend of thought of its leaders. These principles, which distinguish this form of financing from all others, are:

1. The sale of the securities must be direct from company to customer, or through an agency expressly created for the purpose and controlled by the company.

2. The safety of the securities offered must be amply protected by property and earnings.

3. A minimum rate of dividends must be provided for, in so far as honest judgment based on experience can foresee.

4. A reliable resale market must be maintained in some manner so that shareholders who wish to dispose of their holdings can do so promptly at nominal expense.

5. A partial-purchase plan must be operative in order to give every customer who can save a small amount monthly full opportunity to become a shareholder and to encourage thrift.

6. The proprietary interest and responsibility of shareholders must be emphasized, and the shareholders supplied regularly with information regarding their company and its affairs.

7. Loss of capital by shareholders in hazardous and fraudulent offerings from various sources must be guarded against by the rendering of authentic information and advice to shareholders.

8. The number of shareholders must be increased steadily, and efforts should be made to avoid large individual accumulations of stock.

9. Employees must be carefully instructed in order that all representations made to customers or others may be in line with the facts.

10. Managements must realize that customer ownership multiplies their obligations to the public and intensifies the trust reposed in them. It does not replace the constant striving for higher efficiency, good service, reasonable rates, courtesy and progressive public relations policies.

Contrast the policy outlined in these cardinal principles laid down by the industry itself with the apparent lack of policy of the government in connection with Muscle Shoals. When the disposition of this project was under discussion before the Senate Committee on Agriculture and Forestry, the impression was that it would mean a tremendous industrial development in its vicinity. Immediately there were thousands of real estate schemes on the market and literally hundreds of thousands of people lost their entire savings in unsound, dishonest and fraudulent projects. In one instance, an outfit incorporated a town, built what it called a city hall, took pictures of it which were carefully trimmed so as not to disclose the fact it was sitting in the middle of nothing but cotton fields, and then sold lots—in one instance for as high as $7,500 each. In another case "50-foot lots" were sold for five, six and seven hundred dollars each that were worth no more than thirty-five or forty dollars an acre. There was not a city of any size in the United States which did not have its quota of luxurious offices, equipped with fake photographs and elaborate maps, selling real estate on the installment plan in non-existent towns.

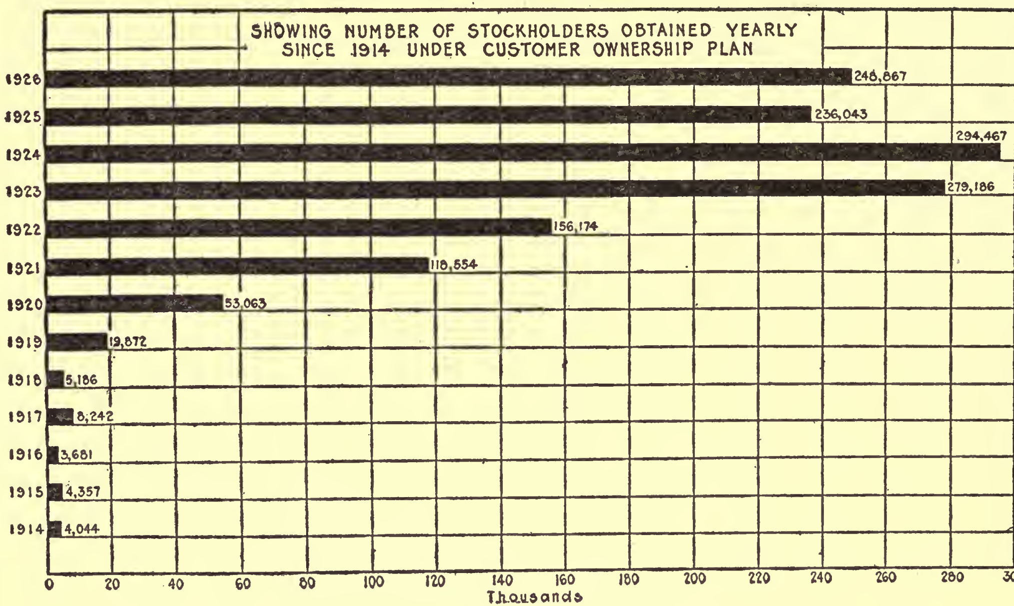
This real estate exploitation on the supposition that the government might sell Muscle Shoals to an industrialist who was supposed to have said he would give employment to a million men if he got it, was a national disgrace. Whether he ever said this or not, no one seems to know. In any event, the duty of the government should have been obvious. The fact that the exploitation of the people of the United States was going on was a matter of common knowledge. It was plainly up to the government to issue a most emphatic warning, stating the exact situation and giving a detailed account of the status of each individual real estate project. It was also plainly the duty of the government to either cut bait, fish, or row ashore. It should have given Muscle Shoals to this industrialist or reached the conclusion that it was not going to do so without delay. This would have put an end to one of the greatest fake promotions in the history of American blue sky finance. Again, for the sake of emphasis, what does the electric industry say?

"Loss of capital by shareholders in hazardous and fraudulent offerings must be guarded against by the rendering of authentic information and advice to shareholders."

An examination of the records of some of the individual power and light companies since the inauguration of the plan is interesting. Take, for example, the Alabama Power Company. It serves a population of about 1½ millions, has 61,185 customers, and of these customers 13,400 are shareholders. The Electric Bond & Share Company, brought to public notice by the Federal Trade Commission, manages properties, which it is supposed to control, serving a population of about 9 million people. They have a little less than 2 million customers and of them nearly 200,000 are shareholders. The Illinois Power and Light Company serves 1¼ million people and has 275,000 customers, of whom 33,000 are shareholders. The Southern California Edison with 355,000 customers, has over 100,000 customer owners. And so it goes on down the line. One customer out of every fifteen in the United States is already a shareholder, and the number is growing larger every month. The people are taking over the public utilities without the intervention of the government and apparently are satisfied to leave the management of their properties in the hands of those whose individual initiative brought them into existence.

One of the most interesting methods of disposing of the shares in a public service corporation has been in force in Philadelphia for some time. There

CUSTOMER OWNERSHIP



State	Population Served	Customers	Shareholders Obtained	Shares Sold
Alabama	1,800,000	114,185	33,916	331,733
Arizona	50,000	18,000	265	1,693
Arkansas	315,000	34,700	2,100	7,917
California	9,243,226	1,565,739	178,822	2,502,910
Colorado	531,939	123,236	12,780	169,129
Connecticut	418,085	104,909	2,785	43,098
District of Columbia	558,000	122,743	4,637	20,000
Florida	570,956	95,986	2,992	14,452
Georgia	269,100	23,242	353	3,396
Idaho	155,000	45,000	4,231	19,038
Illinois	9,402,749	2,583,557	164,383	1,445,580
Indiana	2,572,652	502,411	36,218	256,851
Iowa	3,739,961	377,028	20,059	184,714
Kansas	1,339,300	296,908	22,608	215,102
Kentucky	699,830	156,370	21,958	259,628
Louisiana	688,000	136,557	17,056	61,135
Maine	425,000	84,122	11,277	118,067
Maryland	1,300,000	264,103	21,739	206,210
Massachusetts	304,000	69,146	29,723	182,093
Michigan	3,131,968	770,281	46,117	435,967
Minnesota	2,335,194	459,171	81,226	665,607
Mississippi	125,000	18,000	1,360	12,084
Missouri	2,124,356	591,510	33,714	414,756
Montana	210,000	50,000	4,802	51,411
Nebraska	274,300	72,093	4,914	23,976
Nevada	32,500	900,969	287	3,090
New Hampshire	25,000	10,109	220	6,361
New Jersey	3,407,230	810,586	69,790	417,162
New Mexico	3,500	670	12	20
New York	9,612,887	1,208,245	145,910	1,164,554
North Carolina	443,282	82,348	4,608	53,344
Ohio	5,854,000	923,516	56,095	651,273
Oklahoma	892,759	345,656	17,812	442,737
Oregon	1,725,900	273,874	26,343	195,641
Pennsylvania	5,817,500	938,007	85,591	776,109
Rhode Island	490,000	118,232	10,429	43,280
South Carolina	......	......	949	5,088
South Dakota	130,000	17,280	3,772	10,898
Tennessee	1,728,000	172,382	13,167	88,976
Texas	2,293,868	412,485	18,880	161,538
Utah	407,000	106,750	13,937	99,632
Vermont	38,000	7,500	541	12,363
Virginia	117,000	27,950	2,117	32,384
West Virginia	499,000	62,545	9,824	199,990
Washington	1,506,000	201,592	16,070	145,522
Wisconsin	2,256,000	434,308	44,813	292,115
Canada	2,397,000	73,992	10,415	56,373
Unclassified	3,326,545	622,867	120,660	633,033
Total	85.586,507	15,531,660	1,432,277	13,138,030

Summary of Customer Ownership by States

the thrifty citizen can invest in the Philadelphia Rapid Transit Company on the installment plan through the conductors on the street cars. The conductor will give him a card something like a meal ticket—in fact it might be called a ticket to insure meals at some future time. Every time the holder of this ticket feels like saving a dollar or so, he hands it to the conductor who punches the amount on the ticket. When the full price of a share of stock has been punched, the customer carries it around to the office of the company and gets his share of stock, thereby becoming a customer owner. It has resulted in adding many thousands of car riders to the list of stockholders of the Philadelphia Rapid Transit Company and has encouraged thrift to a degree which has hardly been paralleled by any other plan. Thousands of employees have also taken advantage of it.

The following is a summary of information reported by 228 light and power companies:

Total population of territory served	85,586,507
Total number of customers..............	15,531,660
Gross earnings of combined companies reporting (1926)......................	$1,113,865,470.12
Stockholders obtained through Customer-Ownership Plan......................	1,432,277
Shares of stock sold through Customer-Ownership Plan......................	13,138,030
Percentage of stockholders obtained through Customer-Ownership Plan, to customers.	8.5
Percentage of shares sold on Deferred Payment Plan (1926 average)..............	23.3
Ratio of stockholders to population served.	1 to 59
Weighted average cost of selling per share (1926)...............................	$3.73

But customer owners are by no means the only shareholders in public utilities other than those directly interested in their operation. There are the insurance companies, the savings banks and innumerable other institutions. Hundreds of thousands of persons holding policies of insurance, with accounts in savings banks, or stockholders in companies of this kind, are in this way indirectly interested in the ownership of public utilities.

It is apparent that the public utility industry does not belong to any particular group or groups of people. It belongs to the American public—the thousands and millions of average citizens who have become convinced of the stability of the industry. A number of holding companies have large interests in a number of properties, but, because their interests lie more in the direction of efficient and economical management than in the purely financial aspects of the industry, they have, more than any other group, done much to encourage customer ownership and to secure a wide diffusion of stock holdings. A large number of the light and power companies are independent of holding companies, as are many of the companies in the larger cities.

We have, in fact, public ownership with private management and operation, which is a purely American as well as a 100 per cent sound scheme of organization. The operators of these companies are, after all, the trustees of the money of the people who own them, and it would seem that the government might tend to the business of governing rather than take over the management of a business belonging to the people from the hands of those who apparently have been managing it to the satisfaction of everyone. No one can possibly object to having the government set itself up in judgment of great public service enterprises which have been given virtual monopolies in order that both the government and the people may be assured that they are being operated in the public benefit. It should be made quite certain, however, that the government, sitting as a judge, conducts a fair and impartial trial without fear or prejudice, and that when the evidence is all in the case is not taken from the hands of the jury—the American people—and turned over to the attorneys for the prosecution for decision.

CHAPTER XIII

What is a Holding Company and Why?

What is a holding company and what are its relations to the light and power industry? The attacks on the industry by both governmental and private agencies have succeeded in surrounding it with an atmosphere of mystery, suspicion, and even fear. It has been represented as a device constructed by capitalistic conspirators and designed for the purpose of securing control of the power resources of the United States in order to exploit them for the benefit of the few and to the very great detriment of the many. Let us see.

In the first place a holding company in the electric industry is not necessarily an operating company. It may be an investment company owning stocks or bonds or both in one or more operating companies, or it may be an engineering and management company. There is nothing particularly new in this idea. We have had corporations owning securities in other corporations for a generation or more. Insurance companies, banks and even industrial corporations are large security holders in a great variety of enterprises. In some instances these securities are held simply as an investment, and in others the corporation holding them takes an active part in the company which issued them. In the industrial field the General Motors Corporation is one of the best examples of a highly successful group of operations controlled and coordinated through a central management. Its operations in the automotive industry are similar in many respects to those of the holding company in the electric field operates in the light and power industry. Through its ownership and control of a number of automobile manufacturing enterprises such as the Buick, the Cadillac, and the Chevrolet, plus ownership of all sorts of allied enterprises such as body, wheel, parts, and other plants, the General Motors has succeeded in effecting economies in production, engineering, purchasing, sales and distribution to such an extent that it is largely responsible for the fact that the American citizen today gets more for his automobile dollar than almost any other kind of a dollar.

Through the agency of the General Motors Acceptance Corporation, it has been able to finance time-payment sales for its dealers to an extent never before attempted and at a cost to the purchaser far below the cost of installment-buying of many other commodities. Because of its large-scale production and great volume of business, it has been able to spend large sums in engineering and research to an extent prohibitive to a smaller organization. Through a carefully devised scheme of forecasting it keeps its production schedules at all times in line with consumer demand, thus avoiding overproduction. It is at one and the same time an investment, financing, operating and development company combining the resources and facilities of a large number of companies for the benefit of all. To say that the General Motors Corporation has not been a benefit to the American motoring public and to the automotive industry is to state an absurdity.

In the electric light and power industry, the holding company does for the companies in which it has an interest what the General Motors does for its constituent companies; and because of its existence the customers of these companies reap the same benefits as those received by a purchaser of a General Motors product. To use the words of one of the pioneers in the industry, "its primary purpose is to expand and energize the facilities and resources and activities of the local or subsidiary companies that are under its wing, and to broaden opportunities for safe investment. Still more important to the general public, the effect of what it does is that high grade electric service is placed at the command of more and still more users who would otherwise have far less efficient service or none at all."

The American Telephone and Telegraph Company is the biggest holding company in the United States. It owns all or a majority of the stock of telephone companies in literally thousands of communities, dictates their policies, and in general supervises their operation. In this way these companies are given a financial strength, expert management and engineering advice which the majority of them could not possibly afford if they had to operate as purely local, independent enterprises. In addition, the American Telephone and Telegraph Company owns all of the long distance lines which hook these thousands of communities together making it possible for any telephone subscriber to reach any other telephone in the United States no matter how remote.

The New York Central Railroad, the Pennsylvania Railroad, or in fact any other great railroad system, are nothing more or less than holding companies owning the stock of a large number of railroad companies organized in the days when railroading was young. It is the consolidation of small companies into great "systems" through the agency of the holding company that has made it possible for the United States to lead the world in transportation facilities. The United States Steel Corporation, the Anaconda Copper Company, and many other great industrial enterprises are nothing more or less than holding companies. The holding company in the light and power industry differs from these in purpose and results accomplished not at all.

In 1926, the United States Senate passed Senate Resolution 329 directing the Federal Trade Commission "to investigate and report to what extent the General Electric Company, or the stockholders or security holders thereof, either directly or through subsidiary companies, stock ownership or through other means and instrumentalities, monopolize or control the production, generation or transmission of electric energy or power . . . and to report to the Senate the manner in which said General Electric Company has acquired and maintained such monopoly or exercises such control in restraint of trade or commerce and in violation of law."

The result of this resolution is the report of the Federal Trade Commission on so-called "holding" companies, rendered to the Senate on February 21st, 1927. This report, definitely proves that there is no power trust.

The General Electric Company was selected as a target for the trust-busters to shoot at because of its position as a manufacturer of equipment for electric plants and because it was alleged to own and control the Electric Bond and Share Company, a holding company which in turn was alleged to own the controlling interest in a large number of operating light and power companies. It may also be that some inspiration lay in the alleged fact that the Electric Bond and Share Company owned the Southeastern Power and Light Company, supposed owner of the Alabama Power Company, one of the bidders for the Muscle Shoals plant.

When the holding or investment company first made its bow in the power industry, the smaller cities, towns and villages were stumbling along with low grade service or none at all. It was the holding company which made it possible to extend high-grade service to these smaller communities and even into the rural districts. In 1912 there were 5,221 central station enterprises of all kinds in the country, serving less than 4,000,000 customers. At the present time, there are 6,500 central stations serving over 19,000,000 customers. It should be noted that while the increase in central stations has been but little over 25 per cent, the increase in the number of customers has been nearly 500 per cent. This has been largely due to the development of large generating units in large central stations distributing light and power over wide areas and made possible by the investment or holding company.

This type of organization also greatly strengthens the local operating company. Before a local company can supply service or expand to meet growing demands, it must have capital. The investment company provides the capital usually at lower interest rates than the local company could get for itself. In addition, it supplies expert engineering advice of a quality which the local company could not afford. By massing the purchasing requirements of many subsidiaries, it saves money for all of them. The smallest operating company has at its command managerial experience and ability acquired in larger fields, and which it could not possibly afford as a small isolated company. It has, in fact, all of the advantages of large company experience, ability and financial resources.

The net result is improvement in operating efficiency. The local company is improved in both health and prosperity, as well as in service to the community served. Two blades of grass have been made to grow where only one grew before.

It is interesting to note, however, that the light and power companies in many of the large cities are independent of any holding company or any particular groups operating holding companies. The fact is that the holding or investment company offers to the smaller communities and companies the opportunity to strengthen and expand the small, weak company; and by bringing together through interconnection a considerable number of independent plants operating in small communities, effects what we have called a large-scale operation and gives not only these small communities but also the rural territory surrounding them the benefits of metropolitan service. The big and financially strong operating company, serving literally hundreds of thousands of customers in the big city, is often in a position to obtain for itself and its customers the benefits which the small company can only obtain by being a part of a system managed and operated by the holding company.

It has been the experience of all communities that supervision by an investment company tends to better service at lower rates. Small communities can be given metropolitan service by linking them up with each other and with larger communities and applying centralized production of electric energy and supervision of operation. Properties that could not maintain themselves are converted into profitable units of the larger organization.

