
HYDRAULICS is the most ancient branch of engineering. Doubtless from the very earliest times running water has by artificial means been subjected to the control and use of man. A dam of hewn stone was built at Kosheish, five thousand eight hundred years ago, to divert the Nile from the spot on which Meua desired to build Memphis. In Babylonia, India, Persia, Greece, and many other parts of the world, similar works were usually carried out previous to the inception of the Christian era. These were usually designed to facilitate irrigation or to effect protection from flood, but even at that early period the value of water as a source of power was not entirely unknown, and a rude water-wheel was used in some parts of the East.

The development of water-power was part of the practical statesmanship of that wonderful character, Alexander Hamilton. He was the chief organizer of a corporation styled, "The Society for Establishing Useful Manufactures," which was chartered in seventeen hundred and ninety-one, at Paterson, New Jersey. It erected a plant over the Great Falls of the Passaic. The company, which was the first of its character in this country, is in active existence today. Hamilton was interested in other enterprises of a similar nature and had the greatest faith in water-power as an agency in the development of our industrialism.

The earliest example of the production of electrical energy by water on a practical scale and its transmission to a distance was afforded by the installation and operation of a plant set up by the late Lord Armstrong at Cragside, Northumberland, in eighteen hundred and eighty-two, for the purpose of lighting a private house. But, although the utility originated in Great Britain, its development has proceeded much faster in other countries. The United States has nearly as much water-power in operation as all other countries combined. It is, however, only within the past ten years that great water-powers have been applied to the industrial needs of distant cities in this country, and the art is still in its infancy. Nevertheless, systems distributing hundreds of thousands of horse-power have been installed and their number and capacity is constantly increasing. From nineteen hundred to nineteen hundred and five there was an in-
A PORTION OF THE GREAT SHOSHONE FALLS, IDAHO.
WATER POWER GOING TO WASTE OVER BEARSTRAP DAM, ILLINOIS RIVER.

WATER RIGHT SECURED FROM GOVERNMENT BY SPECULATORS: POWER GOING TO WASTE.
Beardsley Falls and Power Plant,
New York State.

The kind of easily developed water-
power that the speculators have
secured in large numbers.
HYDRAULIC PLANT AT COLGATE, CAL., SHOWING HOW WATER IS CARRIED DOWN MOUNTAIN.
crease of two hundred and seventy per cent. in the amount of electric power in use, and the greater part of it was generated by water.

Fifteen years ago, ten miles was the limit of transmission. Now the energy is commonly conveyed to points one hundred and fifty miles from its source, and considerably longer carriage has proved feasible. The longest line at present in use is that of the California Gas and Electric Company, stretching from the De Sable powerhouse to Sausalito, on the opposite side of the straits from San Francisco, a distance of two hundred and thirty-two miles. The future of water-power depends upon increased facilities for transmission which will not only cheapen the commodity, but also bring natural powers that are now useless within the field of marketable distribution.

WATER-POWER is the most valuable resource of the country. Our fuel supplies are rapidly diminishing with a corresponding rise in prices to the consumer. In the anthracite fields of Pennsylvania coal seams are being worked that fifteen years ago were deemed of no account. The cost of the product is fast approaching the limit at which it can be economically purchased. When it reaches this point, the bituminous beds will be subjected to a greater drain and their final depletion hastened.

Coal, oil, timber,—all the sources of energy save water,—are now in the hands of corporate monopolies and the last of these is threatened with similar absorption. During the past decade, a few affiliated corporations have been acquiring all the water rights possible in the Western sections where coal is scarce. It is almost impossible at the present time to find an unappropriated site for the development of water-power within reasonable distance of a market anywhere in the Northwestern States, or on the west side of the Sierra Nevadas. The extent to which this utility is passing into the hands of large companies is shown by the fact that in California alone four of them have an aggregate capital of fifty-five million dollars and operate thirty hydroelectric plants and eighteen steam plants. The largest of these corporations supplies power to twenty-six individual lighting companies and twelve electric railways, in addition to a number of cities and towns where it has its own substations. There is in constant operation in the State more than two hundred thousand horse-power derived from water.

The complaint against the prevailing conditions rests not so much upon the vast properties operated by these companies, although they
charge exorbitant rates for their service, as on the fact that they are endeavoring to secure all desirable sites with a view to shutting out competition. On four rivers of Northern California, where there is a potential development of eight hundred thousand horse-power, only twenty thousand has been utilized and the balance is tied up by speculative rights. That is to say, seventy-five per cent. of the power possibilities have been alienated from public ownership and less than two per cent. turned to account.

