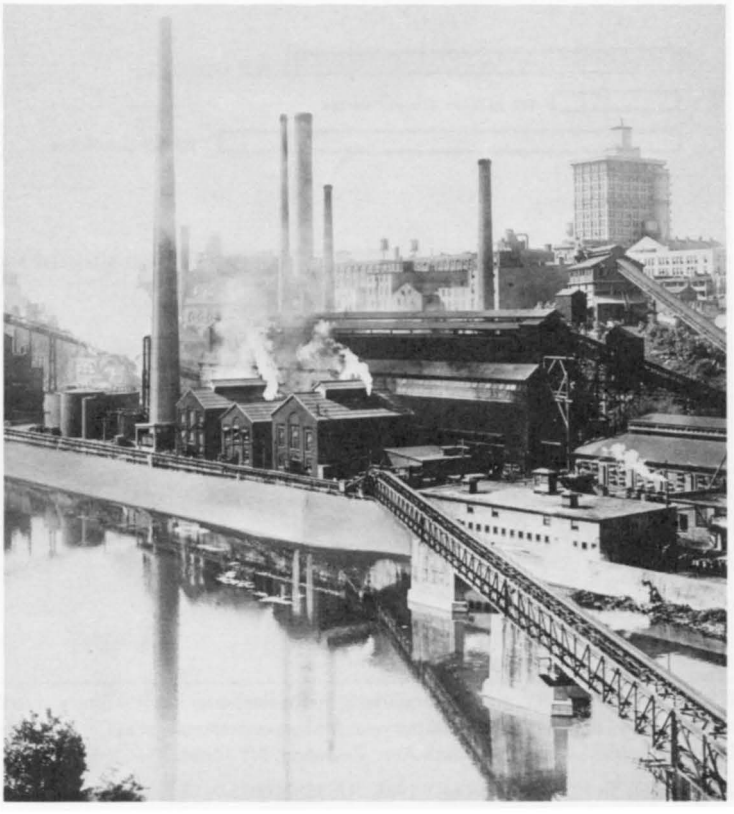
ROCHESTER HISTORY

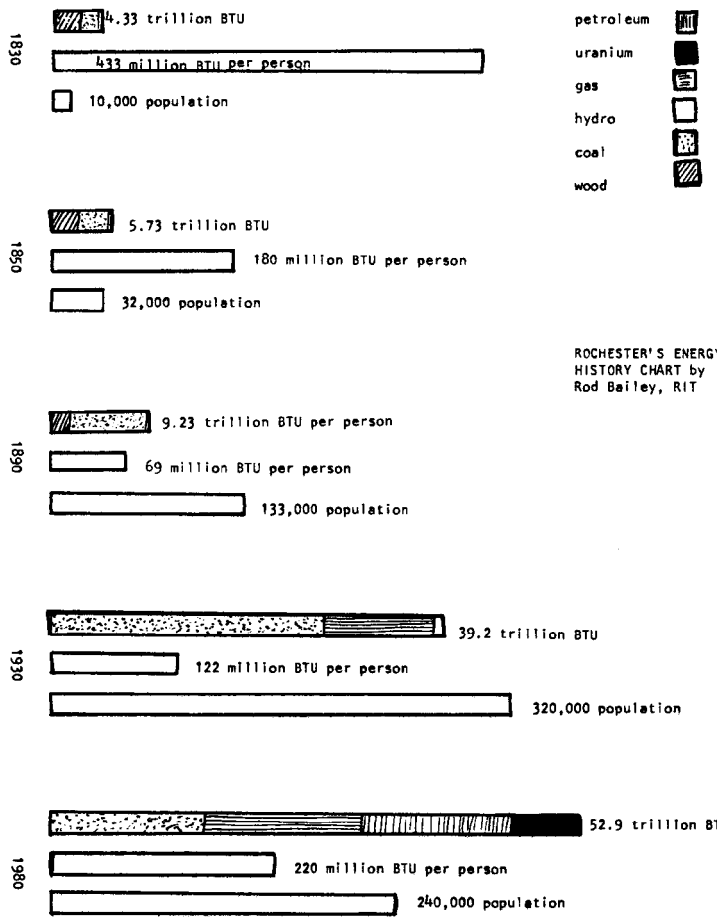
Ruth Rosenberg-Naparsteck, *Editor*

Vol. XLVI July and October, 1984 Nos. 3 and 4

Sources of Energy In Rochester's History

by Rod Bailey





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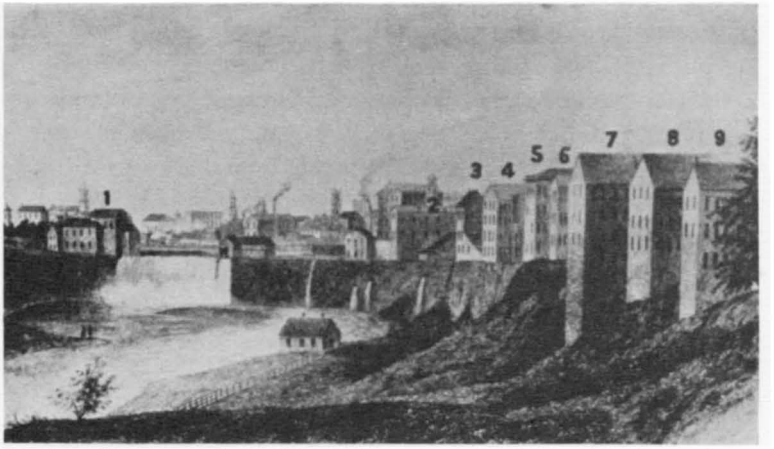
 US ISSN 0035-7413



Nine flour mills were operating in 1860 along the east bank of the Genesee River. These mills near the Main Falls are: 1) The Genesee Falls Mills; 2) The Cotton Factory; 3) Achilles' Custom Mills; 4) Revere Mills; 5) Granite Mills; 6) Phoenix Mills; 7) New York Mills; 8) Richardson's Mills; 9) Silas O. Smith's Mills. the west side mills are on Brown's Race. *(Photo from J.H. French's Gazeteer of The State of New York, 1860).*

Sources of Energy In Rochester's History

Hydropower has never contributed more than two and a half percent of the total energy supply in Rochester, yet, if it were not for the hydropower, the flour mills, clothing mills, and tool fabricators would not have located in Rochester, and the industrial base would not be as strong. Such a condition would not have been critical for a pioneer community developing in the 17th century if it was based only on agriculture or a community that developed in the latter part of the 19th century when steam engines were a major source of industrial energy. But, because of the industrial technology at the time Rochester was settled, hydropower was essential.