There are innumerable examples throughout the United States which can be cited to show the benefits to the consumer, the community and the power and light operating company of the holding and investment company. Take the case of an operating company in central Illinois. It began with service to two or three small cities in 1912. During the war, it was unable to finance itself and was about to go into the hands of a receiver. It was carried along by an investment company, restored to physical and financial health and now serves 230 communities. The largest of these has a population of 38,000, while many of them are little more than hamlets of fifty or sixty people. All of these communities are receiving 24-hour service of the same quality as the city of Chicago. Without the financing or holding company, many of them would be receiving no service at all, while a majority would at best be receiving nothing but night service. There are no less than 135 such companies in the United States.

It is this type of investment or financing company which has made possible the rapid development of interconnection described in a previous chapter. While a certain amount of interconnection by contract between companies serving adjacent territory is possible without the aid of any special financial arrangements, the great network of wires spreading over areas which include territory that is almost entirely rural would be both a physical and financial impossibility without the great resources of credit and expert management which these organizations provide.

The outstanding feature of the report of the Federal Trade Commission is that there is no power trust—in fact the Commission was apparently unable to find any organization which remotely resembled a trust. The General Electric Company did not own a share of stock in the Electric Bond and Share Company. It had turned over its holdings to a new corporation and the stock of this new corporation had been distributed among all of the stockholders of the General Electric Company proportionally. Turning its attention to the Electric Bond and Share Company itself, the Commission found that while it had the financial and operating supervision of a number of operating companies, its holdings of voting stock in these companies ranged from 6.68 per cent to 22.59 per cent. These figures are a long way from a controlling interest. It owns only about 15 per cent of the stock of the Southeastern Power and Light group, but the Commission seemed to think even this significant because this group includes the Alabama Power Company, the original owner, but now one of the bidders for the Muscle Shoals property.

Discussing the list of stockholders of the new corporation organized to take over the holdings of the General Electric Company in the Electric Bond and Share Company, the Commission seems to emphasize the fact that the stockholders of the old and the new company were practically identical. Naturally they could not very well be anything else in the beginning. The Commission admits, however, that there were no large or dominating stockholders in either company and that the original identity of holdings had been reduced by 21 per cent in 21 months. The present boards of directors of the two companies contain no common directors, and the board of the Electric Bond and Share Company manages its affairs independently.

After studying the question of "interlocking directorships," the Commission found that, between the General Electric Company, the Electric Bond and Share Company, "several" holding companies and nearly two hundred operating companies belonging to these groups, "there were numerous interlocking directorships, this being an essential feature of the control and management exercised."

The Commission took considerable interest in the manner in which the General Electric Company acquired its interests in the electric industry. "In the earlier days of this industry," it says, "it was very difficult to build up the electric manufacturing industry, because the *customers for its products were themselves small and financially weak.* [The italics are the author's.] Much of the electric equipment was sold not for cash, but part cash and part stock and bonds of the new power enterprises. At first the necessity of realizing cash for such stock and bonds and later the advantage of promoting a better engineering and operating management in order to increase the sale of electric goods, drew the larger electrical manufacturers into the electric power business."

What better method of developing the power industry and giving to the people of the United States the service it is receiving from public utilities today can be suggested? In fact, it is the only way it could have been done.

In order to understand the benefits derived from the holding company scheme of financial structure in the light and power industry, one must understand the difference between the average utility company which invests approximately five dollars for every one dollar of gross income, and the average merchandising or manufacturing company whose annual gross income is greatly in excess of its capital investment. A trading or manufacturing business will have an income from one and a half to many times its total assets; the typical power and light company has annual sales which at best amount to one-fifth or less of its capital, so that its investment is turned over but once in five years or more. If it generates by water power this turnover rate may be as low as once in eight years.

As a result, the actual investment in the power and light business in the United States is very large. At the end of 1927, it amounted to more than eight billion dollars. This is the largest investment in any public utility group except the steam railroads. The telephone and telegraph companies combined represent an investment of about five and one-quarter billion dollars, the gas industry about four billions, and the street railways about five and a half billions. In the industrial field, we find the iron and steel industry and their products with an investment of a little less than nine billions, textiles with six billions, chemicals and allied products five and one-half billions, food and kindred products four and one-half billions, lumber and its manufactures two and one-half billions, vehicles two and one-half billions, metals and metal products one and three-quarter billions, and leather and its finished products one and one-half billions. Furthermore, the public utilities, unlike any other business, are permitted to accumulate a surplus only by foregoing dividends. Under the present system of regulation, they can only earn a reasonable return upon their investments. They cannot earn enough out of current receipts to pay for the new construction necessary to supply the constantly increasing demand for electric current. They are, therefore, constantly faced with the problem of raising additional capital for this new construction.

In order to provide for future requirements, these utilities frequently base their financing on what is called the "open-end" mortgage in which the total amount of bonds which may be issued is not fixed in the original agreements. It is stipulated that, when the corporation buys or builds new plants, it shall be permitted to issue new bonds of a par amount not to exceed a certain proportion—usually 75 to 80 per cent—of the cost of the property acquired, provided that the earnings have been sufficient to meet the interest charges on the old and new bonds by a wide margin. Under this form of mortgage, bonds are issued from time to time in accordance with the company's needs and the terms of the mortgage itself. The balance of the money must be raised from junior securities—usually preferred and common stock. The stockholders secure a return only after the bondholders are satisfied. They take the risk of the business and consequently they hold in their hands the power of management and the selection of the board of directors.

The holding company as a stockholder rather than a bondholder in power and light companies serves two important purposes. Because of its great financial resources it can supply the necessary capital for improvements and extensions at the lowest possible interest rates, and it can also supply expert management and purchasing facilities which the isolated company could not possibly afford.

These holding companies fall into two classes: first, the holding company owning securities of power and light companies operating in relatively close proximity and, second, companies owning securities in light and power companies operating in territories widely separated. In the first case, ownership of securities by a holding company usually results in interconnection with its many advantages, described in a previous chapter, and in this case the holding company might eventually be replaced by one single operating company. In the second case, we have an example of a type of company which holds to the principle, "Don't put all your eggs in one basket." In either case, the advantages of the holding company are many and obvious. It furnishes an expert staff to the local company, acts as purchasing agent, calculates a scientifically based rate, gives financial assistance, furnishes an expert knowledge of market conditions which the local company cannot possibly possess, makes interconnection possible, finances extensions of distributing lines into rural districts, and, in fact, becomes the very heart of the industry.

As a result of the financial structure of the electric industry, there are few industries whose securities have such a high standing among investors as those of power and light companies. This is evident from the large number of owners of their securities in the United States—approximately 3,000,000.

There are approximately 135 of these holding and management companies in the electric industry representing 57 per cent of the total output of electric current. Of the balance of the output, 4.3 per cent is produced by municipal plants and the balance is distributed among hundreds of independent operating companies. This is hardly indicative of a power trust dominating the power and light business. Furthermore, these holding companies cannot be said to act in concert. One has only to talk to a few of the leaders to find that there is no more concerted action than there is between Mr. Henry Ford and the General Motors Corporation, or Mr. Kresge and Mr. Woolworth, both of five and ten cent fame. They may coincide on certain major policies but they compete quite as actively as two corner grocery stores or a Republican and a Democratic candidate for the same seat in Congress.

The author is absolutely opposed to high finance, unfair monopolies, or unfair trade practices. He does feel, however, that a careful examination of the facts will demonstrate that if political expediency demands that something be pinned on the light and power business, politicians must seek elsewhere than in the field of holding companies. It has been announced that there will be an investigation into the capitalizations of all power and light companies, as well as holding companies, to the end that Congress may "correct any abuses that may exist in the organization or operation of such companies." The electrical industry should welcome the inquiry; there would be no better way to demonstrate to the American public as to whether or not it is worthy of the public confidence. To quote again the Federal Trade Commission:

> "It is obvious in 1924, neither the General Electric Company nor any other single power interest, or group of allied power interests, substantially monopolized or controlled the generation, transmission and sale of elec-

tricity in the United States. . . . There has not been, however, any radical change since 1925, and consequently nothing approaching control has been acquired by a single interest over the electric power industry."

CHAPTER XIV

What Price Electricity?

THERE is nothing in connection with light and power so prolific of controversy as the question of rates. To the average householder, the Spirit of the electric switch is no benevolent genie—he is the malevolent spirit of the electric meter whose monthly bills are always twice as high as they should be. This is human nature. What one of us is there who, watching a taximeter, is not absolutely sure that it registers at least twice the actual distance we have traveled in the cab? We feel the same way about the electric meter. We *know* that it registers more current than we could possibly use; and when it is proved definitely that it does not, then we are quite sure that the rate is higher than it should be and the company, in spite of the law which restricts its earnings to a reasonable return on its investment, has found some way to beat the game to the benefit of the stockholders and at the expense of the consumers.

In the first place, the company cannot fix the rates to suit itself. They are under the control of the Public Service Commission; and if the rate is too high—that is, a rate which produces more than a reasonable net return—our quarrel is with it and with the governor of our state who appointed its members. In order to understand how the rate is fixed, we must understand something of the theory of rate making and what is termed "rate bases."

As in every other line of human endeavor, charges or rates to customers of electric light and power companies must vary with the class of service rendered. There is one rate for residential lighting, another for residential power as for the electric refrigerator, another for commercial lighting, another for street lighting, another for small power users, and another for large power users. In each one of these cases, the production and delivery cost to the company is different from any of the others and therefore the price to the consumer should be different—it is in all well regulated public utility companies—and the different rates or charges are known as the "rate schedule."

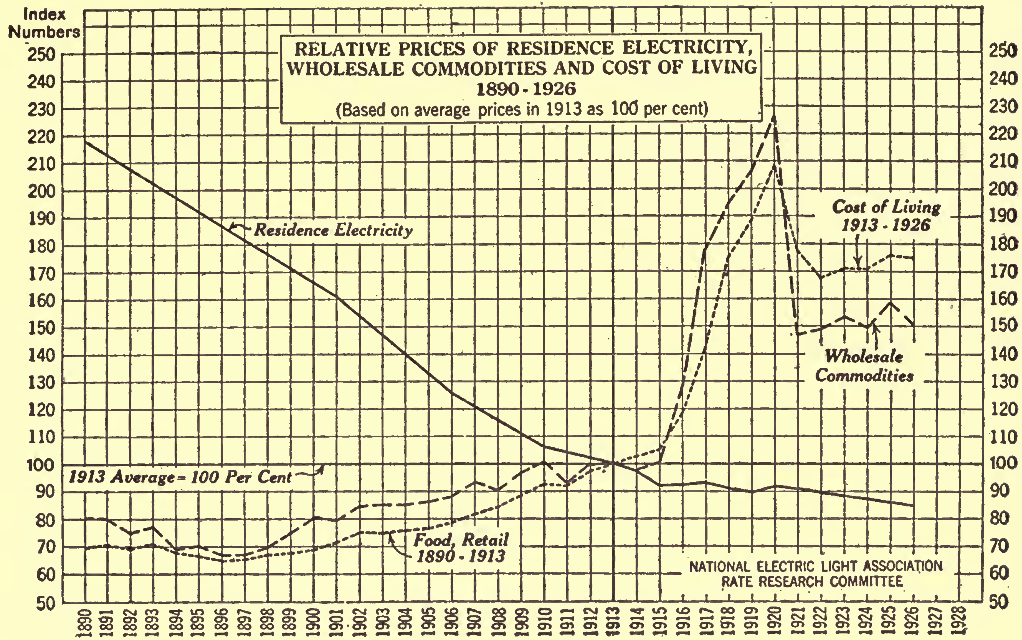
What the light and power company is actually selling is not so many kilowatt hours each month—it is service. Each class of service has its own fixed costs to the company, regardless of whether the customer uses one or one hundred thousand kilowatts a month. The rate therefore consists of a fixed investment and overhead cost which varies with each class of service, plus the cost of producing and delivering the kilowatts which, in so far as the customer is concerned, varies with the number of kilowatt hours he uses each month.

Merchandising electric energy is quite different from merchandising dry goods, groceries or drugs. The retail merchant maintains his stock in such a manner as will, in his judgment, best serve his customers. He can vary this stock with the season, and if he happens to have a call for something which he does not have on hand at the moment, his customer must either wait or go to some other store. If the merchant is clever, he is able to serve his trade with a minimum investment and a minimum operating expense. At Christmas-time, he triples his stock and takes on extra help. Christmas over, he discharges the extra help, and if he has any surplus stock, he instantly has an after-Christmas sale and brings his investment in stock back to normal. As the summer wanes (if his business is one which varies with the seasons) he has a "sale" to make room for fall goods and as spring approaches, he does the same thing with his winter stocks. He turns his capital over three, four, or even five times a year, and if he is a good merchandiser, he is never overstocked and is never paying out operating expenses which are not producing revenue.

The electric service company is not so fortunate. It must have enough electric energy on hand at all times, regardless of the season, to deliver instantly to its customers their maximum requirements. It cannot say: "We are very sorry but we are just out of kilowatts; we have something just as good, or perhaps you can get them from Jones on the other side of town; or, if you can wait, we are expecting a fresh supply at almost any moment." If the reader wishes to get an adequate idea of how irritated the residents of a town can become, let him answer the telephone in the office of any lighting company for fifteen or twenty minutes just after some accident in the power house has plunged the community into temporary darkness. Half the town will call up and 90 per cent of that half will accuse the lighting company of switching off the lights deliberately just to annoy its customers.

The lighting and power company must carry a maximum stock of kilowatts on hand at all times. It is in the same fix as the retail merchant who for some reason has to carry his surplus Christmas stock throughout the year. Being a public utility, it is required by law to have not only enough kilowatts on its shelves to supply the demands of its present customers, but also to keep on hand a surplus stock in case any new customers come along. It cannot say to the new customer: "We are very sorry but we have just enough stock of energy to supply our regular trade." It must be prepared to furnish its service and its energy to all comers at all times, in any amount.

In this, we have the explanation for differential rates. Take the case of residential lighting. It is a well-established fact that the cost to the company of being prepared to furnish service to even the smallest residence is seldom less than $1 per month and frequently more, even though that particular residence does not use a single kilowatt during the month. Let us assume that the company has a residence rate of 10 cents per kilowatt hour for the first 30 kilowatt hours and 5 cents per kilowatt hour for everything over 30 kilowatt hours, and also has a minimum monthly charge of $1. If the customer places no value on the service which the company is ready at all times to render, no matter what his consumption of energy may be, and bases his cost per kilowatt hour by dividing his monthly bill by the number of kilowatt hours he has used, then the customer who has used but one kilowatt hour concludes that he is paying the enormous rate


RELATIVE PRICES OF RESIDENCE ELECTRICITY, WHOLESALE COMMODITIES AND COST OF LIVING
1890 - 1926
(Based on average prices in 1913 as 100 per cent)
Index Numbers
Residence Electricity
Cost of Living 1913 - 1926
Wholesale Commodities
1913 Average = 100 Per Cent
Food, Retail 1890 - 1913
NATIONAL ELECTRIC LIGHT ASSOCIATION RATE RESEARCH COMMITTEE

of $1 per kilowatt hour. On the other hand, the customer who uses 50 kilowatt hours per month, at these rates would have a monthly bill of $4.00 and only be paying at the rate of 8 cents per kilowatt hour.

In the case of the $1 customer, the company would only be getting the actual cost of being prepared to give that particular residence service at all times. In the case of the 8 cents per kilowatt hour customer, it might be making a reasonable profit. According to rate experts, it is fair to assume that whenever the result of dividing the total amount of the monthly bill by the number of kilowatt hours used is in excess of 10 cents a kilowatt hour, the company is getting no more than the actual cost of the service.

The same type of differentials are found in rates for power. While the company can afford to furnish electricity for power purposes in residences at a rate lower than that for lighting purposes, it cannot afford to furnish it as cheaply as it can to a commercial user who may consume thousands of kilowatt hours in a month. This is so obvious as hardly to require explanation. One does not go into a retail grocery store and expect to purchase a bushel of potatoes at the same rate per bushel as that paid by the purchaser of a car load.

Power service rates must also vary in accordance with the investment and the cost of giving the service. Light and power rates also vary according to locality. In thickly populated localities, the rates are almost universally lower than in thinly populated sections. In the latter, the cost of delivery is very much greater than in the case of the former. Comparisons of rates as between communities are unfair if all of these factors are not taken into consideration. Daylight-saving time makes a great difference in the gross income of a lighting company, although its overhead and cost of operation are exactly the same as in the seasons of the year when standard time is in use.

As the electric light and power company is forbidden by law to earn more than a "reasonable return," anything which brings down the unit cost of production—that is, the cost of manufacturing and delivering a kilowatt hour of current—brings down the cost to the consumer. For this reason, lighting rates in industrial centers are usually lower than rates in rural or purely residential sections. A plant which is idle a large portion of the twenty-four hours must necessarily get a higher rate than a plant which is furnishing its full capacity of current for the entire twenty-four hours. For this reason, the well-managed company always joins with the community in encouraging the establishment of new industries. These industries use the power during the day which is used for lighting during the evening and therefore the generating plant is running at maximum efficiency. In other words, it is earning its fixed charges, regardless of the time of day or season of the year. As electrification of farms and the decentralization of industry progresses, the rates in the smaller communities will gradually drop, because this means that from an operating standpoint, the light and power company more nearly approaches the situation of the retail merchant who keeps his stock balanced with his demand.

One of the underlying causes why the public mind is in a state of "resistance" to any and all public utility rates and cannot believe but that they are too high is that they are not regulated by competition. Yet nothing could be more serious than to have the public utilities engaged in the sort of cut-throat competition that so often destroys a mercantile or manufacturing business. Experience has proved that unwarranted competition between public utilities destroys or impairs a service without providing any means of furnishing it from other sources. Furthermore, inadequate revenues, due to competition, make it almost impossible to secure the necessary capital for improvements and extensions.

For these reasons, states and communities now consider the public utility as a "natural monopoly" and grant franchises which enable it to conduct its business with little or no competition. However, when the state grants a right to do business without competition, it assumes an obligation to its citizens to see that this right is not abused. In other words, the utility receiving, as it does, something of great value both to it and to its customers, must place itself under the control of the state as to rates as well as in regard to all other phases of its business. In the chapter on regulation, we shall see how the Public Utilities Commission should guard the interest of the people. In no phase of its work does it operate more successfully than in the matter of rates and charges.