In the past, water rights have been secured from the Government with ridiculous ease. In the Land Office may be seen roughly penciled drawings on which casual and irresponsible prospectors have filed water-power claims, without any intention of improving the properties. In order to keep the claim alive the speculator goes to the place once a year and dumps a cartload of stone, or excavates a few cubic yards of earth, and makes affidavit that his works are in course of construction. Very frequently not so much as this is done, the grantee relying—usually with success—upon one or another flimsy excuse for extension of time. This farce is maintained until the agents of one of the monopolistic electric power companies comes along and purchases the right at a price greatly below the value, but that yields a handsome profit to the man who secured the property from the Government for nothing.

In the ten years, eighteen hundred and ninety-six to nineteen hundred and six, Congress passed thirty-three bills granting the privilege to private corporations and individuals to erect dams across navigable rivers for the purpose of generating power. In twenty-one of these cases no work has been done in furtherance of the proposed improvement and in the majority no plans have been made, so far as the Hydrographic Division of the Geological Survey can ascertain. In not a single instance did these bills provide for any compensation to the people for the valuable properties thus diverted from their possession. It seems to have been deemed quite sufficient to grant the privileges “in consideration of the construction of said dam free of cost to the United States.”

Water-power sites worth many millions of dollars have thus passed out of the hands of the people and in not a few cases it will be necessary for the Government to regain possession by paying the owners at rates based on the utmost valuation. The Gore Canyon case, at present in litigation, affords a striking illustration, though only one of many that might be cited, of the careless manner in which
the Legislature has gifted rights without return, and the expensive process by which the reversion of the property to the State is effected.

Many years ago, the Burlington Railroad secured from the Government the right of way through the canyon of the Gore River in Colorado. The company made no use of its privilege but a few years since conveyed it to the Moffett Line. Recently the Reclamation Service surveyed an important project which involves as an essential feature a large reservoir in the Gore Canyon. The Service had its preparations completed to commence work on the project, when the Moffett Line restrained it from proceeding and commenced the construction of a track through the canyon, though it might, without great additional cost, carry its line outside. It is absolutely necessary—as the railroad officials fully realize—that the Government should occupy the canyon to the exclusion of the railroad and the latter will be compelled to vacate, but not until it has received a compensation which will represent a very handsome profit on a transaction made up of a free gift and a sale to the donor.

IN JANUARY of the present year, a party of promoters came to Washington, bent on one of those usually facile coups which have effected the alienation of public property worth billions of dollars. In this particular instance the lobby proclaimed its purpose on the street corners and declared it to be practically accomplished. This confidence was justified by the assurances of support gained from members of Congress before the opening of the session. The bills in which the lobbyists were interested proposed to confer upon certain affiliated corporations water rights controlling the sources of one million five hundred thousand potential horse-power. The bills would have made these enormously valuable properties a free gift to the applicants. Placing the value of an electrically transmitted water-horse-power at twenty-two dollars and fifty cents per annum, which is a fair average figure, the desired legislation aimed to donate without material consideration the equivalent of more than thirty million dollars a year.

Water rights have been acquired by the electric power monopolies with such ease and absence of question in the past that they did not anticipate any opposition upon the recent occasion. President Roosevelt's Waterways Message, sent to Congress in February, created uneasiness in the water-power lobby by its pointed reference to the necessity of husbanding all our water resources, but consternation spread through the camp of the petitioners when, in his Message of March,
the President flatly warned Congress that he should veto any bill that might be presented to him lacking a provision for adequate compensation to the people for the privileges extended by it. Despite the caution, Congress, in April, passed one of the bills in question and the President, in accordance with his expressed determination, promptly vetoed it.

The present conservative policy of the Administration is actively antagonized by the water trust. It has even exerted opposition to the work of the Geological Survey in the dissemination of education on the subject. An interesting exhibition of its tactics was recently given in connection with the only bill that has ever been presented to Congress for a water right with a provision for compensation to the Government for the privilege sought. In this case the petitioner’s proposition has been pronounced by the United States Engineers to be highly meritorious and of great aid to navigation. It includes supervision by the Government of the company’s rates for service, an annual rental payment to the United States and the limitation of the franchise to the term of the tenant’s good behavior. This bill had no sooner been presented than the attorneys of the trust tried to induce the beneficiary to withdraw it, and plainly intimated that in their opinion he was violating the recognized rules of the game. Failing in the first move, they offered to buy him out, and, upon his refusal, began to subject him to a subtle persecution. They submitted derogatory reports to the authorities regarding him, circulated injurious statements broadcast, and impaired his credit with the local banks.