The development and use of energy resources in the Rochester area are much like those in other river-oriented communities that developed in the late 18th and early 19th centuries. Geologic events within the past 10,000 years left Rochester with two major and one minor waterfalls as the Genesee River bisected Rochester from south to north on its way to Lake Ontario.[1] The overall drop in river level is approximately 260 feet. Successive drops of 92, 28, and 96 feet over the upper, middle and lower falls, respectively, account for most of this. Because of developments in the river over the past several decades, the 28 foot middle falls is not evident today so it appears that there are two major water falls of over 90 feet each.

There is also a dam of approximately 20 feet just south of Court Street. This is a location that has always been significant in Rochester's hydropower development.

From an earlier dam at this location, water was sent into two mill races, one along each side of the river. The Rochester, Fitzhugh and Carroll race ran through the area where the War Memorial now sets on the west side of the river.[2] This race was originally developed about 1814 by some of the founding members of Rochesterville. Horatio E. Fenn's 1820 map of the village shows at least two saw mills, one nail mill, and one flour mill along this race. By 1855, there were at least four flour mills along this race and in 1879, a variety of mills, including three flour mills, two printers, three saw mills and woodworking establishments, and a paint and oil company that utilized a total of slightly over 1000 horsepower (hp) of the river's energy.

On the east side of the river, in the same general location, was the Johnson and Seymour race. This was developed shortly after the Rochester, Fitzhugh and Carroll race. The 1820 Fenn map shows an oil mill, saw mill, paper mill and flour mill along this race. By 1855, there were at least six flour mills using the water power from this race. In 1879 there were sheepskin dressers, a soap and candle mill, a dental and barber chair manufacturer, six flour mills, a brewer, several woodworking shops, and others utilizing 1300 hp of energy from the river.

The largest race, having the potential for the greatest number and variety of mills, was developed by the Brown brothers, Matthew and Francis, about 1815 on the west side of the river at a small dam just upstream from the upper falls. The Fenn map shows a scythe mill, two saw mills, a flour mill, and a cotton factory located at Brown's race. By 1855, almost 1800 hp was being utilized by at least eleven mills on

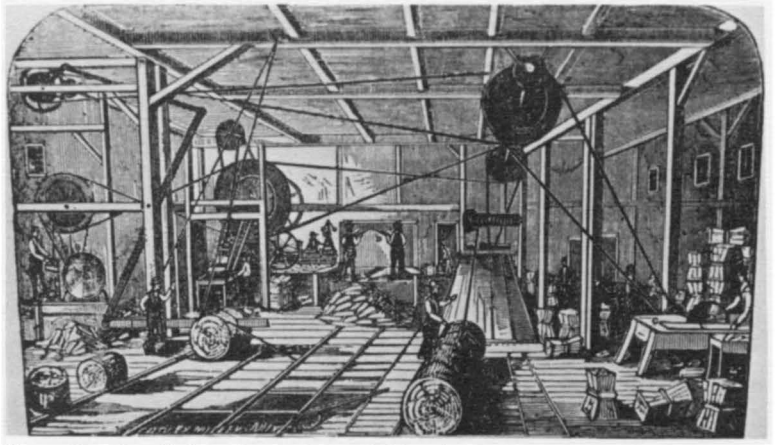
this race, and in 1879 the energy gathered in this one-third mile long race reached almost 3700 hp. There was a variety of manufacturers on the race including nine flour mills, several machine and tool shops, a cotton mill, a last factory, and the Central-Hudson Railroad.

As the early races were developed, and Rochester became more settled, the village trustees appointed race commissioners to insure that each mill along a race got its appropriate water rights. Those with first rights were guaranteed a measured amount of the water flow. Those with second rights were entitled to an amount of water flow left. During the seasons when the Genesee's flow was low, the mills with second water rights might get no water from the race. The flow of water from the race into a mill was controlled by gates which the race commissioners adjusted and checked periodically. Water rights became valuable energy resources, with the rights along the three major races having a value of over $500,000 in 1905; the total hydropower resource in Rochester was estimated to have a value of $1,500,000.

In other areas along the river, because of the steep banks, extensive raceways were not constructed, although methods were employed to capture the potential energy of the water. Notable among these was the development at the east side of the lower falls where the Rochester Gas and Electric Company (RG&E) Station #5 is now located (see map). By 1880 this site had been developed with an estimated power equal to or slightly greater than that at Brown's race.

Over the years, there has been competition over the water needed for the hydropower development and to keep the canals that fed off of the river in operation. Originally, both the Erie Canal (running east-west) and the Genesee Valley Canal (running north-south) drew on the flow of the Genesee River to keep a suitable level of water in the canals. During dry periods, this could significantly decrease the flow through the mill races and over the water wheels. The Genesee Valley Canal drew on the Genesee River throughout its operation but once the Erie Canal was extended to Lake Erie, the lake was used as a reservoir to maintain water levels in the canal.

An early estimate of the total hydropower which was available in Rochester was 12,875 hp, of which 3400 hp was utilized in 1828.[3] In 1882, over 6400 hp was being tapped and by 1897, when over 18,000 hp was utilized, the estimated potential had increased to 31,000 hp because of the improved efficiency of the water turbines available at that time. In 1945, almost 60,000 hp was being used, gen-



The configuration of belts, pulleys, and gears tied directly to a mill's water wheel required the mill to be several stories high like Boughton and Chase's Shingle Factory shown here.

erated mostly at RG&E's Station #5 by the lower falls. By then, most of the mills along the races had discontinued operations since the critical energy resource, falling water, which tied them to the river-side location, was no longer essential. Coal-fired boilers that provided steam, along with electricity provided by RG&E, allowed mills and manufacturers to locate at sites convenient to land transportation routes. Most factories were now in buildings that spread horizontally rather than vertically because motive force for turning shafts and wheels was now provided by independent electric motors and not great configurations of belts, pulleys, and gears tied directly to a mill's water wheel. Today, the only use for the Genesee's falling water is for the generation of electrical power and the enjoyment of the area's residents. The earlier races have fallen into disrepair or are filled in by developments such as the War Memorial.