In a majority of the states the power exists to regulate the rates of public utilities, and, having this power, the question arises: "How shall this duty be performed?" In most rate cases, the value of the utility property is the basis on which the rates are fixed. Briefly stated, it is accepted as a principle that the utility is entitled to a reasonable return on the value of the property devoted to the public service. A rate allowing a greater return is unfair to the consumers for the reasons that the utility has the privilege of doing business without competition and any lesser rate approaches confiscation. Under this rule, it is necessary first to find the value of the property and then determine what is a fair return on that value. Thus, valuation becomes an essential element in rate making and in most of the states the Public Utilities Commission has full authority to fix this value. In many states, the Commission may revalue the property from time to time.

In making these valuations, it is customary to include only such property as is used or is useful in serving the public. There have been many cases where the Commission has excluded unused or incompleted plants, disconnected street railway tracks, reconstructed pumping stations, uninstalled equipment, replaced engines, unused real estate, vacant buildings, etc. It is obvious that when rates are fixed on principles such as these, the public only pays a return on property which is being actually used in its service and not a return on such vague items as good will, real estate of doubtful or no value, inventoried equipment which, in so far as service is concerned, has no value, and the like. In fact, the consumer is paying a rate which is approximately the rate of interest he would have to pay if he went to his bank and borrowed money on gilt-edged collateral. It is suggested that light and power service, with all the risks to capital which attend its installation and operation, is entitled to an even greater return than money which is loaned with no risk to the lender.

It may happen that the public utility has built a plant and installed equipment which is larger than the existing demand required, and immediately the question arises whether this excess of property is to be considered in fixing rates. In such cases there is only one thing to do; apply the rule of common sense. If the company has built its plant far in excess of the reasonable probabilities of the future, that is its hard luck, for the Commission will probably deduct the excess values. If, however, it has been prudent and only added excess plant and equipment to take care of the probable demand for the next few years as shown by the history and development of the territory to be served, then the additional value is allowed and the rates are fixed to give a reasonable return on the total investment. When there has been imprudence in making extensions, the utility bears the burden, but where there has been no imprudence and the property has been developed according to good business principles, the value of the surplus property is included in the rate base. The responsibility is on the utility commission quite as much as on the company. The success or failure of regulation is due to administration and not to virtues or faults in the system.

The valuation of property naturally presents many problems. The value of a thing cannot always be ascertained with mathematical exactness and this is particularly true of an electric light and power plant, as its market value depends largely on its ability to render service. Out of service it has little or no value. Often there is a wide variance of opinion as to values between the rate-making body and the courts, and courts themselves frequently differ.

In fixing the value of public utility property for rate-making purposes, there are three principal methods. These are (1) original cost, (2) reproduction cost, and (3) prudent investment. Under the first method, an effort is made to determine the original cost of the plant and the rate is based on a reasonable return on that cost. This is often difficult and, furthermore, it does not allow for the fact that those who took their chances in building the plant, are, in all fairness, entitled to some return for their initiative and enterprise. Under the second method, the cost of reproducing the property under conditions existing at the time of valuation, less depreciation, is assumed to be the value for rate-making purposes. Under the prudent investment theory, only the actual amount of capital honestly and prudently invested in the utility is taken into account. The advocates of this theory claim that the owner invests "capital" and not "property" and the consumer should be required to pay a return on investment and not on unearned increment. Obviously, this advocates the protection of capital and not the protection of property. The face value of stocks and bonds is given little or no weight in rate making unless they were issued under the supervision of the Public Utility Commission.

Eliminating sentiment, the value of a thing depends largely upon the amount of return it will yield. The grocery store which, because of location, class of trade or business methods of the owner, earns a net return of $25,000 a year, is certainly worth more than some other grocery store which earns only $10,000 a year, even though the buildings of both may have cost the same and though both may carry approximately the same stocks. It also seems logical to say that the owner of the first store, because of his superior judgment, because he works harder, or because he, for any one of a number of reasons, has built up a superior trade, is entitled to a greater return for his efforts and his investment than the proprietor of the second store. He may have only approximately the same amount of capital invested, but because of his better business methods he turns that capital over several times, while the owner of the second store is turning his capital over only once. Yet no one would advocate going into court and demanding that he be required to reduce his prices to a point where he would be earning only the same as the owner of the second store.

All of which of course brings up the question as to how values should be fixed for the purposes of rate-making. One English idea is that a thing is worth in proportion to what it will earn. This method has the advantage of being simple, and it also eliminates the expense of preparing information as to the value of the property which often runs into considerable amounts, these costs finally falling on the consumer. This idea has been generally rejected in this country. One commission might say that it would give it little or no consideration, while another might apply it to the exclusion of all other methods. It might be well for all commissions to give some consideration to the old application of the rule of common sense. Any laborer is worthy of his hire. Most certainly the fixing of rates on a return on the original cost of the plant or on the amount of capital prudently invested is just as unfair as it would be to say that no retail merchant shall make more than any other retail merchant, unless his store has cost more or unless he has a greater investment. The men who have worked all of their lives in the building up of a public service which benefits all should be entitled to have some consideration given to both reproduction cost and to values due to net earnings. The Public Utility Commission should have no difficulty in balancing one against the other and arriving at a rate base which would be fair to the consuming public and which at the same time will not be confiscatory.

At the risk of being accused of indulging in pro-British propaganda, the author maintains that the English idea of values, or worth, is superior to the American idea. Ask an Englishman what he is worth and, if he chooses to answer, he will say "one thousand pounds a year" or "five thousand pounds a year" or "ten thousand pounds a year," as the case may be. He visualizes his worth in terms of annual income. On the other hand the American visualizes his worth in terms of the cash he has invested and in the bank. The Englishman may have a $100,000 estate but if the income from it is only sufficient to pay taxes, insurance and up-keep, it does not enter into his calculation of what he is worth. The American who has paid $100,000 for an estate is inclined to enter it as an asset of that amount, regardless of its earning power or its market possibilities.

While the state, represented by the Public Utility Commission, controls the rate, the public utility always has the right of appeal to the courts if it thinks the rates are unfair. The Fifth Amendment to the Constitution of the United States protects against confiscatory federal legislation, while the Fourteenth Amendment protects against confiscatory state legislation. It is for the courts to say whether rates have been fixed so that confiscation results under these guarantees against "taking property for public use without just compensation" or provisions as to equal protection of the law. The Constitution prescribes and the Supreme Court has said that the owner is entitled to a reasonable return on a fair value of his property, and the principle of that decision is firmly imbedded in the public utility law of today.

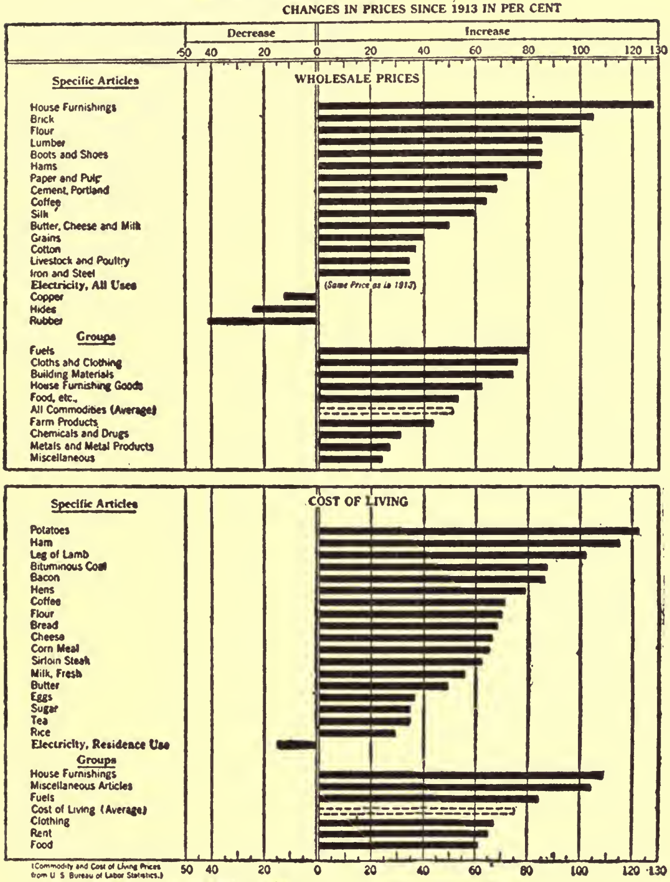
It is doubtful if there will ever be complete uniformity of rates throughout the United States for light and power service. Few, if any, articles purchased by anyone have an absolutely uniform price, although the public is frequently misled by the thought that because an article is advertised nationally it must have a uniform price. The buyer of an article usually pays a price that is determined by the conditions under which he can buy. The man in a remote wilderness town pays a high price for his needs while the suburban dweller will often pay his local merchant more for an article than the price at which he can buy it in the city. The great mail-order houses, with their tremendous buying power and their advantages in distribution, can undersell their competitors on many standard articles. In the last analysis, the price of everything is regulated by the cost of manufacture, competition, the law of supply and demand, and the cost of doing business which varies in different localities.

The public frequently falls into the error of considering that the cost of generation is the principal item of cost and determines the fairness or unfairness of the public utility by the difference between that cost and the charge per kilowatt hour which the company makes to its customers. As we have seen, the cost of generation is often the smallest item of the company's expense. Distance of the customer from the generating plant is also an important factor, particularly in the case of rural customers. Only the United States Post Office, by some weird process of bookkeeping which still shows a deficit of millions a year, seems to be able to do this when it carries a letter 3,000 miles for the same price it carries another across town.

Electricity is the only household commodity the cost of which has remained at the pre-war figure. In fact, the unit cost of electric light today is less than five per cent of what it was forty-five years ago, and the product is infinitely better. It is the smallest item in the family budget, amounting to about eight

CHANGES IN ELECTRICITY PRICES SINCE 1913, COMPARED WITH CHANGES IN PRICES OF WHOLESALE COMMODITIES AND COST-OF-LIVING

Based on Average Prices in 1913 and 1926



(Commodity and Cost of Living Prices from U. S. Bureau of Labor Statistics.)

NATIONAL ELECTRIC LIGHT ASSOCIATION, RATE RESEARCH COMMITTEE

cents per average household per day. The nation's candy and tobacco bills are greater than its entire electric bill for all purposes. The national gasoline bill is three times as much. During the past thirty-six years there were only three years in which the price of electricity for domestic purposes increased. In 1916 the rate increased ½ of 1 per cent and in 1917 it increased 8/10 of 1 per cent. In 1918, however, the rate decreased 2.6 per cent. In 1920 it again increased 2.6 per cent, only to decrease 2.5 per cent in 1922, and it has been steadily decreasing ever since. According to data published by the Rate Research Committee of the National Electric Light Association, the price of domestic electricity on a comparable equivalent 1913 dollar basis has decreased with yearly variations from 27.2 per kilowatt hour in 1890 to 4.2 in 1926. The 1926 rate was but 48.3 per cent of the 1913 rate.

Taking the total output of electrical energy, it is found that the average rate has decreased from 3.36 cents per kilowatt hour in 1902 to 2.3 cents in 1926. The 1926 rate was exactly the same as the 1913 rate, while in equivalent dollars it was but 66 per cent of the 1913 rate.

CHAPTER XV

Let Us All Regulate

WHEN the average citizen reaches the conclusion that he is fitted by experience and the state of his finances to go into the grocery, the dry goods, the drug, or any other similar business, he does just that—becomes a grocer, a druggist, or a dry goods merchant. As long as his place of business complies with the various building, sanitary and other municipal codes, his advertising is honest and he pays his bills with reasonable promptness, he remains in business without interference. His prices may be "all that the traffic will bear." He may give or refuse credit, carry a widely diversified stock or confine it to a few specialties, employ one clerk or many, deliver or refuse to deliver, give his customers the best or the worst possible service—it is his own business. He can conduct it as he pleases, meeting competition if he is a good business man or allowing it to drive him out of business if he is not. It is his property and his stock and the only person who can take it away from him is the sheriff—and he only in the interests of creditors, after the due processes of the law have been invoked.

If, however, this average citizen desires to go into a public service business such as furnishing electric light and power, the matter is by no means so simple. He may have the money with which to finance the project; the necessary equipment and other facilities; own a site which would be admirable for the purpose; even may have engaged the technical men to manage the property. Nevertheless, he cannot engage in the business until he has secured from some constituted authority—generally the state regulatory commission—what is known as a "certificate of public convenience and necessity." This certificate is a permit issued under the authority of the state to engage in the business of furnishing light and power, and it is granted only when the applicant has shown that the territory which he proposes to serve is actually in need of the service and that it is in the interest of the public to allow him to supply it. He must also secure franchises from the municipalities in which he intends to furnish services.

Suppose that a group of citizens should decide they would like to go into the business of furnishing telephone or electric light service in the city of New York. In the language of the day, they would not even "get to first base." New York is admirably served with telephones and electric light, and nothing could be more inimicable to the public interest than the establishment of competing companies. Why? Telephones and electric light and power are affected with a public interest and therefore subject to regulation by the state as to their rates and service. Many people can remember the confusion that existed when there were two telephone systems and business houses were virtually forced to have both phones. With the almost universal use of the telephone today, the only result from two systems throughout the United States would be chaos. The same thing is true of electricity. Where a community is served by an electric light company under the present system of regulation which prescribes everything from the rate to be charged to the quality of service to be rendered, competition means only confusion, poor service, higher rates and general dissatisfaction. Here and there one finds the usual exception wherein a community is served by two competing light and power companies just as one can find on Market Street, San Francisco, two street railway companies, each operating on its own set of tracks on the same street and fighting for the business of the same customers. Such conditions are unusual, however, and experience has taught that to secure the best service at the lowest possible rates, competition must be eliminated and one company granted a virtual monopoly under rigid supervision by governmental authority.

This, then, is the first chapter in the book of public regulation of public services—businesses which have a definite public interest. Unlike the retail merchant, our average citizen cannot go into the utility business until he has shown that he will have a market: that there will be a public demand for his product and that consequently it is in the interest of the community or the state to allow him to serve it.

Having secured his certificate of convenience and public necessity, the entrepreneur is immediately faced with a statute regarding finance. There was a time when he could buy a second-hand dynamo, a few miles of wire and some second-hand poles and go into the business, not so much as a public service enterprise as a stock-selling scheme. In those days, it was possible (and it occasionally happened) to mortgage almost any kind of equipment, issue stocks and bonds to an unlimited amount, sell them to the public, and retire from the service of the community with a handsome profit, leaving the investors holding the bag. Those days are gone forever. Now many state utilities commissions can look him and his property over and tell him the maximum limit of stocks and bonds which he can issue against that property. There is no way that he can acquire large blocks of so-called "promotion stock" representing neither services nor investment, to be sold to the public at prices far in excess of any possible value. Security issues on public utilities are now probably less than their actual value.

Having driven over the bunkers of public necessity and finance, Mr. Average Citizen proceeds to build his plant, lay transmission lines and start furnishing service to the community. The next question with which he must deal is that of rates. He is reminded that he is limited by law as to the amount of profit which his business can make, and this profit is based on the actual value of the property which he uses in the business. He is now in the public service and it is the business of the Commission to see that the public gets adequate service at a reasonable rate, taking into consideration all factors such as the value of his property and operating expenses. The fact that he has a monopoly does not affect the return on his money and there is no chance of excessive profits. As a get-rich-quick scheme, the public utility no longer serves the purpose of the professional promoter.

This question of rates occupies a large portion of the time of most public utility commissions. One needs only to examine the record of any one of them in such states as Wisconsin, New York, or Pennsylvania, to appreciate the enormous amount of labor involved. Hearings must be held which sometimes last over a period of months, for both the public which is paying the rate and the public utility which is charging it have a right to their day in court. The record of these hearings for any one year will fill several five-foot bookshelves.

In addition to the question of rates, the Public Service Commission must give its attention to the question of service. Citizens in certain sections of the community may complain that they are not getting immediate service or that the service is too limited in extent. Once in the public service, the business man finds that he cannot extend his business as the demand warrants, just as the grocer or dry goods merchant expands his business with the demand. Extensions and improvements are in many states under the control of the Commission, may be compelled by it, and can be made only with its consent.

This, then, is regulation of public utilities by state commissions as it exists in almost every state in the Union. It is the supervision and control of the major functions of every utility enterprise. The state issues the permits to go into the business, often polices the securities issued in the interests of the public and the investor, regulates the rates to be charged, and establishes the quality and extent of the service to be rendered. About all that is left to the owner is the right of initiative, the right to supply the necessary capital, and the right of management. But public utility interests, now that the professional promoter has been washed out, like it, and one of the reasons they like it is that the Commission is the final arbiter between the utility on the one hand and the public on the other. It is infinitely superior to continual resort to legislation —requesting economic justice at the hands of a purely political body.

This system of regulation is almost universal throughout the United States and is the direct result of experience in dealing with the railroads and in developing methods for their regulation. In the early part of the nineteenth century, when railroad construction was in its infancy, the companies were allowed to work out their own relations with the public. They made their own rates, could, if they desired, issue securities in unlimited amounts, and economic laws with regard to competition were frequently disregarded. Many "wild-cat" schemes for the building of railroads were projecting on paper for no other purpose than to sell utterly worthless stock to the public. Frequently rates were based on stock issues which represented little more in the way of capital invested than the promoters' rosy dreams of immediate riches for themselves. Promotion or "watered" stock demands dividends quite as emphatically as stock which represents actual cash invested, and, in the absence of regulation, sometimes results in rates far in excess of the requirements of the actual capital employed. Fortunately, however, the promoters and operators of legitimate railroad enterprises were quick to realize the value of a proper ratio of rates to capital invested and the necessity of keeping faith with the public, regardless of legal restrictions or the lack of them. Perhaps no single group of men began earlier to appreciate and admit that their business is dependent on satisfactory public relations with their customers, than the leaders in the railroad field. It has taken the public some time to find this out and to reach a state of mind where it is willing to repudiate the claims of political demagogues. Today the public attitude toward the railroads is one which encourages service of the highest grade to the everlasting benefit of everybody.