There are now in use in the United States about sixteen million horse-power, less than one-fourth of which is produced from water. These proportions are constantly working in the direction of reversal, and in the course of a generation power derived from water will have almost entirely displaced that generated from coal. There is at present available in mainland United States at least twenty-five million water-horse-power. “Available” here is intended to signify the amount that might immediately be put to use, and that is not anything like all the power that might be practically and profitably developed, with changed conditions, diminution of coal supply and increase of its cost, improvement in transmission and other factors that are continuously exerting influences in this direction. In fact, there is enough water-power existent in this country to furnish the energy for all purposes that could possibly be used by a population twice as large as the present. A great deal of the instantly available
power has been given away and not less than one million six hundred thousand is now going to waste over Government dams. A clearer idea of this waste may be gained by the statement that at eleven tons of coal per horse-power per annum, it would require seventeen million six hundred thousand tons of coal a year to produce its equivalent in energy. Coal, it must be remembered, does not reproduce itself, while the permanency of water-power is dependent only on rainfall and the preservation of the forests.

This monopoly of water-power affects every individual in the territory where it exists. Heat, light and power,—particularly the two latter,—are practically controlled by such a monopoly. Prices are not based on a fair return from the amount invested but are so regulated as to fall slightly below the cost of furnishing the same character of service through the agency of steam. Where fuel is cheap, the price of electric power is correspondingly so. In New York, power is supplied from hydro-electric plants at twenty dollars per horse-power per year for twenty-four hour service. In the Carolinas, the average charge is fifteen dollars. In California, as much as ninety-eight dollars is charged to small consumers and fifty-eight dollars is the lowest rate in force. It is safe to say that from twenty-two to twenty-five dollars per horse-power would represent a fair average price for all localities.

With the advantage of electrical transmission, water-power is fast usurping the place occupied by steam-power. In hundreds of towns of America steam engines have been almost entirely—if not quite—displaced by electrically transmitted and distributed water-power. In scores of cities, large steam plants may be seen standing idle. The economy is available to all kinds of industries that require mechanical power in large or small units. No loads are too great to be operated by electrically transmitted water-power, nor are any too small to be economically included in the field of its application. The enormous machinery of rolling mills, or the sewing machines of the shirt factory may be operated through this agency, not only with saving in expense, but also with greater safety and less detriment to the health of the laborers.

Gas, like steam, is falling behind in the competition with water-power. This is true in the fields of light, heat and power, and evidence of it may be found in the cities that have the cheapest gas. Buffalo, for example, not only has illuminating gas at one dollar per thousand cubic feet, but also natural gas at thirty cents per thou-
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sand cubic feet. Yet, during the present decade, the consumption of electric water-power in Buffalo has increased from practically nothing to twenty-five thousand horse-power annually.

The energy may be transmitted great distances and delivered at prices below the cost of coal; and while the tendency of the price of coal is sharply upward, electrical transmission will become very much cheaper in a few years. Then, the labor cost of operation is so very much greater in a steam-power than in a water-power plant that even with free fuel the former could not hold its own in all cases. For illustration, take the case of Buffalo, where the price of steam coal sometimes sinks as low as one dollar and fifty cents per ton and water-power is delivered from a distance of twenty-three miles. Here, a flat rate of twenty-five dollars per water-horse-power-year prevails. This charge is for twenty-four hours' service per day and for three hundred and sixty-five days in the year. It is made to large consumers by several transmission systems and is constant for the number of horse-power covered by the contract without regard to the time during each day that it is actually consumed. If the purchaser of electric power on this basis can use it only ten hours per day and three hundred days in the year, or three thousand hours in all, his rate per horse-power amounts to eighty-three cents for the energy actually consumed. Where the power can be used twenty-four hours per day and every day in the year, the flat rate of twenty-five dollars per horse-power-year amounts to only twenty-nine cents per horse-power. He would have to pay as much as this for the mere labor of shoveling coal into his furnaces if he ran a steam plant.

No factor is so conducive to the development and prosperity of an industrial community as cheap and convenient power, unless it be cheap and convenient transportation. We must ultimately depend upon water-power for the greatest amount of the energy applied to our industrial and domestic affairs. In a comparatively short time, it will be the force operating our manufacturing plants, our farm machinery, our railroads and our urban cars. Not only this, but it will be applied to most of the domestic services. The extension of this utility and its preservation from monopolistic control are matters of the utmost moment to every citizen, for it will soon become a vital factor in the daily lives of all. Already, according to conservative estimates, every man, woman and child in the United States uses on an average about seven dollars' worth of electricity every year in some form. Trolley rides account for three dollars, or nearly half the expenditure, and lighting for one-third.