The first significant settlement, and the first harnessing of the power of the Genesee in the Rochester area, was by Ebenezer (Indian) Allan in 1789.[4] On the one-hundred-acre Phelps and Gorham tract, Allan

erected a saw mill and a grist mill, using water diverted from the west side of the Genesee, just south of the present Court Street dam. Early maps show a series of small falls in the river, with a combined drop of 14 feet, so there was certainly potential energy available. Although Allan, and later settlers, are recognized today for their grist or flour mills, the saw mill was the first water-powered structure Allan built. Allan sold his mill in 1791 to Benjamin Barton and both the saw mill and the grist mill fell into disrepair.

By 1820, the potential energy that had attracted Allan and other early investors to the lower Genesee Valley had been captured by the three major mill races. Many saw mills and flour mills were built along these races, providing a stable manufacturing sector for the commerce of the new village of Rochester. However, milling energy from the river met only a small portion of the village's total energy needs. In the early homes in the village, which were typically one and a half stories with one large room on the first floor and a loft above, heat was provided by wood burned in a single large fireplace at one end of the ground floor room. Cooking was also done in this fireplace. Much of the wood was gathered by individual residents from the forests that surrounded the village. There were unbroken forests about two blocks west of Washington Street in the southwest part of the city. Light was provided primarily by candles and transportation was by foot or horseback. Human and animal muscle-power provided the energy for many of the chores we do today with oil, gas or electricity.

By 1830, there were about 1500 houses in Rochester. The more modest homes were two-story frame houses with two main rooms on each floor and a large fireplace in each room in conjunction with a central chimney. The more affluent residents had four rooms on each of two floors. By one estimate, each of the four major fireplaces in a modest home could consume ten cords of wood per winter (a cord of wood is a pile of 4-foot logs measuring four feet by eight feet). An additional ten cords of wood might be used in the kitchen fireplace for cooking throughout the rest of the year.[5] In 1832, the village trustees were granted permission by the state assembly to appoint official wood measurers.[6] These officials were needed to insure that wood sellers would give a standard load to buyers at the public market or elsewhere. Backyard wood scrounging was no longer providing the wood supply for the village. An 1833 column in the *Genesee Farmer* noted that wood was selling for $1.50 per cord with another 50¢ per cord being

charged for cutting and splitting.[7] However, the 1831 report of the village wood inspector measurer gave a tabulation of about 92,000 cords of wood sold (hickory, oak and pine) for $597,000 or almost $6.50 per cord.[8]

The same 1831 inspector's report accounted for 54,300 tons of anthracite, 12,000 chaldrons (a chaldron is equal to 36 bushels) of Virginia coal, and 272,000 tubs (a tub is about a half barrel or almost two bushels) of charcoal being sold in the village for a total cost of $606,000. This means that the average per capita energy expense was $120, for a family of five or about $600 per year.

If homes were being heated by coal, how was all of the coal being used? Steam, which could have been generated by either coal or wood, was not being used in the flour mills until 1851.[9] Certainly some coal, and probably all of the charcoal was being used in foundries and other machine or tool shops.[10] By numerous accounts, in the 1830s, and even until 1848 by one account, coal was not being used in homes for heating.[11] But, there were articles in the *Genesee Farmer* in the early 1830s on basement coal stoves and closed parlor stoves that could burn coal to heat a house much more efficiently and cheaply than the open wood-fired fireplaces.[12] As early as 1829, advertisements for coal, coal stoves, and grates appeared in the newspaper.[13] By the early 1840s, there were several newspaper accounts of Franklin stoves being used and large fireplaces being bricked in. A Franklin stove could burn either coal or wood. Based on the small size of some fireplaces and chimney flues in homes that were built in the 1830s, it appears that some of the homes were using coal as their major supply.

Beyond the energy for heating, and the mill-power captured from the Genesee, energy in the village of Rochester consisted of some whale oil for lamps and, as in the 1820s, human and animal muscle-power. These latter sources are difficult or impossible to quantify. We can, however, make an attempt to estimate the consumption of the river's energy. Assuming the 3400 hp of the river's potential energy was being utilized by the mills, and further assuming that the mills typically worked ten hours a day for six days a week, we can estimate that the river accounted for approximately 0.03 trillion (30 billion) BTUs of energy. The combined energy from the wood and coal supplied to the village in 1831 was 4.3 trillion BTUs, for a total village energy consumption of 4.33 trillion BTUs or an average per capita energy consumption in the village of 10,000 of 433 million BTUs. (An average

Rochester house today requires 100–200 million BTUs of heat during a typical Rochester winter.)

The 433 million BTU per capita energy consumption (see chart) was quite high. Energy was being used inefficiently. The *Genesee Farmer* said, "we should never persuade a single housewife to admit a close stove, with a range of 'black nasty pipes,' into her. . . parlor."[14]

The paper noted that a basement coal stove would require only eight tons of anthracite at $64 instead of $300 for the 50 cords of wood that were typically consumed by a household.

The Rochester Gas Light Company began manufacturing gas from coal in 1848 at a small plant on Mumford Street (now Andrews Street) by the river.[15] Initially, the gas was used only for street lighting, replacing the whale oil lamps that had been lit only on moonless nights. When gas was first supplied, there were four miles of street mains in place, and 50 to 60 lamps were lit. By 1850, seven miles of gas mains had been laid in the street and the Rochester Gas Light Company had 650 private customers and was providing gas to 87 public lamps. This level of production required only 1500 tons of coal so the overall impact on the city's energy consumption was rather slight.[16] As gas lighting became more prevalent in succeeding decades, whale oil and lard, as lamp fuels, were slowly displaced.