The first remedy for the bad practices of a few railroad managements was through stringent laws providing drastic penalties for some of them, but the evils continued. This was followed by the enactment of maximum rate laws which "decreed" the rate companies could charge; but again, these laws, because they ignored changing economic conditions, failed to cure. Then in the early 'seventies an experiment in commission regulation was tried to a limited extent. Although these first commissions had very limited jurisdiction, the results obtained were so promising that during the following ten years, railroad commissions were established in a number of states. In 1890, the Supreme Court held that giving state commissions the rate-making power was proper and not an unlawful delegation of legislative authority. This gave great impetus to their creation. In 1905, Wisconsin, Washington and Indiana authorized their commissions to regulate rates and service of railroads, both passenger and freight, and express companies. The Wisconsin law extended jurisdiction over steam railroads and electric roads outside of cities as well as to street, express and private car line companies. The Indiana law included jurisdiction over pipe lines.

Until 1907, the jurisdiction of these state commissions extended generally to railroads and express companies. In this year, upon recommendation of Governor Charles Evans Hughes, New York established two public service commissions with jurisdiction as to rates and service of street railroads, gas and electrical corporations and in the same year, Wisconsin provided for commission regulation of telephone, heat, light, water, street and interurban railway, telegraph and power companies. These states were the pioneers of state commission regulation of utilities other than common carriers. Other states followed, until today there are forty states, including the District of Columbia, in which there is commission control of electric utilities.

The commissions are composed of from one to seven members and are designated as Public Service Commission, Corporation Commission, Railroad Commission, Public Utilities Commission, Commerce Commission, Department of Public Utilities, Railroad and Warehouse Commission, Railway Commission, Board of Public Utility Commissioners, Board of Railroad Commissioners, Railroad and Public Utilities Commission and Department of Public Works. As a general rule, the Commissions have the power to tell our average citizen whether he can engage in the business of dealing in light or power or not, can tell him what he must charge for his service, how to keep his books, and require him from time to time to make extensions and improvements to his plant as conditions may warrant. If he wishes to consolidate his plant and business with some other public utility, the consent of the Commission must often be obtained.

In every state where there is this form of regulation and control, the owner of the public utility has the right of appeal to the courts from the decision of the Commission if he thinks it is unreasonable or unlawful.

All modern utility law is based upon the theory of regulated monopoly: monopoly in the sense of one concern serving the community under supervision. The once prevalent belief that service is stifled by monopoly and bettered by competition has been completely abandoned, it now being recognized that competition among utilities means only unnecessary duplication of plants, poor service and additional costs. Such competition is wasteful, unscientific and uneconomical. While the history of the common law shows a hatred of monopolies, the public service law marks a radical change in existing conditions by creating a new set of rights and public duties, the natural consequence of which is to prevent ruinous competition and protect the public.

In considering applications for a permit to engage in the light and power business, the Commissions look only to the good of the general public. The overpowering desire of some applicant to start a public utility in his home town is not sufficient to show that public necessity warrants the service.

The word "public" is used in contradistinction to the individual or any number of individuals involved, and the decision is made from considerations of sound public policy. The courts usually feel bound by decisions of the Commission granting or denying these applications and, unless it has obviously acted unfairly, arbitrarily, or in disregard of the evidence or law, its conclusions are usually followed.

The reasons for refusing applications to engage in the light and power business are many and varied. It may be that the plant of the applicant is too small to meet the demand for power in the district it is intended to serve; the demand for power may be too small to justify the plant; the applicant may have failed to demonstrate sufficient financial strength to insure permanency and stability of operation, or he may have refused to define the territorial limits of his operations; the Commission may conclude that the territory naturally tributary to an existing company should be developed by it and not by another company. These and many others are reasons for refusing a certificate.

The power to grant or refuse the right to engage in the electrical business is a powerful weapon in the hands of the Commission to compel adequate service and to control rates. The existing company which has the privilege of serving the community to the exclusion of all competitors, may wake up some morning to find that it is faced with competition through the granting of similar privileges to another company if it is not living up to its obligations. This certificate of a right to do business should not, however, be confused with franchise.

The public utility must obtain both a certificate and a franchise.

In many states public control over utilities extends to control over finances by requiring the consent of the Commission to the issuance of corporate securities. In the early days of regulation, public utility corporations contended that values for rate-making purposes should be determined in accordance with the stocks and bonds outstanding, arguing that earnings must be sufficient to pay operating expenses, interest to bondholders and dividends to stockholders upon their face value. The modern rule, however, is to disregard face values and to fix the rate base upon the value of the property of the utility used at the time that it is being used for the public service. Control of the issuance of securities, therefore, is of primary importance to the investors and to the financial structure and credit standing of the utility, rather than as a basis for rate making.

This scheme for the control and regulation of public utilities in the interest of the public, provides every safeguard for both consumers and investors. Behind the Power Dispatcher described in the first chapter is the firm hand of the state Commission, seeing to it that the supply of power never fails, that facilities for redistribution are always abundant, and that the equity of the people in the good things brought forth by the electric industry is at all times preserved.

It has been claimed that this form of state Commission regulation and control has failed; that instances can be cited where rates are too high and the service poor, in spite of the fact that the Commission has the power to lower the rate and compel a betterment of the service. There are such cases, but it cannot be said that it is the fault of the system —rather it is the fault of its administration in those particular instances. The author is the last to deny that those engaged in the light and power business are anything other than human; and no doubt in some instances where the Commission is lax for one reason or another, the company has taken advantage of that fact and charged excessive rates for service of poor quality. These, however, are isolated instances and most certainly prove the exception rather than the rule. Most utility commissions are both honest and efficient, with a high regard for their obligations to the commonwealth; and though they may make mistakes in judgment from time to time, this should not condemn the whole idea.

It should be remembered that this whole experiment in commission regulation is only twenty years old. It is a relatively new plan of relationship between the government, the people and business. But the utilities commissions have been pioneering and are gradually building up a new body of utility law by their decisions—an unwritten law comparable with the growth of the common law under the English system of jurisprudence. It is but natural for them to make mistakes from time to time in their decisions. Courts make mistakes and render decisions which on appeal are reversed, overthrown or repudiated. No lasting harm is done. The system remains. When a Commission makes a mistake in judgment, either side has the right of appeal and sooner or later the mistake is corrected. The people have a simple remedy for official failure. One does not destroy a whole tree simply because it bears an occasional unpalatable apple.

The critics of the present system of regulation by state utility commissions present their criticisms as final arguments for government ownership and operation. A committee appointed by the legislature of Tennessee to investigate the development of power sites has taken upon itself to answer this argument. In its report, the committee, which recommended the granting of permits to utility companies and opposed state ownership and operation, inserted the following paragraph: "Finally, we have faith in the integrity of our State Government which prevents us from being alarmed over the weakly expressed opinion that the state is unable effectually to regulate and control great aggregations of capital. Nor are we able to forbear the observation that, if Tennessee lacks the political character and stamina necessary to control large aggregations of capital, it must also lack the character and stamina necessary to take over and operate these enormous enterprises."

Prior to the development of interconnection, control and regulation of public utilities was always considered a question for the individual states. Except for power sites on navigable rivers, little or no thought was given to possibility of federal control. Electric light and power companies served municipalities or areas within individual states, and their supervision was a police power of the state. Interconnection, however, raised the whole issue of interstate transmission of power and immediately the theory was advanced that if and when the power business became interstate, it should be subject to the same sort of supervision as that over the railroads through the Interstate Commerce Commission.

But has interconnection brought about an interstate factor of sufficient importance to take control and regulation out of the hands of the state governments and centralize it in Washington? Turning back to the chapter on interconnection, we might again note that it does not necessarily mean that certain specific power is transmitted over long distances. It may simply mean that, by "bucket brigading," power generated in one section of a given area may very well be "felt" in another section, although that section is hundreds of miles from the point of generation.

In the light of these facts, does there exist any such issue as "Federal *v.* State regulation of public utilities?" Does the fact that a small percentage of all the power generated in the United States crosses state lines warrant federal interference with what is obviously state jurisdiction to such an extent that this important service shall be subject to the disadvantages of a federal bureau or commission?

Having accepted the principle that all public utilities should be subject to government supervision in the interests of the public which they serve, we have accepted the principle of an arbiter in the form of a government commission between the manufacturer of light and power and his customers, the citizens of the community or state which he has been given the exclusive privilege of serving. It is not a question of states' rights but rather a question of the best interest of the public. Can a federal or national arbiter located in Washington serve the people of the forty-eight states and the tens of thousands of cities and towns as well as forty-eight local arbiters?

Let us suppose that the people of a section of a small community feel that they are not getting adequate service or that the rates they are paying are too high. Which is the easier—to file a complaint with a state commission where, as proven by innumerable past experiences, they can get quick action, or go to Washington, and, once there, through all of the expensive and drawn-out routine of dealing with a federal commission? When one stops to consider that such a commission would at all times have literally tens of thousands of similar complaints regarding rates and services, it is not hard to appreciate the delay and expense involved in a project of this kind. The consumer in California who thinks he has been overcharged will become discouraged when he discovers what he has to do to bring his complaint to the attention of the authorities in Washington whose duty it will be to deal with it; and this is not a reflection on the authorities in Washington.

On the other hand, it should be noted that while the amount of power which crosses state lines at the present time is so small as to be almost negligible in any consideration of a possible change in the methods of regulating and supervising light and power companies, there are indications that this will not always be the case. The power industry is going through a period of natural consolidation of various local companies, and interconnection, both between independent companies and subsidiaries, is progressing rapidly for purely economic reasons and without any regard to state lines or company ownership. Large power sales and interchanges of power are becoming a common practice, and each year sees more and more power generated in one state and consumed in another.

The courts have held that the transmission of electricity from one state to another is interstate commerce. Before this question arose in connection with electric energy, the United States Supreme Court had held in a series of cases that the piping of gas from one state to another was interstate commerce. When it is sold wholesale to some local distributor who retails it to his customer, it is interstate commerce, and while the wholesale contract may be free from state control, the local rates and service are always subject to state control. When it is retailed direct to the local consumer, it is still interstate commerce, but of a character that the state in which it is consumed has full regulatory power. Under a recent decision, the same privileges appear applicable to the transmission and sale of electric current. So it may be said that power generated in one state and sold in another is subject to national regulation if sold wholesale to a local distributor, but subject to state regulation if retailed by the generating company. It is a federal matter as long as it is being handled in wholesale lots, and a state matter as soon as it is being retailed.

This is confusing and there are other complexities. A company may generate electricity in one state and retail it in that state and also in another state. In this case the commissions of two or more states may exercise full jurisdiction, but that jurisdiction consists wholly in regulating local rates and service. While it may be said that the utility thus operating is subject to the control of two or more separate state commissions, in practice it causes no embarrassment. If the commission of any one state acts unjustly or unfairly its action is subject to review by the courts in exactly the same manner and with the same force as in the case of a utility operating in one state only. If the company generating the power sells to a distributor in another state, the wholesale power contract is not subject to state regulation, but the distributor who has bought the power wholesale and is rendering local service is under complete supervision as to rates and service. Thus it is seen that the situation can never get beyond the control of the state, regardless of the fact that strictly speaking, such wholesale contract for interstate power is not under state control.

There are many who insist that this power must be under some form of control when it crosses state lines and in the nature of interstate commerce, and many suggestions have been made as to how this shall be done. One provides for the creation of regional regulatory agencies, giving them the same power over interstate electricity as the Interstate Commerce Commission now has over the railroads, and making the public service commissions of the various states the regional tribunals. This, however, would mean the displacement of state authority with federal authority and it is not at all unlikely that such tribunals might assume jurisdiction over local commerce in light and power on the theory that it is purely incidental to the regulation of interstate transactions, thus divesting the state of its entire jurisdiction.

Another plan provides for compacts between the affected states in various power zones, these states selecting some agency which would be given by Congress authority to regulate interstate power. Objections to this plan are founded on the fear of unfairness or lack of appreciation by a commission representing states having divergent attitudes and interests, and the multiplication of commissions, since there must be as many compacts as there are power areas. Overlapping might result.

A third scheme which requires no legislation has been brought about by the New England Council and is actually working. Under this plan, all of the public utility companies in the affected states have met with the public utility commissions and have agreed voluntarily to abide by the rulings of a joint agency representing these commissions on all rate matters in connection with the transmission of electricity where two or more states are affected. The undertaking is made effective by inclusion in the contracts of the companies concerned. It is a purely voluntary agreement on the part of the companies cooperating with the utilities commissions, seems to work in a thoroughly satisfactory manner, is dependent on neither legislatures nor Congress, and is at least some evidence that business can get along with government to the benefit of everybody.

The fear is frequently expressed that if there be any federal agency set up in Washington to regulate interstate power, there will be a natural extension of that authority to purely local rates, and there is some ground for this fear. Upon the formation of the Union, the states yielded to the federal government the right to regulate interstate commerce. They reserved to themselves the right to regulate all internal commerce. But a doctrine of law has been built up through the years by the Supreme Court, to the effect that if state action within its own field of intrastate commerce prejudices interstate commerce, then, as the federal authority is supreme, the state regulation goes out. For instance, if the State of Minnesota should fix a rate of 2 cents per mile for passengers by rail between St. Paul and Mankato, the Interstate Commerce Commission would displace it by a four cent rate if it deemed the two cent rate prejudicial to a rate from St. Paul to a point in Wisconsin. Thus the state's authority is supplanted and the federal government becomes supreme. Now if Mr. Average Citizen felt that the four cent rate was too high, he would be required to take up his complaint in Washington and do business with an agency not responsible to the local people and not as familiar with local conditions as the utility commission of his own state. It is not difficult to see where Mr. Average Citizen would land.

Yet just this result may follow if the Federal Power Commission or the Interstate Commerce Commission at Washington dips its fingers into the regulation of interstate power; and the states seem fully to sense the lurking dangers. If what is sauce for the goose is sauce for the gander, then the states say: "Mr. Federal Government, you effectively took from us authority to regulate our local railroad rates. Now it seems only becoming that you refrain from doing the same thing to the rates for electricity. We are the customers who pay what the local company meter reads and fix the rates. You have no such interest."

Opposed to any such theory is the statement of some that the federal government has never affirmatively yielded to any state any of the powers conferred on the central authority. This is not so. In the electrical field itself is an important exception. The federal government recognized the right of all states to regulate the rates of hydro-electric companies receiving the permit of the United States under the Federal Water Power Act.

CHAPTER XVI

The Federal Water Power Act

WHILE there seems to be no convincing reason why the present system of government supervision and control of public utilities by State Commissions should be abandoned in favor of some form of national supervision and control, there is an important phase of power development in which the federal government already plays an important part. This is in the development of power resources on sites located on navigable rivers. The navigable rivers of the country are under the jurisdiction of the federal government, and the right to develop hydroelectric power on sites located on them has been placed under the authority of the Federal Power Commission operating under the Federal Water Power Act.

Congress has jurisdiction over all "navigable" waters and public lands of the United States and may determine what structures may be erected on or over them, and under what conditions. It also has control over power sites on streams of the second class—that is, streams within the jurisdiction of Congress other than those defined as "navigable waters"—if a proposed construction would affect the interests of interstate or foreign commerce. Under this authority the federal government *has control over the disposition of about eighty-five per cent or six-sevenths of the potential water power of the United States.*

The Federal Water Power Act defines "navigable waters" as "those parts of streams or other bodies of water over which Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several states, and which either in their natural or improved condition notwithstanding interruptions between the navigable parts of such streams or waters by falls, shallows, or rapids compelling land carriage, are used or suitable for use for the transportation of persons or property in interstate or foreign commerce, including therein all such interrupting falls, shallows, or rapids; together with such other parts of streams as shall have been authorized by Congress for improvement by the United States or shall have been recommended to Congress for such improvement after investigation under its authority." Apparently a navigable river is any stream deep enough to float a canoe. In fact, we find in the first report of the Federal Power Commission the statement that "the commerce, however, may be of the crudest kind and may consist merely of rafts or floating logs, if such is the customary character of commerce in the locality."

Prior to 1920, when the present Federal Water Power Act was passed, existing legislation did little more than hamper the development of this power. Between the years 1910 to 1920, only 63,300 horsepower were developed. Prior to 1910, about 1,300,000 had been developed, and for a long time it had been evident that any considerable utilization of these sites would require new legislation which would protect capital invested in projects under federal control, and at the same time protect the rights of the public. That it has succeeded in doing so is shown by the fact that from the date of its passage to July 1st, 1927, the Federal Power Commission, which administers the Act, has issued 176 permits and 293 licenses, of which there are now outstanding 66 permits representing an installation of 4,500,000 horsepower, and 274 licenses representing 5,900,000 hp. of installed capacity, of which 2,000,000 hp. is primary capacity. Of the licenses outstanding 86 are for major projects, and the balance of 188 are for transmission lines, minor projects of less than 100 hp. or minor parts of complete projects. Something of the magnitude of this work is shown by the report of the Commission for 1926 which says:

> "When consideration is further given to the character of a large number of major applications as, for example, the development at Louisville on the Ohio River, which involves not only a power installation of 135,000 horsepower, but also the navigation improvement of one of the most important internal waterways of the United States; the Conowingo project on the Susquehanna River, which affects the interests of two states, and will cost more than $50,000,000; the series of projects under way by the Southern California Edison Co., which will require an expenditure of some $135,000,000; and the St. Lawrence projects, which, when undertaken must be handled by the Commission with due regard to the public interests of the state of New York, of the United States,

and of Canada, as well as the hundreds of millions of investment that will be required, a better appreciation can be had of the task placed upon the commission, and of the utterly inadequate means which have been given it to perform that task."

The Federal Water Power Act of 1920 accomplished the seemingly impossible. It satisfied Congress, it satisfied and protected the public, and it satisfied the electric industry by providing a safe and sane way to proceed with the development of hydro-electric power on navigable streams. In place of the uncertain tenure and the absolutely unknown requirements of all previous legislation, this Act provides that an applicant for a power project may secure a license for a period up to fifty years which, if granted, becomes a contract between the government and the licensee. It cannot be altered during its term either by the Executive or Congress, if the licensee sticks to the spirit of his agreement. If he fails to begin construction his license may be cancelled; but after he has begun construction, it can only be cancelled by judicial action. When the license period expires, the United States may take over the properties, or it may permit them to be taken by someone else, or it may renew the license.

If for any reason the government decides to take over any property developed under the provisions of the Act before the license expires, "just compensation" must be paid and the amount of this compensation determined by the courts in condemnation proceedings. If taken over when the license expires the price which the government must pay is the "net investment"; the original cost less whatever reserves may have been accumulated out of earnings in addition to a fair return on the investment. If the properties are not taken over by the government or given to someone else, then the licensee is entitled to a new license upon such terms as will be reasonable in *view of the then existing conditions.* Every dollar of honest investment is given full recognition by the government.