A by-product from the coal-to-gas conversion process was coke, which was used in a few homes as a heating fuel. Interestingly, this became a fuel of the wealthy and the poor.[17] The wealthier citizens would have the coke delivered by the load to their houses, while the poor would pick up a bushel at a time for 6 to 8¢ at the Mumford Street plant. However, the main sources of home heat were still wood and coal. By 1850, there is no question that coal was being used extensively as a home heating fuel. One account mentions that Jonathan Child began selling "small debris," resulting from the handling of the lump coal he sold to the foundries, to homeowners in 1847 or 1848. Shortly thereafter he began purposely breaking up the lump coal (mostly Lehigh coal) for homeowner use.[18]

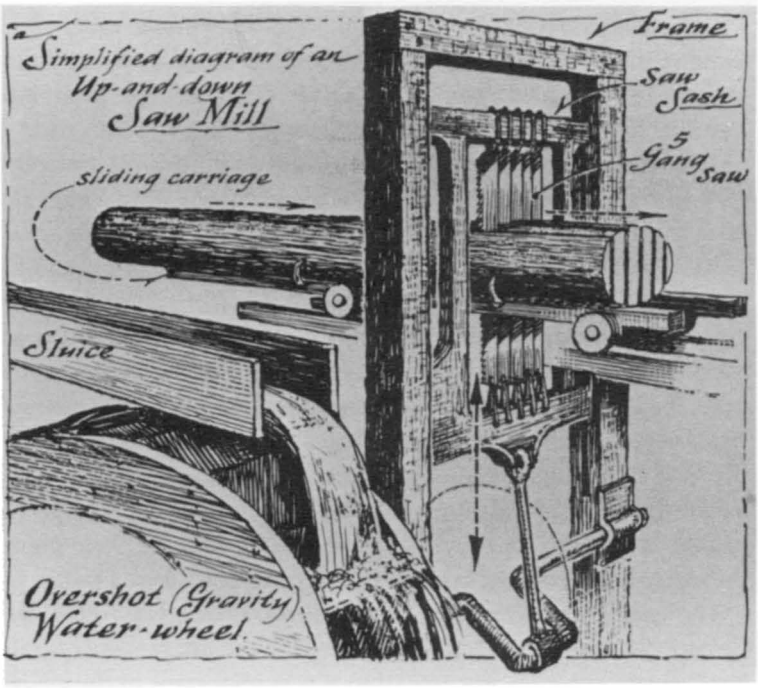
In 1850 Roswell Hart became the first coal dealer who was supplying anthracite primarily to the residential market. The *Rochester Daily Union* of August 18, 1852 noted that wood prices had recently been quite high and that the competition from coal and coal stoves might bring those prices down.[19] Coal was finding more use in the mills by the early 1850s also. One account notes that some steam power was

being used in the flour mills in 1851, supplementing the water power which had been the mainstay for all of the mills until that time.[20]

While there were no clear records of either total wood or coal used in Rochester in 1850, estimates based on the number of households in the city (5800), the type of stoves, furnaces, and fireplaces being used, and both earlier and later fuel accounts, suggest that about 90,000 cords of wood and 140,000 tons of coal were consumed. The river was providing basically the same amount of energy as in 1830. An overall estimate of energy provided by coal, wood, and water in 1850 is 5.73 trillion BTUs, or 180 million BTUs for each of the 32,000 inhabitants. This per capita energy consumption is significantly less than in 1830 or, one could say, energy use had become more efficient. The primary reason for this was the use of closed stoves and furnaces for home heating (see chart).

The years between 1850 and 1890 were some of the most important decades for Rochester's energy development and, indeed, the industrial development that gives Rochester much of its character today. In this period of time manufactured gas became the primary source of energy for lighting, and gas was beginning to be used as a cooking fuel. Electricity was introduced in Rochester in 1880, and ten years later the city's street-car system was being transformed from horse-powered to electrically-powered trolleys. Wood virtually disappeared as a source of home heat, its place being taken by coal and coke. Kerosene and other liquid petroleum products became common energy sources for lighting and cooking; and they provided some industrial energy. The harnessing of the Genesee River energy became more efficient, although by the end of the period most of the water rights on the river were owned by the electric utility companies. George Eastman, a friend of Thomas Edison, founded the Eastman Dry Plate Company and established a pattern of on-site industrial energy generation that allowed manufacturing to move away from the river. This capability, pioneered by Edison and Eastman, allowed the creation of industrial parks that exist today.

By 1890 there was very little wood being used for home heating, although it is possible that some wood was used for cooking. About 60,000 cords of wood were used in Rochester in 1890 for cooking. In the meantime, coal sales were going up. In 1874 and 1884, there were about 150,000 tons of coal bought by Rochesterians, but by 1890, the city's residents and businesses consumed about 300,000 tons of coal.[21]



The gas manufacturing industry in Rochester in 1880 was consuming 13,000 tons of coal annually to manufacture 155 million cubic feet of gas for 8000 customers.[22] In 1872, the Rochester Gas Light Company was joined by Citizens' Gas Company, located north of the Smith Street bridge (now Bausch Drive) on the east side of the river on Canal Street at the RG&E West Station.[23] All three merged into the Rochester Gas Company in 1889.

In 1870, the Rochester Gas Light Company undertook a project to bring natural gas into Rochester. A pipeline made of sections of hollow white pine logs, with joints sealed by old civil war blankets soaked in pitch, stretched 28 miles from West Bloomfield to the outskirts of Rochester. It was joined there to a metal pipeline designed to deliver the gas to the Mumford Street plant where it would be treated to make it compatible with the manufactured gas and to have a similar heat content. The blanket-wrapped joints leaked so much that there was not enough pressure left to push all the gas through the line and the project was eventually abandoned at a loss of $800,000.[24]

Industrial power in 1879 still depended heavily on the water of the Genesee River but there was increasing amounts of coal used by industries that were located away from the river. Flour milling was a minor industry by 1890, although in 1896 the mills still had rights to 15% of the potential power that the river provided. Other mills controlled 32% of the power, while the various electric generating companies were using over 52% of the water power. As mentioned earlier, over 18,000 hp of the potential 31,000 potential horsepower along the river was being utilized by 1897.[25]

A Rochester Gas and Electric Company estimate at this time showed their capture of 18,000 hp from the river.[26] Apparently many of the other facilities with rights to the water power were not utilizing those rights very extensively. With technology in transition in the late 1880s, the river, in a relatively short period of time, became over three times as powerful; but at the same time, the industries that needed power backed away from the river and eventually received their power through an electrical cable rather than a turning shaft or a belt.

The major manufacturing development in the late 1800s was George Eastman's Dry Plate Company. This had not become a significant energy consumer by 1890, but it was important in the energy development of Rochester because it began the move toward on-site electrical generation.

The Eastman Dry Plate Company used coal as its primary source of power, converting the energy of coal into steam to drive motors, shafts, belts and pulleys to generate electricity and to run an ammonia compressor to provide cooling (air conditioning). Early equipment included a 35 hp steam engine installed in 1882; a dynamo (about 1.25 kw) installed in 1881 and another (about 5 kw) installed in 1882 to provide electricity for some of the earliest incandescent bulbs used in the city; a 10 kw bipolar dynamo in 1889 and a 50 kw bipolar dynamo in 1891 (both run by steam engines), and a 50 ton ammonia compressor in 1891.[27]

In 1880 James Melville Bois developed a plan to use the power of the Genesee River at the lower falls on the east side to compress air into large cylinders that could then be used to power the trolley cars. He also had visions of using the compressed air to supply light and mechanical power for factories. The *Union and Advertiser* of May 13, 1880 reported a working model of the compressor that was displayed at Bois' Hydraulic Motor Company on West Main Street. An account in the

same paper of January 5, 1881 gave a partial description of the 116-foot-high building constructed against the ledge at the lower falls. The building contained 300 cords of stone in its base, which was comprised of a crib 140 feet long. The six-foot diameter cylinders for the compressed air would rest in this crib. There was no account found of Mr. Bois compressing any air with his scheme and by 1881 the Brush Electric Company owned the building and the water rights at this location.

The first electric company in Rochester, formed in 1880, was the Rochester Electric Light Company. It began operating hydroelectric generating stations in the Beehive Building on the Rochester, Fitzhugh, and Carroll race in a building on the east side at the upper falls, which came to be known as Station #4. The Brush Electric Company, occupying the Bois Building at what is today called RG&E Station #5, was the first to transmit alternating current several miles making it useful to clothing plants located in the area. In 1886, the Edison Electric Illuminating Company was formed and began generating electricity with steam in a plant on Exchange Street (near the location of the War Memorial). It generated hydroelectricity on Brown's race at the site now occupied by the RG&E Station #2. The Edison Electric Illuminating Company was the first to place its wires underground; and, since it was the first to use steam to generate electricity, it was also the first to provide 'waste' steam to nearby buildings in the winter for heating. Today this is called co-generation. A fourth electric company, the Citizens Light and Power Company, was formed in 1892. It generated electricity using both steam and hydropower in a building on Brown's race now called RG&E Station #3. By 1904 all of these electric companies, as well as the existing gas companies, had been combined by purchase and merger into the Rochester Gas and Electric Company.[28]

The advent of available electricity, and the demise of Bois' scheme to power street cars with compressed air, led to the rather rapid electrification of the Rochester Railway Company's trolley system. From its beginnings with the horse-drawn omnibuses in 1848, the street-car system had expanded its track mileage and ridership. In 1862 there were 6.6 miles of track and in 1885 there were 25. The trolleys were carrying several hundred thousand passengers a year while they were still horse-drawn; by 1900, there were 23,000 passengers on the electrified trolleys. The first electric trolley ran along Lake Avenue in 1889. The last horse was retired in 1893.[29] The operator of the line, the

Electric trolleys replaced horse drawn trolleys by the turn of the century. Note the absence of horses and cars in downtown Rochester. *(Photo courtesy of city historian's office).*

Rochester Railway Company absorbed what was the Rochester Gas and Electric Company (although the name was eventually changed to the Rochester Gas and Electric Company), which resulted in a major consolidation of municipal services into the hands of a private corporation. The primary advantage of this arrangement was the elimination of repeated street disruptions as electric, gas, or trolley lines were laid through an area.

Although manufactured gas was being used more and more for lighting in the home, it had competition from both kerosene and electricity. Following Colonel Edwin Drake's discovery of oil in Pennsylvania in 1859, kerosene lamps became available and started to displace the old lard lamps by the mid-1860s. By 1890, kerosene was still used mostly for lighting. Early electric lamps were arc lamps, not the incandescent bulbs that became more prevalent after 1890. The arc lamps were good only for large public spaces such as Reynold's Arcade or street lighting. Gas lights were still used in Rochester houses until the 1920s, so electricity was more of a novelty than a necessity before the turn of the century. Refrigeration equipment for the home was still unavailable though Eastman was using ammonia compressors for industrial cooling. Rochesterians used ice boxes to keep food cold. The ice was cut from Irondequoit Bay and other area ponds and lakes and stored under sawdust in ice houses.

Rochester's major energy sources by 1890 were coal, wood, water from the Genesee and a small amount of kerosene (see chart). The 69 million BTU per capita consumption is considerably more efficient than in 1850, due primarily to more efficient space heating.

Industry was using energy quite efficiently in on-site electrical generation schemes like the Eastman Dry Plate Company, or co-generation operations such as the Edison Illuminating Company.

By the turn of the century electricity provided most of the light in Rochester's homes, much of the industrial power that it used, transportation on the street car and the subway, and various home labor-saving devices such as washing machines and vacuum cleaners. Diesel oil was powering the cars and beginning to power the buses. Gas, still manufactured from coal, was finding its way into the home as a heating fuel. Coal and coke were still being used as the primary source of home heating, a pattern which would change rapidly following WWII as gas and oil displaced the dirtier solid fuels like coal and coke.

At the turn of the century, the electric trolley transported most of the city commuters, but by the late 1920s, cheap gasoline and assembly-line production made the automobile the favored form of transportation. In 1902, Rochester had 100 registered automobiles among its citizens. That number grew to 4000 in 1912, 40,500 in 1922, 103,300 in 1927, and 111,000 by 1930. At that point, considering that the population was 320,000, there was one car per three people, or, on the average, at least one car per family. Initially, the family car was used for pleasure driving. Residents in the city utilized the trolley system for many of their daily commuting and shopping trips as is clear from the rapidly increasing ridership: 23,000,000 passengers in 1900, 68,000,000 in 1908, and 106,000,000 in 1919.[30] These ridership figures can be appreciated more when compared to the 1980 figures from the Rochester Transit Service. Ridership for its entire system was about 25,000,000.[31]

By 1930, the average car was using about 550 gallons of fuel per year.[32] Within a thirty-year period, gasoline became a significant source of energy, accounting for about 25% of the overall energy consumed in the city.