The licensee under this Act, has, of course, very specific obligations. His plant must be built with due regard to safety and efficiency. It must make the fullest utilization of the water power available and must be maintained in full operating efficiency. Reserves must be established out of earnings and a system of accounts prescribed by the Commission must be kept. The Act also provides that the government *permanently retains title and control over all power sites on public lands and of the power privileges in navigable streams.* It prohibits capitalization for purposes of rate making or for the purchase of rights, franchises, lands or other properties in excess of their actual cost. It provides for compensation to the United States and also provides that a part of any earnings in excess of a reasonable return shall be used for the retirement of the investment in the properties.

It would seem that this Act adequately protects every legitimate public interest. In fact it is more drastic, if anything, than the system of regulation of public utilities by state commissions. It polices investment and security issues; it controls rates in the interests of the consumer; title to the property remains vested in the people of the United States and no one can possibly say that our hydro-electric resources are being given away; if the licensee fails to live up to his obligations, the government can walk in and take his properties; at the expiration of the license, the government can do exactly as it pleases —renew it, take it over, or give it to someone else. Here again we seem to have a case where the people are able to eat their cake and still have it for the next day.

And it works. Take the case of a great hydro-electric power development on a certain navigable river which is nearing completion. It is one of the biggest in the country. The group building it wanted to base their rates on fluctuations in the price of coal. In other words, they wanted to advance the rate as the cost of coal per ton advanced, agreeing to reduce it as the price of coal came down. But the Federal Power Commission said "No. You must fix and maintain your rates on the basis of a reasonable return on the money invested." And the utility people making the development agreed without further argument.

But while the Federal Water Power Act is designed primarily for the protection of the public in the preservation of our natural resources and against their exploitation, it also protects the equities of the capital involved in their development. That it does so is evidenced by the rapid development, by individual initiative, of this class of hydro-electric power since its adoption. Installations under the

Act, plus applications for licenses, involve, in the aggregate, an estimated installation in excess of twenty-five million horsepower. This amount exceeds the combined potential water-power resources of Norway, Sweden, Finland and the Arctic and Baltic drainages of Russia—the chief water-power region of Europe. It is twice the combined resources of France and Italy. It is more than six times the aggregate of all applications for power sites under federal control in the twenty years preceding the passage of the Act. The government has handed the electric industry legislation which protects everybody and made everybody like it.

It must not be thought that the Federal Water Power Commission in its administration of the Federal Water Power Act invades or encroaches upon state jurisdiction in the regulation and control of public utilities by State Utility Commissions. Under the provisions of the Act, it has certain strictly administrative duties in dealing with the development of water powers on rivers which are under the control of Congress. These are receiving and advertising applications, issuing permits and licenses, conducting investigations, collecting annual charges, and assessing benefits from headwater improvements. It also has certain functions which are more or less regulatory and supervisory, such as the approval of maps and plans and the design of projected works; construction, maintenance and operation; retirement and replacement of project works and property; creation of depreciation and amortization reserves; expropriation of excessive profits; valuations of property; submission of reports; accounting practices; and the regulation of rates, service and securities. On the other hand the regulatory rights of states over rates and service are carefully preserved—the Federal Commission can only act when the states do not act.

One of the first things which the Commission does, however, is to require all applicants for licenses to present satisfactory evidence of compliance with the state laws with respect to the appropriation and use of water, to the right to do business within the state, and the right to engage in the generation, transmission and distribution of power. When an application is filed it immediately notifies all state agencies which may be interested, as well as neighboring municipalities; publishes notices of each application in a local newspaper for eight weeks; and checks all applications for compliance with the state law. In this way, it cooperates with the various state agencies for the protection of the state's equity in the hydro-electric resources within its boundaries.

The Federal Power Commission has no control over steam generating plants, even though these plants may be supplementary steam plants which are part of an interconnected system containing one or more hydro-electric plants built on navigable rivers. Its jurisdiction stops with control over plants coming under the provisions of the Federal Water Power Act. Nor can it grant a license to any one who has not complied with the state laws or who has not been granted the right to do business within the state. It exercises no supervision or control over any hydro-electric plant not so situated as to come under the authority of Congress, even though it may be part of a system containing plants so situated. The same thing is true of street railways though they may be supplied with power furnished by a plant operating under the Act. State jurisdiction over state business has been carefully protected, Congress having made every effort to avoid encroachment on "states rights." The Commission, in its administration of the Act has exercised the same care, and as a result we have a federal establishment working in absolute harmony and with the full cooperation of the various state governments.

This, then, seems to be one answer to the claims made by various groups that the power interests are "grabbing" all of our natural water-power resources when one considers that eighty-five per cent of these resources are owned by the federal government, are absolutely under the control of Congress, and that title to them can never pass to private interests—that the best these interests can do is to lease them for fifty years under conditions which require their fullest development. If all the State Utility Commissions in the United States should suddenly decide to make a present of all the water powers under their jurisdiction to private corporations, they could only give away fifteen per cent of the potential water power in the country, and this fifteen per cent would supply but a little over five per cent of the power demand. The best the power "grabbers" can do with complete consent of states is to acquire enough power to supply five per cent of the demand, and a considerable portion of this class of potential power is remote from any possibility of demand.

Thus we seem to have a somewhat different picture from that which has been held up to our view. Seven years ago Congress provided for the retention of title to practically all of the major water-power resources of the United States. It provided that these might be developed by private initiative and enterprise but only under the rigid supervision of the federal government. It provided that the government could "recapture" the site and any developments thereon at any time. In addition it provided for all of the protection of the public interest contained in the most drastic state utility law—security issues representing only capital invested; rates which will give only a reasonable return on the investment; quality of service; and complete control by a federal commission.

But the most amazing thing about the whole business is the attitude of the electric industry itself toward these conditions. It accepted them, and went to work to develop these resources wherever feasible just as fast as it could economically be done.

CHAPTER XVII

The Legend of Ontario

"For a number of years," says the *New York Commercial,* "every major proposal to put the government into the electric light and power business has assumed that Ontario, in the electric business, has accomplished great things for its citizens of which the people of this country are being deprived while a few are getting vast wealth out of improper profits. This has been behind the demand for federal government operation of Muscle Shoals. It has been the argument advanced by those who want to plunge the state of California into the electric business to the tune of half a billion dollars."

Governor Smith of New York (who is undoubtedly sincere when he says that he "wants the state's water powers developed for the benefit of all the people,") takes this same position when he says: "Power is generated at the present time on both sides of the Niagara River, in our state and in the Province of Ontario. In our state, we have given long leases and grants, some of them for nothing, some for a nominal sum, to private corporations to carry on the development; and in the Province of Ontario the development has been carried on by the province. The result is that with no stockholders in the province to be rewarded with dividends, the power is distributed to the average householder at one-half the cost to householders of our state."

During the past fifteen years, the extreme radicals have had two great opportunities to impress their theories of government, industry and property-ownership on the world. The first is the startling experiment in Russia with a Soviet form of government and its still more startling results. The second is the scheme behind what is known as the Ontario Hydro-Electric Commission, which is the most highly developed example of government in business on this continent. The Soviet government of Russia, with its abolition of property, religion, the family, and sound economics, has given the world in its "Dictatorship of the Proletariat" an example of the most rigid and uncompromising bureaucracy in all history, while the Hydro-Electric Commission of Ontario has given a splendid opportunity of comparing government ownership and operation of light and power companies with private ownership and operation. If Governor Smith is right, then Senator Norris, Senator Hiram Johnson, ex-Governor Pinchot, Senator Heflin, Carl Thompson, and all the other advocates of government ownership are right, and President Coolidge, ex-President Taft, Mr. Herbert Hoover and a majority of the American people are wrong.

Governor Smith, by comparing the Province of Ontario with New York State, has opened the door to a practical discussion of this much discussed Canadian project and the possibilities of superimposing the Canadian plan on the electric industry of the United States. It is a question which cannot be ignored and the author proposes to present the facts as he sees them. At the outset, however, there is one thing he cannot do and that is accept the Governor's thesis that money, just because it is working for the government, works for nothing, any more than a government employee will work for nothing just because he is working for the government. A government has only two sources from which to obtain capital for its business ventures; it must be obtained from the people it governs in the form of assessments or taxes (and in that case the people contributing it lose the interest it would be earning if they could have invested it in private business enterprises), or it must borrow it; and governments must pay interest on borrowed money just as private individuals or corporations must pay interest on borrowed money. In either event, it is the people who pay the wages of the money working on the government enterprise. Furthermore, a government business pays no taxes and therefore the government must tax the people additionally in order to make up this loss in the revenue necessary to carry on the business of governing. These factors in any comparison between the public utility situation in Ontario and the public utility situation in the United States cannot be ignored if the comparison is to be a fair one.

In order to understand the situation in Ontario and the activities of the Hydro-Electric Commission, it is necessary to go back a bit into history. Canada, under the British North American Act of 1867, has control over navigable rivers, but public lands are vested in the various provincial governments. This gives the various provinces control over water-power sites and water-power developments on navigable rivers. It is essentially different from the situation in the United States where the development of water power on navigable rivers is under the control of Congress, this control being exercised through the Federal Water Power Commission which administers the Federal Water Power Act. In Ontario, the provincial government has exclusive control over the Canadian side of Niagara Falls, as well as over any other water powers on which can be termed navigable rivers.

In 1902, there began a series of political controversies between various municipal councils and the Ontario Provincial Legislature which resulted in a movement extremely hostile to the operation of public utilities by private corporations. A very complete history and description of these controversies will be found in Professor James Mavor's book, *Niagara in Politics*. It is sufficient to say here that as a result, the provincial government in 1903 introduced a measure "to provide for the construction of municipal power works and the transmission, distribution and supply of electrical and other power and energy." This bill was the government's response to the clamor of the Ontario municipalities. It gave them authority to organize a municipal supply of power, the government undertaking no responsibilities and assuming no liability for any expenses. It required, however, that all projects should be thoroughly investigated by a commission before being undertaken. This resulted in the formation of the "Municipal Electric Commission" by a group of municipalities.

The Municipal Electric Commission devised a scheme for some seven communities by which they were to act in concert; but before its report was issued there was a change in the provincial government. The new administration came into power in 1905 and almost immediately the advocates for "Province-wide Hydro Development" began an active campaign to force it to back new legislation which would not only help these various municipalities to carry out their projects but also to save them the trouble and risk of financing them. The final result was the appointment of the Hydro-Electric Power Commission for the purpose of doing on a large scale what the Municipal Electric Commission had been attempting to do on a small scale.

The early propaganda of this Commission (the chairman and chief engineer both being committed to government ownership and operation), was quite as plausible as much of the government ownership and operation propaganda in the United States. It also indicated keen political sense. The advantages of public ownership were extolled and the small consumers of light and power were assured that their "rates would be cut in two." The Commission avoided any direct attack on property and was conciliatory in every way. As Professor Mavor says: "Only after their propaganda acquired momentum did they become truculent and then they became very truculent."

The story of the development of "Hydro," as the Commission is popularly called, from a modest and rather self-effacing start to the position which it occupies today—stronger if anything than the Provincial Government itself—is an intensely interesting one to the student of politics and political economy. Unfortunately it has no place here. Whether intentionally or not, a political hierarchy was gradually built up, and though the Commission was threatened with investigation and actually investigated a number of times, nothing ever came of it. The most recent and perhaps the most important of these was conducted by what is known as the "Gregory Commission," the conclusions of which seem to have been suppressed. Much of the evidence given before the Commission was, however, published in the newspapers from time to time. The only inferences which can be drawn from this evidence are that the Commission refused to be controlled by the government and that its financial legislation threw the accounts of the province into the greatest confusion.

We are concerned with the political effects of the establishment of the Hydro-Electric Commission of Ontario only to hold them up as a striking example of what Secretary Hoover meant when, in his speech on Government in Business, he warned against a political hierarchy based on government ownership and operation of the railroads and all public utilities. The Commission does all of the things which the advocates of government ownership and operation in the United States would have some branch of our own federal government do. It is a producer and wholesaler of electricity, a banker, a merchandizer of electrical apparatus, a court of appeals on rates and service matters, an operator of electrical railroads and a farmer on right-of-way lands. It generates, transmits and sells electric current to the various municipalities which in turn distribute this current to their citizens. Bills are rendered monthly, and if at the end of the year the Commission decides that it has not charged the municipality enough, it renders a thirteenth or supplementary bill. The municipality in turn renders supplementary bills to its citizens. Unpaid bills are liens against the property where the service is used and may be collected in the same manner as unpaid tax bills are collected—by a sale of the property. Large sums of money which are spent by the Commission on engineering work, inspections, and surveys come out of the provincial treasury—that is, out of the taxpayers—and are not charged against the electrical enterprise, as in the case of a private corporation. Even a part of the salary of the chairman is paid out of this same treasury and is not charged against the cost of operation. Furthermore, fifty per cent of the capital cost of constructing transmission lines in rural districts is paid out of the provincial treasury and is not charged against the Commission. The so-called cheap service to farmers is really paid for by the taxpayers of the province as a whole.

In spite of the fact that nothing like the Hydro-Electric Commission exists in New York or any other state, New York as a power area and Ontario furnish an illuminating comparison. On this side of the Niagara, the entire northern and western part of New York is served by hydro-electric power. In area and physical make-up, it is quite similar to that part of Ontario served by the Hydro Commission. It should be noted, however, that the water power in New York is supplemented by six large coal-burning power-generating plants which are presumably more expensive to operate than the hydro plants.

In the year 1925, the average cost of electricity distributed to the consuming public in the New York area was 96/100 of a cent per kilowatt hour generated. Included in this cost were nearly six million dollars in taxes which amounted to about eleven per cent of the revenues received by the companies from the public. Without these taxes, the cost would have been 85/100 of a cent. In Ontario, the average cost was 97/100 of a cent per kilowatt hour generated and the taxes paid by the Commission were an insignificant part of the total. In other words, the privately owned, privately operated companies in the New York State area sold the sum total of their electricity to the people of New York State just as cheaply as the Hydro Commission in Ontario and paid a huge sum in taxes to the state, saving the taxpayers just that much on their own tax bills.

It might possibly be said that this is not a fair comparison; that there has been much greater development of industry in the New York area giving the New York utilities an advantage over the Hydro-Electric Commission by having many more users of large blocks of power. This is true. Low power rates have stimulated industry in New York while high power rates have retarded it in Ontario. But if we must load the figures with some number which will represent the ratio between the number of power users in New York and the number of power users in Ontario it is only fair to also load them with the ratio between taxes paid by the utility companies in New York and the taxes paid by the Hydro-Electric Commission of Ontario. This is a calculation requiring the mathematical abilities of an expert but in all probability the tax loading would more than counter balance the ratio of power users.

If this is true, then what becomes of the implications in Governor Smith's statement that power is sold in Ontario to the average householder at one-half the cost to the householder in New York State? It is quite true, but unfortunately, without being intentionally so, it is a half-truth. Power *is* sold in Ontario to the householder at much less than it is sold to the householder in New York State. But in New York State, the charges for domestic service are in some proportion to its actual cost. The private utility company, not burdened with considerations of political expediency, operating under the American plan of rate making, fixes its rates for its various classes of service in accordance with the cost of rendering the service. In New York, rates for domestic service are higher than in Ontario, but rates for industrial power are much cheaper. In New York, the domestic user pays his full share as he should; in Ontario he is subsidized by the state, the business man and the manufacturer. His bills for light may be less than they would be if he lived in New York, but he makes up the difference in increased taxes, increased cost of commodities, and increased costs of doing business. Which is better: abnormally low rates for domestic service and high costs of power to business, or fair rates for domestic service and rates for power sufficiently low to attract and encourage industry?

The author is not prepared to say that the Commission deliberately furnishes electric current to the great mass of domestic consumers below cost simply as a matter of political expediency. Many people sincerely believe that the small householder should be subsidized at the expense of business generally. Unfortunately, subsidies of this kind result in no material benefit and the Commission has been accused again and again of ignoring sound business principles in order to secure votes.

A comparison of the industrial situation on the Canadian and New York sides of Niagara is interesting. In 1926, Ontario was in the grip of a severe industrial depression. Factories were shut down; some were advertised for sale; many immigrated into the Province of Quebec. To quote again the *New York Commercial:*

> "Premier Ferguson publicly said that 'many of our people are in dire distress and must be provided with the means of sustenance for themselves and their families;' and scores and hundreds of workingmen from Ontario have been and still are applying for jobs to the industrial establishments of Buffalo, Rochester and other New York State cities. While this happened across the international boundary, New York State cities, where large users of electric power obtain very low rates under the American system [of rate making] are flourishing, their factories are running and new ones are being built, and public officials are not appeal-

ing for help for starving workers and their families.

"The difference in the operations of the government-in-business system in Ontario and the American system is best illustrated by a comparison of industrial power charges in Toronto and Buffalo. Toronto power furnished through the Hydro is Niagara power. Buffalo power is largely Niagara power; but part of it is furnished by a steam generating station of the Buffalo General Electric Company which is now being enlarged because there is not sufficient Niagara power to take care of the demand."

Referring to a paper read by P. T. Davies, president of the Canadian Electrical Association at the International Power Conference held in 1924 at Wembley, England, the *Commercial* continues:

"That paper gave a list of Toronto's factories operated by electrical power. There were 3,174 factories listed, and their demand —that is, their maximum requirements for power at any given moment—ranged from 20 to 315 horsepower. If those factories had been located in Buffalo, using the same amount of power at the Buffalo Company's rates, they would have saved $207,000 in round numbers in the year. And if the Buffalo company's rates had not included taxes, there would have been an additional saving of $307,000."

It is true that domestic rates for electricity in Ontario are exceptionally low, and that a comparison of the average bill for residential lighting and power with the same thing in the United States is greatly to the disadvantage of the latter. But low domestic rates are but a poor consolation to the workman out of a job because the high cost of industrial power has forced his factory to shut down.

Continuing our comparison of the situation in Ontario with the situation in a similar power area in New York State, we find that the average price of electricity to the public per kilowatt hour generated has been steadily increasing in the province and steadily decreasing in New York. In 1923, this average price in Ontario was .907 cents. In 1924, this increased to .920 cents and in 1925 to .930. In New York State for the same period, the price in 1923 (deducting taxes) was .898 cents; in 1924 it decreased to .876, and in 1925 to .854 cents.