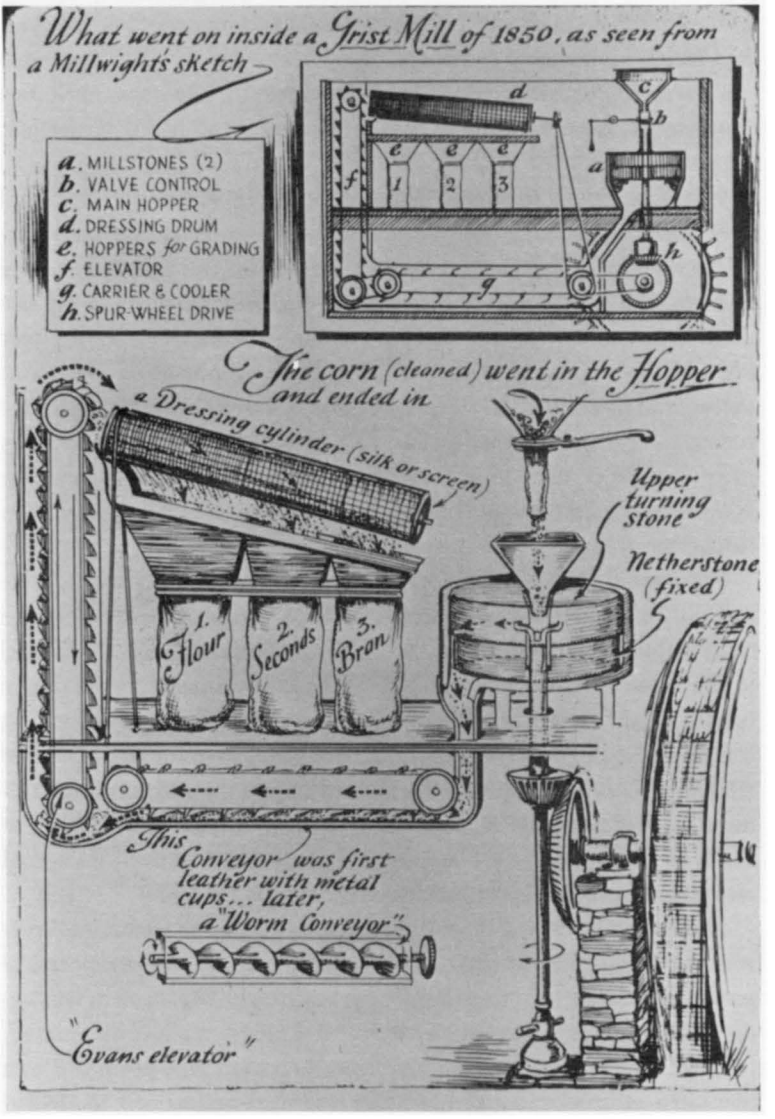
In 1927, the Rochester subway began to operate. The project had been in the planning stages for many years. City and state officials were interested in finding some practical use for the old Erie Canal route which wound its way through Rochester from the northwest to

the southwest. By this point, Broad Street had been built over the old canal aqueduct through the center of the city. The original objective of the subway was to provide a connecting link, and some heavy-duty track, for the inter-urban trains that came into Rochester from Sodus, Syracuse, Buffalo, Lockport, and other communities. Up to this time, those heavy trains had been running on the surface of trolley tracks, tying up city traffic and damaging the tracks designed for lighter street cars. By 1930, however, the various inter-urban trains had all but ceased operating because of competition from private automobiles, and the subway began to function as an intra-urban, mass transportation system in competition with the street cars and buses. The height of ridership and service on the subway came during WWII as gasoline for cars and buses became scarce. There had been talk prior to the war of abandoning the subway, but the boost in ridership with the war years kept the subway alive until 1956. In 1944, the subway carried about 3,500,000 passengers. It achieved its approximate design load of 5 million passengers in 1946 and 1947.[33]

While the subway continued into the 1950s, the main electrified form of transportation, the trolleys, gave way to rubber-tired, diesel-powered buses by the 1930s. The last trolley in Rochester finished service in 1941. The loss of this electrical demand was not felt by the utility company because homes and industries came to depend more and more on the local electrical service for a broad variety of tasks.

By 1904, all the electric companies in the city had been combined into the Rochester Gas and Electric Company (RG&E). Many independent companies in other parts of Monroe County and adjoining counties were also purchased or merged with RG&E. Exceptions were municipal companies in Fairport, Spencerport, and Churchville, which continue as independent operations today. It was during this period that RG&E assumed nearly all of the water rights to the Genesee River around Rochester.

By 1940, RG&E controlled over 98% of the river flow at the dam which fed into the Johnson and Seymour and the Rochester, Fitzhugh and Carroll races; over 96% of the river flow at the upper falls (Brown's race and the east side at Station #4), and 100% at the now combined middle and lower falls which fed through a tunnel into the station #5 at the site of the old Bois Building or Brush Electric Company.[34] The combined power from these sites was in excess of 64,000 hp, dramatically above the assumed maximum potential of just 30 years earlier


What went on inside a Grist Mill of 1850, as seen from a Millwright's sketch
a. MILLSTONES (2)
b. VALVE CONTROL
c. MAIN HOPPER
d. DRESSING DRUM
e. HOPPERS for GRADING
f. ELEVATOR
g. CARRIER & COOLER
h. SPUR-WHEEL DRIVE
The corn (cleaned) went in the Hopper and ended in
a Dressing cylinder (silk or screen)
Upper turning stone
Netherstone (fixed)
1. Flour
2. Seconds
3. Bran
This Conveyor was first leather with metal cups... later, a "Worm Conveyor"
"Evans elevator"

because of improvements in turbine technology. Overall electrical demand had burgeoned from a peak of 15,000 kilowatts in 1905 to a peak demand of 88,000 kilowatts in 1930. The total generating capacity of the RG&E system included almost 48,000 kilowatts of hydropower and 76,000 kilowatts of steam-generated electricity in 1930. To generate the steam, RG&E burned over 250,000 tons of coal. This was almost as much as the total amount of coal consumed by all of Rochester just 40 years earlier.[35]

Coal was crucial for many tasks in the city in addition to electrical generation. At RG&E's two gas works, known as West Station (located on the site of the present Beebee Station on the west side of the river near the Platt Street Bridge) and the East Station (at the site of the Citizen's Gas Company plant north of Bausch Drive), over 289,000 tons of coal and almost 3.4 million gallons of oil were converted into gas and 184,000 tons of coke.[36] Based on earlier and later records it is estimated that Kodak Park consumed about 140,000 tons of coal in 1930, and other Rochester industries were using another 100,000 tons. Coal provided about 75% of the energy consumed in Rochester in 1930.

Gas production by RG&E in 1930 was over 4.6 trillion cubic feet, but only a little of this was being used for home heating in 500 of the 68,000 homes in Rochester. By 1938, this number had more than tripled to 1800 homes, that consumed 20% of the gas produced. The majority of the gas was used for various appliances in the home such as cooking ranges and water heaters. RG&E had 850 miles of gas mains and over 90,000 gas service connections in Rochester and the surrounding communities.[37] Since little oil was being used in home heating until the 1950s and gas was used for heating in fewer than 3% of the homes, coal was still the predominant residential heating fuel.

The Edison Electric Illuminating Company plant on Exchange Street was the first utility to provide by-product steam from its electrical generating operations to neighboring buildings. This system was expanded as the several electric utility companies were consolidated. In 1892, steam for the downtown steam system was produced in a plant at Station #2 (near Brown's race hydropower station); in 1898 at Station #3 just north of Station #2; and in 1925 and 1927 at Stations #8 and #9 opposite one another on the east and west sides of the city respectively. In 1930, Rochester had the sixth largest steam distribution system in the United States. It was supplying the heat equivalent of

100,000 tons of coal to commercial buildings and some industries. For many large building owners, it was the cheapest source of heat. For RG&E, it offered a combined process of producing both electricity and steam that were saleable products so that the efficiency of the coal-to-energy conversion was optimized and the cost of both products was kept at a reasonable level.

By 1930, with the population surrounding Rochester slowly increasing and with service by RG&E spreading to the suburbs, estimates of the energy consumed by Rochesterians is based, in part, on their proportionate representation in the county's population. Energy followed people to the suburbs, through wires, pipelines, and automobile gasoline tanks. The move to the suburbs began in the late 1920s and peaked just after WWII. The cause and effect of this pattern is arguable and it may be that population-spreading could not have taken place without the energy technology to support it. Certainly, major manufacturing facilities were no longer tied to the river for their power, and the general population, by 1930, was no longer tied to trolley lines or a few major gas pipelines for their transportation and energy needs. The city's population of 320,000 accounted for 75% of the total population of 424,000. The increasing energy use over the 40-year period was coming primarily from the increased use of electricity and, since the introduction of the automobile, a drastically changed transportation system. The greatly expanded downtown steam system, the increased efficiency of the hydroelectric turbines on the Genesee River, and the almost universal use of coal in residential basement furnaces increased energy efficiency during this period of from 1890 to 1930. At the same time, though, houses were being built bigger and people were using gas and electricity produced from coal and transported long distances by pipe and wire, for cooking and heating which had been done more efficiently with coal in 1890.

Since 1930 significant energy consumption changes have evolved. The downtown steam heating system is nearly out of use. Gas pipelines are now filled with natural gas piped into the area from Texas and other distant states. It is not manufactured from coal. A significant portion of RG&E's electricity comes from a nuclear power plant. The trolleys and street cars have completely given way to cars and buses. The subway has disappeared. But, hydropower is still used for generating some of our energy. Coal and petroleum products such as gasoline, diesel fuel, and fuel oil, still contribute a major portion of

our energy supply although natural gas is almost as significant a contributor as petroleum products.

The RG&E centralized steam heating system has gone from a relatively efficient inexpensive way to heat buildings with coal to an expensive, oil-supplied source of steam. The transformation reflects the development of an environmental awareness and an attempt to make the air cleaner. Within the past few years, faced with ever increasing steam costs due to the rising cost of oil and the relatively modest cost of an on-site natural gas heating system, many RG&E steam customers unhooked from the system. This simply drove up the cost of the steam for the remaining customers, making it an uneconomical source of heat.

Until 1951, all of the gas in the RG&E lines was manufactured from coal just as it had been over a century earlier when gas first became available in Rochester. In 1951, however, RG&E began bringing natural gas into the area. Since this gas differed in heat content from that produced at the West Station plant, RG&E had to treat the natural gas in a catalytic cycle plant to make it compatible with the manufactured gas and the existing gas appliances in homes.[38] RG&E continued to supply a mixture of both natural and manufactured gas to its customers until the mid-1970s when the gas plants were finally retired and all the gas consumed in Rochester came from distant natural gas fields. Gas and fuel oil became the preferred home heating fuels. Coal dropped out of the market. As RG&E's electrical service grew, doubling every ten years from 1930 until 1975, the company supplemented what was primarily a hydropower generating system with coal, oil, and then uranium. RG&E was one of the earliest utility companies to build and operate a nuclear power plant. Construction on the Robert E. Ginna plant was begun in 1964 and the plant began generating electricity in 1969. It was only the 12th commercially operated nuclear power plant in the United States.

Not only did the technology, and the availability of the energy embodied in that technology make this population migration and expansion possible; but, once the new settlement patterns had been established by the 1960s the energy requirements increased dramatically as families purchased a second and sometimes a third car and had all the family vehicles on the road much of the time. The competition which these private vehicles gave to the public transportation system is reflected in ridership statistics. During a time of increasing popu-

lation, the bus system's annual ridership declined from 111 million passengers in 1948 to 67 million in 1951, to only about 25 million in 1980. Trolleys disappeared from Rochester by 1941. Buses surpassed trolleys as a form of intra-urban mass transportation as early as 1980, and the subway carried the county's commuters. In slight contrast with the movement of freight, the changing transportation pattern for the movement of people became more and then much less efficient. In a period of only 50 years, the efficiency declined from 5000 BTUs per passenger mile for a rail system to 3000 BTUs per passenger mile for an average bus system. It then increased to 8000 BTUs per passenger mile for the private automobile.[39]

There are other significant inefficiencies that crept into the energy patterns between 1930 and 1980 because, until 1973, our energy costs went down year by year. Most home appliances became less efficient as electricity costs dropped. Large, leaky and uninsulated homes became the standard because gas and oil were readily available and cheap. Industries barely paid any attention to the cost and use of energy since it did not play a significant role in profit margins. Much of this has changed since 1973 with the organization of oil-producing nations and we are now making appliances and cars that operate as efficiently as their smaller, less-streamlined counterparts did 30 years ago. Many in the county and city have rediscovered wood as a home heating source and a few have even rediscovered coal. The stoves and furnaces that burn these fuels are more efficient than their late 19th century predecessors.