The whole question resolves into one of systems of rate making. The American system under private ownership and operation is based on the principle that the costs of service shall govern the rates paid. It is a principle followed in all business. The small lot purchaser cannot expect to get the same price as the wholesale purchaser, whether it be apples or kilowatt hours. The Ontario system under government ownership and operation subsidizes the householder, giving him service at a loss and taking the loss out of the merchants, manufacturers and the taxpayers generally. The American system encourages industry, increases wages and prevents unemployment. At the same time it works no hard-ship or injustice on the householder for it only asks him to pay a fair price for his service—a legitimate profit on the cost of rendering it. The Ontario system discourages industry, keeps wages at a lower level and often results in unemployment. As far as the total production of electric energy is concerned, the privately owned, privately operated public utilities of New York State in a comparable area, operating under the supervision and control of the New York State Public Utilities Commission, furnish light and power for actually less per kilowatt hour than the Hydro-Electric Commission of Ontario has been able to furnish it and at the same time pour into the treasury of the state millions in taxes. The fact that the Ontario scheme has not spread into other provinces indicates that even the Canadians may prefer the American scheme.

CHAPTER XVIII

Power and Politics

One of the most curious phenomena in connection with that elusive thing called "American public opinion" is its ready and joyous reaction to any well-phrased propaganda demanding some kind of a change in anything. With a fine healthy disregard for history, the experience or, rather, the lack of experience of the propagandists, an awe-inspiring indifference for social and economic facts and a brave ignorance of probable motives, there is always a valiant host ready to cry "here, here," if the voice of the advocate crying in the wilderness is loud enough, if the English is sufficiently imposing, and if the message that is to "save" America from something or other requires the acceptance of the principle that there must be a change. And so we have organizations of every sort and description set up by honest people who are quite sure that these United States are going to crash like a pre-war flying Jenny not later than a quarter after three tomorrow afternoon.

The author would not have it inferred that he does not think this a good thing. After all, it is dissatisfaction which makes for progress. The satisfied individual makes no effort to add to his daily tasks, even though the addition might improve his social and economic status, because he is satisfied and cannot possibly see any reason why he should take on more work. The smug and satisfied nation, secure in its prosperity and strength, seeing no reason for any further endeavor, comes to a standstill and eventually slips backward or comes to a complete cropper. It was dissatisfaction with all sorts of things that brought about the founding of the United States of America; it has been dissatisfaction that has kept it going and moving steadily onward; and it is only dissatisfaction and a desire to continue to improve that will enable us to maintain our high position in world affairs and also maintain conditions which, though commonplace to us, are to the people of other nations the most extreme luxuries.

On the other hand, there are several degrees of dissatisfaction. There is a right kind of dissatisfaction and there most certainly is a wrong kind of dissatisfaction. For example, a politician out of a job is naturally dissatisfied. If he is a "good little" politician and has the interests of his constituents at heart, then any effort on his part which brings about a change and gives him the job he wants is a good thing for the country at large. If, however, he is not the right sort of politician, then his dissatisfaction may be translated into action which may not be so good for the country at large. The political party out of power is naturally dissatisfied and this is a good thing, for it keeps the party in power in order, or, if it doesn't, throws it out that the opposition may have a chance to show how much more efficient it is.

Consequently, politicians and political parties are constantly in search of local and national issues with which to go to the public, demanding this or that change in the local or national policy for the good of the nation and its people. Sometimes it is obvious that some sort of change would be for the better; sometimes it may mean swapping horses in the middle of the stream and the new and untried horse may not have sufficient strength to carry its rider ashore.

We seem to be faced with some such situation in the case of prohibition. The corner saloon of the old days had multiplied until it had become a national disgrace. Certainly no sensible person would ask for its return. Unfortunately, however, instead of becoming the subject of thoughtful and scientific study in order to have some method of controlling it in such a way as to eliminate its most objectionable features, it became a political issue for groups, organizations, politicians and parties. Prohibition became the battle-cry. Instead of attacking the saloon abuse, *per se,* the personal habits of the people of the United States became the patient. The result has been a condition which presents a problem not much less serious than that of the corner saloon. That institution we still have with us in a guise which places it almost beyond control. Our new team, the Eighteenth Amendment and the Volstead Act, cannot carry its load to the shore.

At the moment, it seems to be electric light and power which offers the greatest apparent opportunity for politicians, parties and groups with ideas for a new social and political order. Almost overnight, it threatens to become both a state and national issue. It is the public utilities, tarred and feathered by so many editorial sticks with the all-inclusive term "the power trust," which at the moment has been selected as a burnt offering on the altar of political issues by the devotees of the great god "Change." We have with us today the terrifying picture of a giant octopus with tentacles of infinite length reaching over cities and farms, through every hamlet and into every home, squeezing the very lifeblood out of its customers—the leaders of the industry being so stupid, of course, as to kill the goose that lays the golden eggs. There is, however, very little evidence at the present time that the public is at all interested.

To digress for a moment, there are several distinct types of political issues. There is the issue which establishes party lines clearly and distinctly: such an issue is the tariff. The Republican party has always been in favor of a high protective tariff, while the Democratic party has always favored a low tariff. The tariff issue is a manifestation of political creed. Then there is the issue which feeds on some great social question such as prohibition. Here party lines are broken down. There are wet Republicans and dry Republicans just as there are wet Democrats and dry Democrats. This is why neither party is inclined to go any further than dealing with this question in sparkling but meaningless generalities. Third, there is the issue in which party lines are apparent but with small although highly articulate groups breaking away from the party pasture and seeking subsistence in new but, what seem to be, greener fields.

There is every indication that electric light and power as a political issue is falling into this third category. In the Republican party, a majority of the members are in favor of the development of all business by private initiative. The party as a whole and under its present-day leadership is distinctly in favor of keeping the government out of business and of keeping its nose to the grindstone of governing. Critics of this particular political and economic philosophy, both within and without the party, say that it is a policy of favoritism toward "big business." Within the party itself is a more or less powerful group which is vociferous in its demand for government in business and for government ownership and operation of public utilities. The designations applied to this group by its critics—both within and without the party—range all the way from "insurgents" to "communists."

While some Democrats seem to lean toward some degree of government in business, particularly with regard to electric light and power, it cannot be said that the position of the Democratic party is much more than a negative one. A large proportion of the members are distinctly opposed to government ownership and operation; but the group which does believe in some measure of government in business is much larger than the similar group in the Republican party, although perhaps it is not so articulate. In any event, while there is some evidence of the existence of party lines in the light and power issue, they are not nearly so well-defined as in the case of the tariff. It cannot be said that the issue is a manifestation of party creed.

Until the Muscle Shoals project, politics and power, or power in politics, was essentially a local, or at best, a state issue. There were local municipal ownership fights and local and state controversies over rates. The utilities thought they were pretty good, while certain groups of private citizens and types of politicians thought they were thoroughly bad and ought to be policed with the club of drastic regulation and the threat of confiscation. Many local political battles were waged around them for no other reason than that there was no other issue at the particular time which might serve as a public welfare platform on which candidates for office might stand and shout the "battle-cry of freedom."

Muscle Shoals was the first government enterprise to become a national issue. It was not projected as a power enterprise. It was a war emergency measure to provide nitrates for the manufacture of munitions: "cheap fertilizer for the farmer in peace times" was tacked on to make it more palatable. In other words, it not only would serve its purpose as a war measure but would pay its way with interest on the investment in times of peace and thus provide some salvage from the great losses which the war entailed.

After the war, interconnection proceeded rapidly and power threatened to become a national issue as a possible interstate business and therefore subject to federal regulation and control. That it can hardly be considered as an interstate business in the sense that railroad transportation is interstate, the author attempted to show in the chapter on interconnection. The word "super-power" was coined and immediately there appeared the opportunity to picture a great corporate consolidation, controlling all of the power in the United States—a monopoly holding within its grasp every comfort and necessity.

Hard on the heels of Muscle Shoals and Super-Power, came the proposed Colorado River development. Starting out as a flood-control scheme for the protection of the Imperial Valley, it progressed to a flood-control and irrigation project to which was added a "potable water supply for Southern California," finally to blossom out into a government-owned and operated power project largely for the benefit of the city of Los Angeles and adjacent municipalities; an enterprise which would enjoy an income from the sale of power sufficient to pay the entire cost of the flood control, irrigation and water supply projects. As a political issue, it bids fair to involve all of the favorites being groomed for a four years' residence in our remodeled White House.

Unfortunately, when light and power become a political issue resolving into a question of government ownership and operation versus private initiative, the discussion cannot be confined to one of industrial, social and economic philosophy. The campaign becomes one of mud slinging; and unbiased, scientific, dispassionate investigation is impossible. To the pro-government ownership groups, the electric industry is as black as the pitch of Hades and even the Federal Trade Commission cannot persuade them otherwise—at least this is indicated by their public utterances. To those who favor private development, ownership and operation, the pro-government ownership people range in color all the way from bright pink to the deepest blood red, trying to undermine the Constitution with the theories of communism. The real issue—the development of public services for the greatest benefit of the greatest number of people—is entirely forgotten in a joyous wrangling over political and social creeds.

To make a long story short, electricity, while bringing about tremendous changes in both the social and industrial phases of the life of the nation, has been laying the groundwork for a demand for a change in our whole political philosophy. Prohibition, woman suffrage, and other milestones in our political history are the most trivial incidents when compared with the proposals of those who would take the electric industry and use it as a point of departure from the traditional American idea of government; abandoning, if you please, the ideas written into the Constitution that constitutional government is for the purpose of governing, turning to some great paternalistic state where everybody exists by taking in someone else's wash. Ignoring the experience of other nations, the advocates of government ownership and operation are quite certain that some such revolution in political creed would succeed in the United States.

The question which the advocates of government in business would create for the American people today is: "Shall we take electric light and power—this great force which affects every phase of our daily lives—away from the men who conceived and built it and turn it over to political parties to become a football during every Congressional and presidential campaign? Or shall we continue its operation by highly-trained, experienced men who, it may be frankly admitted, have the incentive of a fair profit—the only incentive after all which makes for industrial progress. Lined up on one side of the fence we find such men as Secretary of Commerce Hoover, who believes that such a change would result in a great political hierarchy with nothing in the way of compensation; President Coolidge, with his sound New England ideas of the line between government and business; Chief Justice Taft, who knows more about constitutional government than any living man; Owen D. Young, one of the greatest industrialists the world has ever known; and a host of others of similar caliber. On the other side of the fence we have Senator Norris, whose Committee on Agriculture and Forestry has been trying for ten years to find the answer to the Muscle Shoals problem; Senator Heflin; Governor Smith of New York; Senator Johnson; and a host of officials of organizations seeking to be a part of the Big Parade.

The United States is today the most prosperous nation in the world. This is not said boastfully; it is simply an inescapable fact. It is prosperous because of its vast power development; and certainly some measure of credit for this development must go to the electric industry. It is a highly technical, complicated machine, requiring absolute freedom from politics and political influences if it is to continue to function at its present rate of speed. To say that it can be turned over to Congress or to the forty-eight state legislatures for operation and remain free of politics is to state an absurdity. On the other hand, it can be regulated and controlled and supervised by the state legislatures, remain free of politics, and at the same time have the many advantages of private operation. Which is the better?

In spite of the fact that the electric industry has been thoroughly investigated by the Federal Trade Commission, the same group which demanded this investigation—dissatisfied with the results—is demanding new investigations. To this the industry has replied that it does not fear an honest and impartial investigation by persons qualified to make it, but that it proposes to appeal to the fairness of the American people to protect the properties of their millions of shareholders from an inquiry for political purposes. It would certainly seem that the Federal Trade Commission, as it is now constituted, is better qualified by training and experience to conduct such an investigation than a Senatorial committee. If the one already made has not been satisfactory, or if it is considered that it was not broad enough, it should be a simple matter to authorize it to continue its studies, broadening their scope if necessary. Certainly there would be much less danger of having the inquiry turned into a sort of political holiday for the benefit of candidates, parties or political creeds.

The industry should welcome a thorough-going investigation of all the phases of its business if for no other reason than the laying of a number of illusive ghosts. Mr. George Horace Lorimer, writing in the *Saturday Evening Post,* has said that "the fear of the politician is the sign of a caravan mentality surviving in business." The average business man does fear the passage of his business through politics just as two thousand years ago the trader with his goods on a camel train feared the passage through Mongolia. If he has been conducting his business honestly he has no fear of an inquiry by honest investigators familiar with its particular complexities. He does fear, however, playing the part of the ball in any political game, big or little.

It has been said that government control of the light and power industry will be a major issue in the coming session of Congress and be carried into the 1928 presidential campaign. At least one outstanding advocate of government ownership and operation has declared that the Walsh investigation will "arouse the people and force state legislatures or Congress to further safe-guard their rights." But the well-managed utility has little or nothing to fear other than the annoyance of having the facts about its business distorted in order to provide material for campaign speeches and propaganda. If there are abuses here and there, the industry itself should be glad to have them exposed and condemned. It is quite as anxious to have its own house in order in the interest of its customers and security holders as any big or small bore politician—in fact it is more anxious. It knows better than any that, in the main, abuses have been eradicated, rates are fair and service excellent. The American people are much more receptive to sound economic facts than they are to the ranting of demagogues who claim that they have been "mucked and gouged by the power industry" without producing any evidence that this has been so.

CHAPTER XIX

A Few Facts About Taxes

WHILE, as some one has expressed it, "proverb has it that taxes are to be classed with mortality among the inevitable vicissitudes of life," there is perhaps no stone in our whole economic structure about which so little is known to the average citizen as "taxation." Direct taxes are simple enough and easily understood by the man who is so fortunate as to be in a position where he can be taxed. If he owns his home he knows that he must pay taxes on its assessed value. If his income is sufficiently large as to require the payment of an income tax he understands that, even though the filling out of his annual income-tax return is a problem which gives him several acute headaches. He knows that if he dies leaving anything but a memory, the government is going to take a part of what he leaves, in the form of an inheritance tax. He understands a school tax and that it is for the support of the public schools.

But indirect taxes—that vast sum of money carrying the bulk of the burden of the cost of government—which he pays just as surely as he pays his income or real estate tax, is something about which our average citizen very rarely thinks, and if he does, dismisses it as a subject for the statisticians and economists. Yet he never spends a cent from the time when he makes his first excursion to the candy store with a penny until the day when it is his turn to contribute to the evidence of the accuracy of mortality tables, that he does not make some contribution to the tax collector. Whether he buys a pound of beefsteak for his family or gives a great dinner, takes a street-car ride or acquires an automobile, pays an electric light bill or one for a ton of coal, adds the Encyclopedia Britannica to his own library or a school book to his children's, buys a box of cigars or goes to the theater—in fact, pays out any money, in any amount, for any purpose—he is contributing a certain portion of that money to the expenses of government. It makes no difference whether it be the salary of a justice of the peace or the budgets of the army and navy of the United States, each individual expenditure of each and every individual man, woman and child must bear some infinitesimal portion of the tax burden.

The reason for this is a simple matter. Every business in the United States, from the one-man boot-black stand in a country town to such enterprises as the U. S. Steel Corporation, is a tax collector for the government. Manufacturing, transportation, communications, light and power, wholesaler and retailer, all must pay taxes in one form or another to local, state and federal government; and all of them quite properly pass these taxes almost in their entirety on to the ultimate consumer—quite properly, because taxes are definite costs of doing business and the price which the purchaser pays must be based on the cost of manufacturing and delivering his purchase to him.

Here again we find the business of supplying kilowatts—units of electrical energy for power or lighting—no different from the business of supplying apples or automobiles. Every time the individual turns on an electric switch he is being charged by the meter down in the cellar with an indirect tax which he must pay just as surely as he must pay his electric light bill if he wishes his service to continue. The electric light and power companies of the United States pay in direct taxes more than 10 per cent of the gross revenue they receive from the public, and in 1926 this amounted to the astounding sum of $136,000,000. This amount was actually turned back to the people of the United States, because if it had not been paid by the light and power companies—if they had been exempt from taxation—these 136 millions would have to be collected by the government from some other source; either by taxing the people directly or by adding to the tax bill of other enterprises which in turn would have passed them on to the ultimate consumer.

This annual tax bill of the light and power companies is therefore reflected in the rates. They have to get it some where for, after all, it is nothing more or less than a form of rent—a price paid by the companies for the privilege of doing business. As all rates are based directly on the cost of generating and distributing electrical energy to the ultimate consumer, all cost factors must be included in the equation by which the rate charged is fixed. In many cases this tax bill or cost ranges all the way from 25 to 50 per cent of the company's net profit; and if it is not included in the rate base it can easily make the difference between profit and loss—the difference between continuous service and an abandoned plant, for sale as junk to the first purchaser.

So in the last analysis the light and power companies are collecting $136,000,000 annually from the people of the United States and turning it over to local, state and federal government in the form of taxes. If they could be exempt from these taxes, then the average rate would automatically be reduced by about 10 per cent. When a corporation reduces its cost of doing business, no matter what form that reduction may take, it normally increases its profit. In the case of a public utility company this does not happen; for under the system of regulation by state utility commissions it is only allowed to earn a reasonable profit on the value of its property and a reduction in the cost of operation means almost at once a reduction in rates.

But it makes little difference to the consumer whether the light and power company collects these taxes or not. The $136,000,000 must come from somewhere for it has been anticipated in government budgets. If the consumer does not have it included in his electric light bill he must pay it in some other way, either in an increase in direct taxes or in an increase in indirect taxes through the increased cost of some other commodity. The government has to have it and it is perhaps more economical to collect it in this manner (just as it collects hundreds of millions of other dollars through other business enterprises) than to try to collect from individuals by direct taxation.

All of this seems to point to another fallacy in the arguments of the advocates of government ownership of public utilities. It is maintained that the government-owned, government-operated plant can furnish service at a lower rate because it pays no taxes. Theoretically this should be true, although it has not been the history of municipally-owned plants. On the other hand, the private-owned plants might be exempted from the payment of taxes and required to reduce their rates by the amount of their former tax bill. In either event the net result is to relieve the tax payer of paying a portion of his taxes with his electric bill and require him to pay it in some other way. As a matter of fact the light and power companies of the United States have been able to pay this $136,000,000 and at the same time furnish service at an average unit cost less than any municipally or government-owned plant in this country or in any other.

The history of the annual tax bill of the light and power industry shows a steady increase both as to total amount and as to the ratio between gross revenues and taxes. In 1902 this bill was $2,654,885 which was only 3.43 per cent of the gross revenue. By 1912 it had increased to $13,117,198 which at that time was 5.24 per cent of the gross revenue. Since then it has increased steadily, until now the companies are paying out over 10 per cent of their gross revenues in taxes. While this has been going on, the trend of rates for service has been steadily downward.

Turning to the figures of the Bureau of Internal Revenue for the year 1924 we find the commercial electric light and power stations at the top of the list in the payment of taxes in proportion to gross revenue with 7.41 per cent. The telephone companies come next with 7.13 per cent, the private electric railways third with 6.28 per cent and the Class 1 railroads fourth with 5.17 per cent. However, the private electric railways top the list in the payment of taxes in proportion to net revenue. These street railways in 1924 paid 54.61 per cent of their net incomes in taxes. The Class 1 railroads paid 44.89 per cent, the telephone companies 32.62 per cent, and the commercial light and power stations 26.85 per cent.

One of the reasons for the tremendous burden of taxation placed on transportation and public utilities is that this class of enterprise is more subject to government regulation and control than any other and because they are easy to "get at." Rates of service are fixed and taxation is incident to the fixing of these rates. Another is perhaps the attitude of the average voter toward the whole subject of taxation. He would much prefer to see the burden placed on the railroads, street railways, light and power companies, the telephone and telegraph than on himself individually. Failing to understand clearly the philosophy of taxation, he does not understand that he is paying these taxes just as surely as though he paid them to a government tax collector. Furthermore, it does seem easier to pay taxes in small bits which amounts usually to only a few cents or even a few mills at a time than to pay them in fairly large amounts once or twice a year. Again, the public utilities are conspicuous and easily reached.

But while this class of enterprise may provide a fine flock of geese producing progeny it will not do for governments to go too far in the egg-laying contest which they seem to have been conducting. There is a very distinct limit in the public mind with regard to rates. If the government wants more of these golden eggs it will have to feed its geese with more and more rates which may be a simple, if inexpedient, way to kill them off.

If we extend the scope of a discussion of taxes imposed on our modern Aladdin and include the street railways, we find a class of public service companies which is infinitely worse off with regard to taxes than the light and power companies. The light and power company, like the telephone company has a virtual monopoly under government supervision and control. It has no competition in the sense of other electric services. Its rates are regulated by law and taxes are taken into account. The street railway company, however, has no such monopoly. True, it does not have to compete with other street railway companies any more than the light and power company has to compete with other light and power companies, but it does have to compete with the private automobile, the low-rate taxicab, and in many instances with independent motor bus lines. Like other public service corporations, its rates are regulated by law with taxes included in the consideration of the rate-fixing body; but this element of competition which has entered into the business has reduced their possibilities of income and therefore tended to increase the cost of operation per passenger.

Street railways have not only enormous direct taxes but are still burdened with certain archaic forms of indirect taxes. Take, for example, the almost universal requirement that street railways must maintain the paving between the tracks and, in some isolated instances, the pavement from curb to curb. This is a heritage of the old days when street cars were drawn by horses or mules which destroyed the road surface between the tracks. Now, however, the requirement that the street railway company pave and maintain the street between the tracks simply means that they are adding just so much to the street facilities for motor vehicles and are keeping up something for the city which does not benefit them in any particular. The street-car rider, who can least afford it, is paying in an indirect tax for facilities for the driver of motor vehicle.

Street railways in almost every city must carry policemen and firemen free. In one large city, and perhaps in others, a considerable portion of the gross revenue received by the street railways is taken from them for the up-keep of parks, although more people visit these parks in automobiles than by means of the street cars. In the city of Chicago it cost the street railways over a million dollars to keep their tracks clear during a protracted snowstorm, only to have them used so intensively by motor traffic that the street cars themselves could not be operated except in the most haphazard way. All of these costs are paid in the last analysis by the street-car rider. It is a case where the whole attitude of the public toward the taxation of public service corporations should be readjusted.

In 1922 the New York state committee on taxation and retrenchment came out in a scathing denunciation of the public utility tax law and offered what is claimed to be a simple and scientific method of taxation known as the gross-net tax for public, regulated utilities. This has since been endorsed by the National Tax Association.

The gross-net plan imposes a varying tax rate on gross revenue, the rate varying with the net profits. In other words the companies pay higher taxes as their profits increase and lower taxes as their profits decline. The exact percentages are presumed to vary with the tax needs of the state. For New York State it has been suggested that every company shall pay an annual tax based on gross earnings as follows:

Net earnings in per cent of gross earnings	Per cent of gross earnings to be paid as tax
When less than 5	1
Between 5 and 10	1¼
Between 10 and 15	1½
Between 15 and 20	1¾
Between 20 and 25	2
Between 25 and 30	2¼
Between 30 and 35	2½
Between 35 and 40	2¾
In excess of 40	3

Obviously, if this scheme is to be applied to state taxes, then both local and federal taxes must be adjusted to it. For example, in 1924 New York State electric light and power companies received a gross revenue from the public of $177,386,000. They paid total local, state and federal taxes of $16,789,000 or 9.44 per cent, of which the state got $1,709,000 or a little less than 1 per cent of their gross revenues. Under the gross-net scheme of taxation and using the above schedule, these companies, in order to keep their state taxes down to 1 per cent of their gross revenue, would have to show that their net profits were less than 5 per cent of the gross. The question at once arises as to whether or not, if their profits are less than 5 per cent of the gross, they could afford to pay the enormous local and federal taxes which in 1924 amounted to over 15 millions, without an increase in rates. On the other hand any increase in rates, or lowering of local and federal taxes, means an increase in profits and an automatic increase in state taxes. This question is raised not as a criticism of the scheme but simply to indicate that some adjustment would be necessary.

In any event the whole scheme of taxing public service corporations would seem to be out of date and inclined to work hardships on consumer and corporation alike. An even more simple method of getting out of the difficulty would be to exempt all public service corporations from taxes of any kind. Then, in the case of the light and power companies, rates could be lowered so as to reduce gross revenues by ten per cent, giving the consumer the benefit.

Incidentally it should be noted that this ten per cent of their gross revenue which is paid by the light and power companies is not their entire contribution to the national tax bill. Their securities are taxed in an amount which equals approximately an additional eleven per cent of their revenues. This comes out of the pockets of the real owners of the business—the security holders—and reduces their return on their investment by just that much.

CHAPTER XX

Research

Hugh Farrell, in his fascinating book, *What Price Progress,* tells in a dramatic way just why industry must keep pace with science and why so many varied industries must spend countless millions on their industrial research laboratories. Science knows no law nor international boundaries and bows to neither creed nor man. If the industry is to protect its investors and the integrity of its securities, it must not only keep pace with science, it must keep just about one step ahead of it. At any moment some chemist or physicist may hit on something that will knock any one of a number of industries and their products into a cocked hat and turn valuable interest-bearing stocks and bonds into just so much worthless paper. The major industries appreciate this and have adopted the policy of beating science to it by harnessing scientists and placing upon them the responsibility of keeping the industry in step with the parade of progress. All of which protects the investor and benefits the consuming public. The heart of any great industry is its research laboratory.

Take for example the wood alcohol distilling business cited by Mr. Farrell. There are about 100 million dollars invested in this industry and its products are valued at about $35,000,000 a year. In the beginning of 1925, everything was fine. Two months later, it did not know whether it was an industry or not; it looked, in fact, like a closed chapter in the history of American industrial development. A Frenchman and a German had discovered a process for manufacturing methanol (the scientific name for wood alcohol) so much cheaper than the wood distillation process that if all the claims made for it are true, the wood alcohol industry in its present form will simply cease to exist. Fortunately, the process is covered by one of the blanket patents issued to the Germans before the war and now owned by the Chemical Foundation. But for this fact, American users of wood alcohol would be forced to rely upon German producers.

Probably no single group of industrialists were so quick to realize the vital importance of research as the leaders in the field of applied electricity. Certainly none have approached the subject with greater vision and imagination. Research is dependent on three things: the scientist, imagination and capital. One has only to visit the great laboratories of the General Electric Company in Schenectady, under the direction of Dr. Willis R. Whitney, to appreciate this. Here will be found scores of scientists and inventors quite different from our traditional idea of inventors and scientists whom so many persons think of as shabby, down at the heel, absent-minded, impractical people. Their working conditions are superb. No equipment which they may call for is too expensive or too much trouble to install, even though they may not be able at the moment to say whether the expense and trouble will ever be justified. They may work for years without producing a single thing that can be turned into a commercial article which can be marketed profitably. They may produce all sorts of things which at the time of production may seem to have no commercial value. On the other hand, there is a corps of engineers watching their work constantly, ready to snatch this or that product away from the laboratory and turn it into the field of commercial production. The important thing is that these men work with little interference. Most of them are prima donnas and no industry knows better than the electric industry how to deal with prima donnas and get the best results out of their efforts.

The protection of its investment or the preservation of its existence is by no means the sole end of the industrial research laboratory. Every industry must be constantly seeking ways and means of widening its field of possible customers, or develop processes by which present customers become larger consumers, or both. To do this, it must constantly improve the quality of its products and must constantly strive to reduce unit costs. Both depend on the industrial research laboratory. The reduction of costs is brought about by refinements in process and by mass-production. There is nothing particularly altruistic about these efforts. Lower costs and greater volume mean increased profits per dollar invested. This has been proved in every line of business endeavor from manufacturing to retailing.

Again, for the sake of emphasis, the manufacture of kilowatts is no different from any other manufacturing enterprise, except that because of the public interest factor, it has a natural monopoly and operates under government supervision and regulation.

Like any other industry, it must keep pace with the times and must continually progress both in the quality of its service and in the reduction of costs. Probably no other industry has made such rapid strides in the advancement of the art of producing its commodity. The credit for these advances is due exclusively to the great electrical research laboratories.

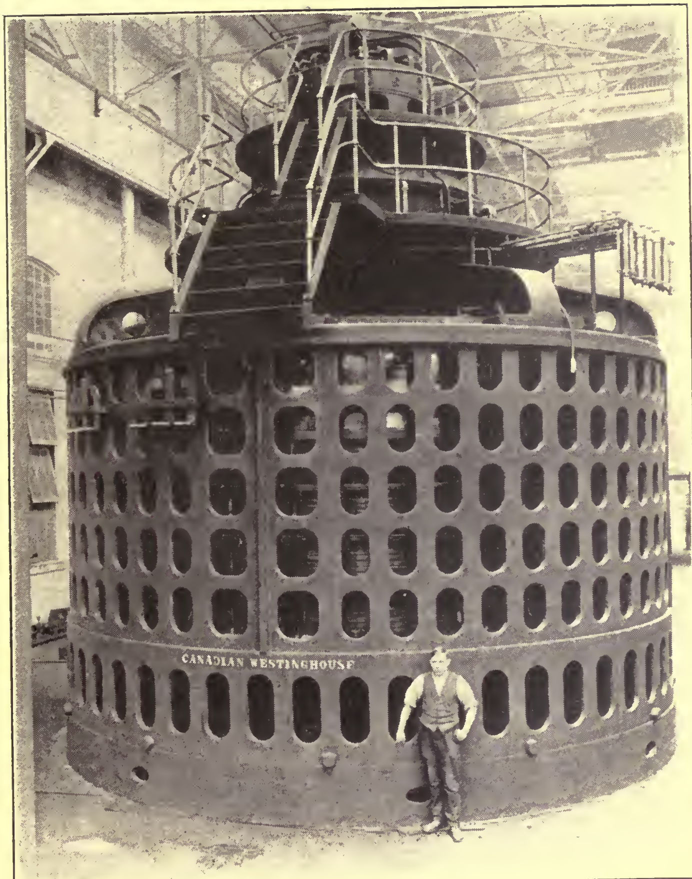
Take the humble electric lamp. In 1900 it was supposed that the incandescent lamp with the carbon filament had been so perfected that there was no room for further improvement. Yet the modern Mazda lamp gives four times as much light with the same amount of electrical energy as the lamp of 1900. This has meant a saving of hundreds of millions of dollars each year to consumers of electricity for lighting purposes. In fact, if a customer would be willing to use the old carbon filament lamp, the industry should pay him a cash bonus, for he would have to use four times as much current to get the same lighting results as he gets with the improved Mazda. It is difficult to visualize what this means, not only to the householder but to other industries, to transportation and to the nation generally. With our artificial lighting requirements today, we would have to spend the equivalent of 80,000,000 man-power to supply the additional current needed if we had to return to the lighting devices of 1900.

The invention of the Mazda lamp created a new problem—glare. This was turned over to the research laboratory with instructions to find out how to eliminate glare without affecting the lighting efficiency. A bulb frosted on the outside was tried but it was found that this cut down the efficiency of the light and that it was a great dirt catcher. Then frosting on the inside was tried. This did not affect the efficiency of the light but so affected the strength of the glass that it would break at the slightest blow. Eventually the laboratory found a way to frost the bulb on the inside without affecting the strength of the glass.

Has the industry stopped with the Mazda lamp? It has not. It admits that even this latest lamp is only about four per cent efficient when compared with a theoretical one hundred per cent efficient cold light and the industry wants a lamp that more nearly approaches this light. It wants a lamp that will give twenty-five times as much light as the old carbon filament lamp with the same amount of current. Would this cut down its income? Not at all. It would simply release a large amount of electrical energy which could be used for other purposes such as more cheap power for industry generally.

But the progress of the electric industry has not been confined to the field of lighting. In power, its strides have been, if anything, even greater. What these developments in the production of power are was described by Mr. Owen D. Young on the occasion of the dedication of a new steam turbine generating plant at Cincinnati, Ohio. He said:

> "The great power station open today will produce energy equivalent to the work of 9,000,000 men. There is a population of 1,000,000 in the service area of the Columbia



A TITAN AMONG MACHINES: THE MODERN HYDRO-ELECTRIC GENERATOR

Gas & Electric Company. This means, on the average, that nine additional slaves have this day been dedicated to the service of each man, woman and child in this community. In Athens each free citizen had but four.

"This is the way America must solve her problem of maintaining higher wages than any other country in the world and at the same time keeping her goods competitive in foreign markets. We must put more energy back of the worker in order that he may be a director of power rather than a generator of it. In this way he can increase his production and with increased production he may not only maintain but increase his wage. At the same time, the cost of the product may be diminished, and our goods may meet effectively in the foreign market the production of other countries where lower wages and lower living standards prevail. I congratulate the producers of goods in this community, whether they be employers or workers, on having in their service 9,000,000 more inanimate slaves.

"I want to see this art run not only the giant industries of the cities, but I want it also to be so humble and true in its social service that we shall banish from the farmers' homes the drudgery which in the earlier days killed their wives.

"We have come here to dedicate a power plant—an instrument of utility. Is it only that? Perhaps it is a temple."

The story of the development of the stream turbine which has made possible the enormous units in the modern central generating station is an enthralling one. The difficulty with the old-fashioned steam engine was that while bigger and better engines were being built, their power could only be used in the immediate vicinity of a boiler. The makers of electric generators announced that they could build efficient generators a hundred times bigger if they could find engines to run them and that the art had reached its uttermost practical development until the production of primary power made a new advance. The effect of this has been best described by Chester Crowell, writing in the *Saturday Evening Post.*

> "This announcement would have been a wail of despair but for the fact that tremendous strides had simultaneously been made in the steel industry, in machine tools, in the elimination of friction and the efficient burning of coal. By coordination of these diverse achievements it was now possible for the steam turbine to be born. Briefly, this machine is a big steel bottle with a shaft or axle running through it lengthwise. Attached to this shaft or axle are numerous wheels in the form of thin, solid steel disks, each fringed with numerous steel blades set sidewise, so that when the steam strikes them the disks revolve and thus turn the central shaft. By this extremely simple and direct application of power, speed far beyond what a steam engine could provide was economically

obtained and high speed steadily maintained is what produces electricity.

"Even in the earliest steam turbines remarkable advances were made in reducing friction; the best ones, when once brought to their highest speeds, would run for several days with the power cut off, so perfect was the workmanship. They were the mechanical marvel of their day —a quarter of a century ago—even as they are the mechanical marvel of today."

With the steam turbine it seemed as though there might be no limit to the size of a unit in a central generating station. They grew bigger and bigger until one day something happened—a steam turbine blew up. Later on, another blew up and then another. No one knew what was the matter. The turbine would be running along apparently in the best of health when suddenly it would explode, spreading death and disaster. Once more progress in the industry faced a stone wall.

The problem was turned over to the research laboratory. It was a problem that had to be solved. Dr. Whitney says that the impossible is only the thing which we have not yet learned how to do. Big steam turbines had to be built and they had to be built so that they would not blow up. The laboratory had to find out what made them revolt in this fashion. So the laboratory went to work and found out how to build Gargantuan turbines that would not explode. It took four years and cost millions of dollars but the problem was solved.

The disks in a steam turbine are set very close together. Any vibration causes them to rub together, resulting in friction at high speeds which turns the turbine into a first-class bomb. Some bright mind suggested that the explosions were caused by vibrations of the steel disks. So a rubber wheel was built and revolved at high speed. It was discovered that a wave was set up moving slowly in the opposite direction from that in which the disk was revolving. It had the same effect as a flag waving, so the scientists went to work and spent a small fortune in finding out what makes a flag wave. This led to England where a series of experiments were being conducted with gears made of glass so that by means of changes in the light effects, changes going on inside could be observed. The search had now progressed from a study of what makes a flag wave to chasing rainbows. Finally, they were able to chart every sort of vibration that can possibly go on in a steam turbine wheel. They found the speeds at which each kind of vibration would appear in each type of wheel. Now turbines are equipped with wheels whose vibration point is known beyond the possibility of a doubt, and the turbine is so keyed that it can never run at that speed. The result is steam turbines which will produce eighty, a hundred, and even two hundred and fifty thousand horsepower. The steam turbine of 1903 produced 730 kilowatts of electrical energy per ton of coal consumed. The steam turbine of today produces more than 2,000 kilowatts per ton of coal. Much of the credit for cheap light and power must go to this great machine, the product of the industrial research laboratory.