In spite of regaining some of the lost energy efficiency, by the late 1980s we are careless in our use of energy. We have a greater mix of energy sources today although all sources, except uranium, were present in 1930.

By 1980 we have the highest per capita energy use since the very earliest days of Rochester when wood was being burned in large open fireplaces. Major contributors to our 1980 energy mix were: petroleum, 34%; gas, 31%; coal, 27%; and uranium, 7%. Hydropower from the Genesee River contributed less than one half of one percent to our energy needs.[40] Still hydropower was critical to the growth and development of early Rochester and other industrial cities of that technological period.

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Footnotes for Sources of Energy

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2. Lewis Henry Morgan, Dwight Porter, et al., "Water Power Documents in **Rochester Historical Society Publication Fund Series,** vol. 23, part II, Blake McKelvey, ed., Rochester, NY, 1946.
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11. William Peck, **Semi-centennial History of the City of Rochester,** 1884; quotes from **Rochester Daily Union,** August 18, 1852.
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16. **Rochester Daily Advertiser,** February 19, 1851, p. 2.
17. **Rochester Daily Democrat,** December 9, 1852, p. 2
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21. The exact figures for wood and coal usage in Rochester in the last decades of the 19th century are not available. To arrive at the estimates of 60,000 cords of wood and 300,000 tons of coal used in 1890, I have extrapolated from known or approximated usage figures (from 1865, **Union and Advertiser,** November, 4, 1865; from 1874, *Ibid.,* December 11, 1874, p. 2; from 1877 **The Industries of Rochester,** Elstner Publishing Co., Rochester, NY, 1888.
22. Robert Gustafson, "Gas Manufacture in Rochester, NY in 1880," personal communication, February 24, 1984.
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27. These notes are from the text of a display prepared in 1952 by J. Howard Cather, Superintendent, Power Division, Kodak Park, Rochester, NY.
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30. *Ibid.*

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35. **The RG&E 1930 Yearbook,** Rochester, NY 1931.

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37. **Gas Manufacture and Distribution, RG&E,** Flower City Press, Rochester, NY, 1938.

38. *op. cit.* Arthur P. Kelly.

39. Estimates for these energy efficiencies are from: C.A. Lave, Transportation Res. 14A, 321 (1980); R. Stobaugh and D. Yergin, **Energy Future,** Ballantine, NY, 1980; D.J. Kulash in **Urban Transportation: Perspectives and Prospects,** H.S. Levinson and R.A. Weant, ed., Eno Foundation for Transportation, Inc., Westport, CT, 1982, and E. Hirst, **Science 192,** 15 (1976).

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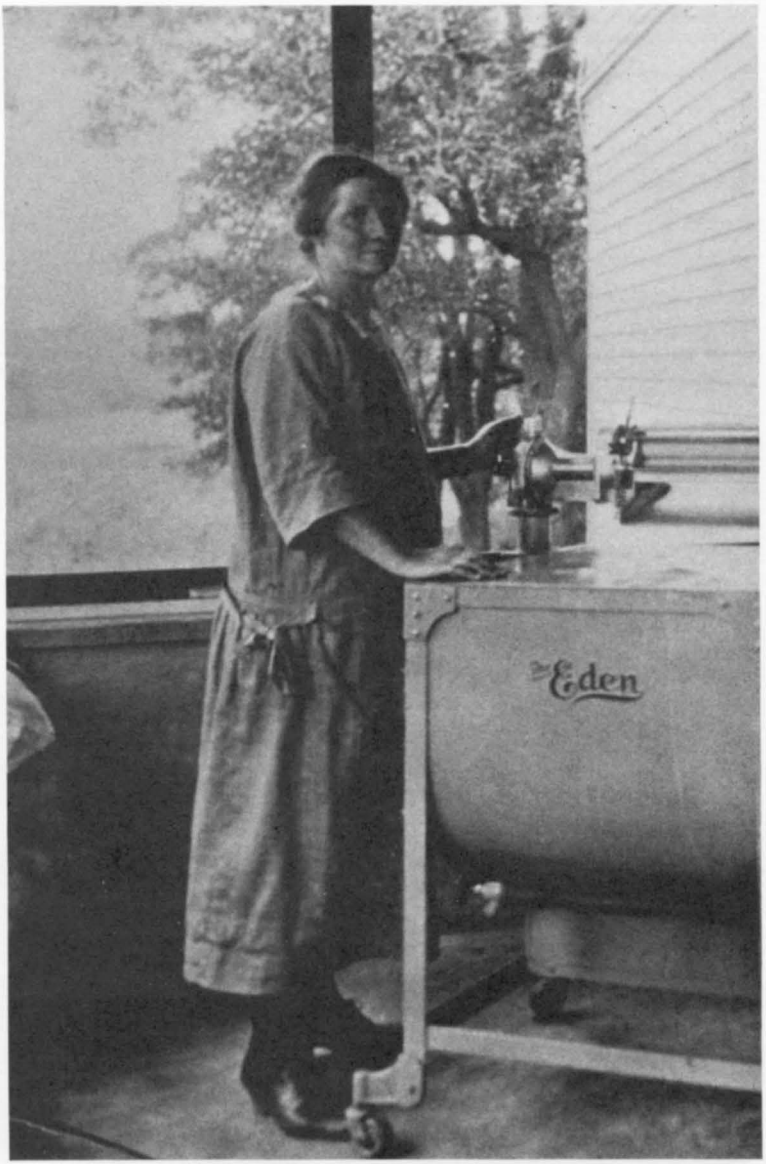
RG&E Home Service employees trained other women how to use gas and electric efficiently in their homes and encouraged the public to modernize their homes with these utilities. ***(Photo courtesy RG&E)***



Changes in technology and sources of energy allowed this rural woman to make use of electrical energy generated by the Genesee River miles away. ***(Photo courtesy of RG&E)***