Problems of generation of electrical energy are not the only ones handed to the laboratory. Hard on their heels come the problems of transmission, and particularly the problem of the carrying capacity of existing transmission lines. For example, an increase in the conductivity of commercial copper of ten per cent would release for other fields an enormous tonnage of copper. The radius of existing transmission systems would be increased ten per cent, and the area served, twenty-one per cent. Underground cable subways in cities, many of which are taxed to their full capacity today, could, without enlargement, carry additional loads.

Calculations made in the General Electric laboratories indicated that copper composed of a single crystal should have a conductivity fourteen per cent greater than ordinary copper. So the problem became one of producing single crystal copper. Today they can show you a piece of single crystal copper the size of a lead pencil. Given a jerking motion, it will bend like soft wax; the only difficulty is that the structure is destroyed and it is very difficult to bend it back. Sooner or later, however, this copper will pass from a laboratory fact to a commercial fact and another enormous saving to the ultimate consumer will have been effected.

New problems of transmission with their solutions bring new problems in insulation. The search for new isulating materials is always going on in the research laboratory, and the many types of service require many different kinds of insulating compounds. In some work it is essential that the compound be mechanically rigid and strong; in other work flexibility is the controlling factor. Some applications require heat induction to carry heat away from winding, while others require heat insulation to retain heat in ovens and furnaces. Some devices require insulations that resist abrasion while others must have insulating materials that wear down uniformly with the conductors, as in commutators. Some must withstand dampness, moisture, mine waters that are acid, fumes from chemical plants, or alkalies; others may be completely immersed in mineral oil.

Two of the latest synthetic products to be added to the list of insulating material are Glyptal and Mycalex. The first is one of several synthetic resins developed by the General Electric Company and is composed of glycerine and phthalic anhydride—a chemical curiosity produced from moth balls. It formerly cost $5 a pound and now sells at 25 cents a pound. Combined with glycerine, a by-product of the soap industry, there is produced a synthetic resin infinitely superior to shellac as binding material in the manufacture of pasted mica insulation or micanite. Glyptal-pasted mica has from 10 to 60 per cent more dielectric strength, more resistivity, less dielectric loss, is denser, stronger and more translucent, and the mica will not slip as it may when shellac is used. It is only slightly affected by heat, has only a slight tendency to carbonize and the products of decomposition do not attack copper and are nonconducting.

As so often happens in the research laboratory, glyptal is found to have many other uses than that for which it was sought. It has many advantages in the manufacture of ornaments and novelties such as penholders, pencils, cigar and cigarette holders and other smokers' articles, beads, ornamental boxes, etc. It has permanence of color and resists wear. It can be made in much lighter and clearer colors than other synthetic resins, and its initial colors are permanent. Luster is retained to a high degree and articles made from it are less liable to breakage.

Anyone who has had to work in an office while a modern skyscraper has been under construction across the street has formed an opinion of riveters which is unprintable. The ordinary steel riveter is doomed. Electric welding is taking its place. In such a city as New York, which is perpetually going through a process of tearing down and building up, the electric welder is a contribution to the comfort of the city dweller which should cause him to remember the electric industry in his prayers forever. This again is a product of the research laboratory.

There is a chapter in the history of electrical research that might very well be entitled "Much Ado About Nothing." According to *Research Narratives,* an interesting little monthly publication issued by the Engineering Foundation, scientists have been unable to attain a vacuum wherein a cubic inch includes fewer molecules than there are people in the world. They have succeeded in eliminating all but one out of every ten billion, but there are still left forty billion molecules in every cubic inch of what we call a vacuum. "If from a vessel holding a quart," says *Research Narratives,* "there were removed a million molecules a second, it would take

750 million years to remove practically all of its molecules. Yet the Langmuir condensation pump will exhaust the air in a Coolidge X-Ray tube at the rate of removing it from a quart container in two seconds."

The American people are paying $1,000,000 a week for vacuum contained in glass and it is only a partial vacuum. It is responsible for suction pumps, thermometers, incandescent lamps, many improved physical and chemical processes, the X-ray, transcontinental telephony, radio broadcasting and reception, the transmission of photographs by wire and wireless, such commonplace things as the thermos bottle and, strange as it may seem, the success of the great steam turbine.

With the development of the vacuum tube has come the Coolidge high-powered cathode ray tube. To quote Mr. L. A. Hawkins, engineer of the General Electric laboratories: "For instance, until very recently the electron, discovered nearly thirty years ago, had been taught to do his tricks within the walls of glass or metal, but with the development of the high power cathode ray tube, we now have huge armies of high velocity electrons turned loose in the air or in anything else we wish to shoot them into. One tube has an electron output equal to that of two or three tons of radium. We have a new tool of undetermined possibilities but of tremendous power. We know it is capable of producing new chemical reactions, some of which may prove to have great commercial possibilities. Conceivably large new industries utilizing cathode rays may add a novel and considerable load to the central station's lines."

During a recent tornado that swept over the Middle West, a woman received a severe fracture of the knee which eventually required moving her to New York for treatment. The time is rapidly approaching when the New York specialist will be taken to a case of this kind or in fact to any community anywhere by means of the X-ray and the radio or wire transmission of pictures. Dr. Coolidge has perfected a portable X-ray machine that can be carried into the sick-room. When an immediate consultation with a distant specialist is required and the patient is too ill to move, this machine can be carried to the patient, pictures taken and these pictures sent by radio or telegraph to the specialist who within the hour can wire back his diagnosis and suggestions for treatment. Dr. J. M. Steiner, X-ray expert of Roosevelt Hospital, New York, has pointed out the possibilities of this as follows:

> "Medical consultation between doctors on X-ray plates transmitted by radio or telegraph is a realization that should find a most useful place in these progressive times. The quick transmission obtained by this method should afford untold satisfaction to both the consultant doctor and the anxious family. In New York hospitals, we frequently have patients who are either injured or taken ill while traveling. These patients, being in strange hands, naturally desire their home physician in consultation. If explicit information could be quickly

> transmitted to the home physician, much needless travel could be avoided, saving the home physician or family a trip to New York.
>
> "Many times, physicians in other cities, desiring an opinion from a New York consultant, could materially shorten a tedious delay if X-ray plates were quickly transmitted by telegraph to New York consultants, who in turn could render an opinion within an hour, where otherwise several days to a week or more might be involved. Written descriptions or word pictures even of such simple conditions as fractures are often most misleading, whereas the actual conditions shown graphically in X-ray plates are more convincing."

And the entire procedure owes its possibilities to the vacuum tube and the development of its various types.

It may seem that too much attention has been paid to the laboratories of the General Electric Company, to the exclusion of other and perhaps equally important industrial research laboratories. If he has done so, it is only because of the limitation of space and because he is inclined to agree with Mr. Farrell when he says this company employs the "most notable group of research workers in the world." The General Electric does not hold the place it does hold in the field of the manufacture of electric equipment because it is the creature of some group of super-financial wizards, highly skilled in trust building and in the manipulation of stocks and bonds. Some such idea was evidently in the minds of those senators demanding the investigation by the Federal Trade Commission and who are demanding a still further investigation of the entire electric industry. If this is so, it only goes to show the utter failure of a political group to dig down into the fundamental principles on which any success in industry is based. The General Electric is a long way from having a monopoly in its particular field. It is merely a big factor in a highly competitive field —a large company with a tremendous volume of business. And even the Federal Trade Commission cannot call upon a company to "cease and desist" from doing a large volume of business if it can get the business to do.

The success of the company is due to the fact that it is doing exactly what the author claimed in the beginning of this chapter every industry must do: keep one step ahead of science by hiring science, harnessing it, and making it work for its customers and its shareholders. In the General Electric laboratories the pursuit of science is a part of the routine of the industry. As Mr. Farrell says, fundamental research is not merely tolerated, it is encouraged and even required. Langmuir's development of the vacuum tube was directly due to fundamental research, which is investigation of phenomena for the purpose of discovering new facts and laws. The vacuum tube and its progeny, including radio, transcontinental telephony, the Coolidge super X-ray tube, the mercury boiler, the high pressure steam boiler, the 70,000 horsepower steam turbine, the automatic hydro-electric plant, coal conservation, reduced costs of transmission, the carbon filament lamp and then the Mazda lamp, electric welding, and a thousand other things contributing to higher and higher standards of living, are all products of the research laboratory and can be traced back to fundamental research.

In the field of communication, the laboratories of the American Telephone and Telegraph Company are quite as noteworthy as the laboratories of the General Electric Company in the field of applied electricity. The telephone instrument we are using today is the result of the thought and work of thousands of scientists. It is the result of constant effort to give better and cheaper service. No less than 3,500 scientists and technicians are making it their business to see to it that the Bell system knows first and knows all there is to know about the art of communication.

Research is not a response to some great public demand, and perhaps this is the reason why it has always been difficult to get across to the public what it really means. As Mr. Hawkins says, it is one of the greatest factors in present prosperity and is the best insurance for continuing health, wealth and happiness. The public demand for the product of the research worker comes only after he has produced and it has been definitely established that his product has a commercial value—that it will add to health, or wealth or happiness or reduce the cost of something we already have and which has brought us additional health, wealth and happiness. When the product of the laboratory becomes an assured fact, the public immediately adopts it, demands it in quantities and at a price where all may enjoy it. It becomes commonplace almost immediately—it is human nature to refuse to allow anything to be a wonder for more than the allotted period of nine days. The energy, brains, imagination, money and time which is behind its birth are either never known or, if known, are quickly forgotten.

It is unfortunate that this is so. Industrial research is an important factor in any discussion of government ownership and operation of public utilities and public services. Literally hundreds of millions of dollars are being spent in research work by these businesses and progress is absolutely dependent on a continuation of these expenditures. But how would these huge sums look to Congressional committees in the annual budget? What would the Director of the Budget have to say if some future U. S. Director of Research should come along with a request for an appropriation of a hundred million dollars? What would the President, constantly harrassed with demands for lower taxes on the one hand and warnings from the Treasury on the other, think about it?

The present Bureau of Standards, a great scientific institution, the experimental work of the Department of Agriculture, and a dozen other productive services in our present government establishment are constantly hampered in their work by lack of funds—by the fact that Congress and those in charge of the budget do not seem to have the imagination to realize what these services mean to the people.

It has been said that these services get all that they ask for. True: but they only ask for what they are instructed by the cabinet officer head to ask for, who in turn has received strong intimation from the Bureau of the Budget as to the maximum limit of his total appropriation. Who is there in the government with the nerve and the force to sponsor and jam through year after year a 100-million-dollar appropriation when the best the advocates of the bill could do to support it would be to indulge in vague scientific prophesies? Yet without this expenditure, all progress in lighting, power, transportation and communications must stop.

CHAPTER XXI

Summary and Conclusions

THE author approaches the writing of a "summary and conclusions" with considerable trepidation. Conclusions are, at best, dangerous. They sometimes suggest that what has gone before has been written with certain preconceived notions and that the writer has started out to "prove something" and has "concluded" that he has done so. If conclusions are indicated in any of the previous chapters, it is only because their preparation developed a series of facts that lead to obvious conclusions: quite as obvious as the conclusion that two plus two must always equal four and not five or three. These are conclusions, not in the sense that one forms certain opinions because of the facts, but conclusions that are established as facts quite as definitely as the facts from which they are drawn.

The statement that the development of applied electricity has, between the years of 1882 and 1927, brought about a tremendous change in our industrial and social life hardly admits of argument. Whether that change is for the better or for the worse is a matter of individual opinion. No doubt there are many who, reading of the "good old days" of the American colonies, or the early days of the British Empire, or of Marco Polo's adventures, or even of the civilization before the days of Christ, wish they might have lived in "those stirring times." All of us have these desires at times, just as children entertain themselves by the hour playing "make-believe," living in some fanciful time and pretending to do things which for the moment are very real to them. That we would be the most unhappy people in the world, in the light of our present-day knowledge of comfort, is quite beside the question.

Electricity, harnessed and put to work in a multitude of ways, bringing the telephone, telegraph, rapid transportation, the automobile, talking-machine, radio, motion pictures, modern lighting, safety in daily occupations, increased production, higher wage levels making possible the consumption of increased production, lower unit costs, and a thousand and one other contributions to an improved standard of living, has effected a change more marked than any other change in the history of civilization. The fact that all of this has come about within forty-five years indicates clearly that there must be some basic principle in our industrial and political philosophy which makes possible accomplishments almost beyond the range of human imagination.

What is this basic principle? Nothing more or less than the hope of profit and a form of government which makes it possible for the ambitious to translate that hope into a reality. It is all very well to say that we like to create, to do something which will benefit mankind, to do things that will cause our names to go down to posterity as great contributors to the advancement of nations and of peoples. That is true. We do like to create and we do like applause, particularly if there is a permanent record of the thing we accomplish so that the applause will continue through countless generations. This is, perhaps, an example of "adult infantilism." The child loves to create and loves applause. But back and beyond the desire to create and thereby obtain applause is an even more urgent desire—the desire for fortune as well as for fame.

This does not mean that a majority of those who have made great scientific discoveries or produced some new invention have been actuated in their work by anything other than a love of the work itself. In fact, scientists and inventors are notorious for their utter lack of regard for the possibility of material compensation. Mr. Edison's entire personal history is an example of a man stimulated only by a desire to create. Such money as may have come to him has come of itself; he probably has never in his whole life given a thought to the financial returns from his efforts, and there are many other scientists and inventors making history who have the same attitude. But it is doubtful if many of them would have ever made any great contribution to civilization if they had not become associated with other men who, while just as anxious to help in the making of these contributions, were in the last analysis motivated by the hope of some kind of profit.

Again, for the sake of emphasis, it is only the hope of adding to one's worldly possessions that keeps the wheels of progress moving rapidly and smoothly, and this hope or desire requires no apologia. It is a desire which is responsible for the fact that of twenty-seven million automobiles in the whole world, twenty-two million are in use in the United States. Back of this enormous production of motor vehicles is the electric industry which has made possible great mass production in the automobile industry and which in turn had its own hope of profit in supplying these facilities. It is the hope or desire for profit that has given the United States 18,000,000 telephones and the superb telephone system which we have today. It has given us over 6,000,000 radio receiving sets and the wonderful programs put on the air every night by hundreds of broadcasting stations.

The average American appreciates that improvements in the standard of living, additional facilities for getting the most out of life, higher wages, fewer working hours and lower costs, are due to the fact that someone is making a profit out of the accomplishment of these things. Whether it be manufacturing, selling, or the rendering of personal services, everyone expects and should receive just and fair financial compensation. The public service corporation is no exception to this rule and there is no reason why it should be. The light and power companies are owned by 3,000,000 American citizens. The money which this army of provident people has invested represents some portion of what they have been able to save out of the compensation received for their daily efforts. It is just as entitled to wages as it would be if it were placed in a savings account or invested in some other kind of enterprise.

It is frequently argued that any business which has a definite public interest should be owned and operated by the government, with Congress and the various state legislatures acting as boards of directors and managers. Those who argue in this fashion classify the railroads, street railways, telephone, telegraph, coal, oil, light, power and water companies as businesses which have a definite public interest. Why stop with these industries?

Certainly the automobile, which is no longer a luxury but a necessity has a definite public interest. There are 4,000,000 more automobiles in the United States than there are telephones and they are quite as necessary to our daily lives. Or it may be fair to say that if the government is going to take over all business which has a definite public interest, it should take over the production of the raw materials for these businesses, which brings into the picture the entire mining industry and the lumber industry. Having gone this far, we can safely say that the production of food and clothing, as well as the building of houses, has a definite public interest, and that the agricultural, textile, and construction industries should be owned and operated by the government.

There is much evidence of truth in the statement that progress in any industry is only accomplished when it gives opportunity for private initiative and enterprise. Practically every improvement in steam railroad transportation has come from the privately-owned, privately-operated railroads of the United States and Great Britain.

In the light and power industry, there is the fact that, during the past year or two, literally hundreds of municipally-owned plants have been sold to private interests in order that the communities in which they operate might receive service comparable with the service received from privately-owned plants in other communities. One has only to attempt to use the government-owned telephone in Europe and then use the privately-owned, privately-operated telephone in America or ride on the government-owned, government-operated railroads of Mexico and then cross the border and ride on any one of our great transcontinental systems to appreciate that after all, governments are not designed to operate business enterprises.

In the preceding chapters, an attempt has been made to give the barest outline of the contribution made by applied electricity to our social and material welfare and progress. The chapters themselves are little more than summaries; each one of them might easily be developed into a number of volumes. We have seen that the light and power companies do not belong to a favored few or to any particular group of financiers. This was demonstrated clearly by the report of the Federal Trade Commission. They are owned by millions of American citizens. It is in fact, a publicly-owned industry but, unlike the scheme of the advocates of government ownership and operation, it stops short at ownership and leaves operation to those who are better fitted for the task than any government department, bureau or commission could possibly be. Government ownership and operation eliminates the stimulus of profit, and once this is accomplished, progress will stop. This is no reflection on governments.

We have seen what the electric industry has accomplished in the past forty-five years for the housewife, the worker, industry, the farmer, transportation, communications—in fact for every phase of existence. It certainly cannot be denied that whoever has been responsible for it has done a good job and has earned some right to applause. It has been admitted that abuses in the form of profits out of all proportion with the capital invested crept in here and there; but on the other hand, it has also been shown that state supervision and regulation has put a stop to that sort of thing. And it must not be forgotten that in spite of almost universal legislation limiting profits to a fair return on the value of the property used in the public service, the industry has gone on spending literally hundreds of millions of dollars for the betterment of the service and for the reduction of costs of service.

It has been shown that the trend of rates has been uniformly downward in spite of the rapidly rising cost of living. The American people today are receiving more for their electrical dollar than they are for any other commodity dollar, unless it be the automobile dollar. This, too, in spite of a rapidly rising tax bill.

No nation in the world even approaches the United States in facilities for lighting, power, transportation and communications. There must be some reason. And the wisdom of abandoning our traditional political and industrial philosophy in order to worship at the altars of strange gods provided by those who would impose upon us European creeds which are little to our liking, is at least open to question.

For
FUTURE
REFERENCE

You may find it convenie
use this flap to jot down
numbers to be rememb
and other notes for refe
use.

....

....

....

....

....

....

....

....

....

....