



District Heating 6809

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The Philadelphia Steam Story . . . Approaching 90, and Still Going Strong

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Introduction and Background

The history of steam heating in Philadelphia can almost be viewed as a history of the city itself, starting in the late 19th century up to the present time. By the 1880's, industrial development, based on abundant coal, gas, and steam power, had catapulted Philadelphia into the leading industrial center of the U.S.A., second in population only to New York City. While life styles during the 18th century had remained virtually unchanged, the 19th century saw one amazing new industry after another created. Suddenly there were railroads, telephones, elevators, steam driven machinery, and now arc lights! What next?

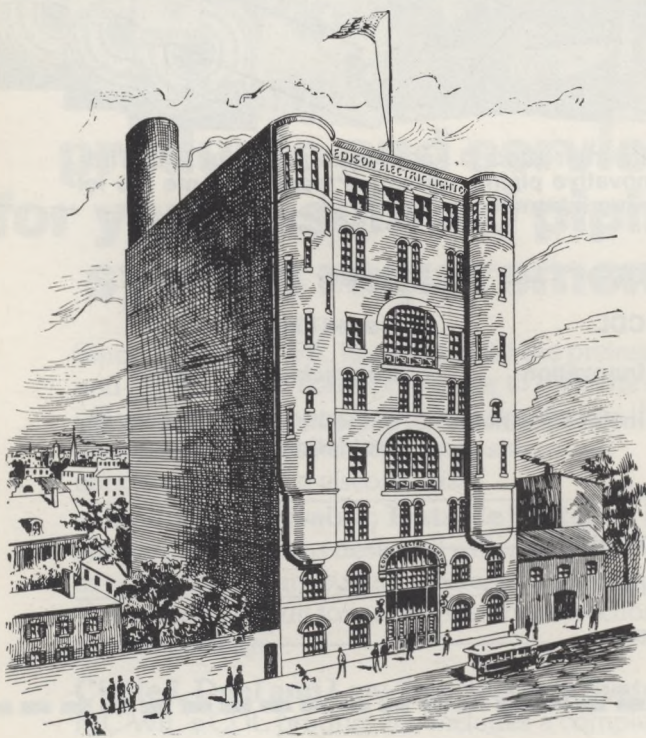


Fig. 1 - Philadelphia Edison electric light station.

Well, for one thing, "district heating," although it didn't cause too much excitement. Actually, 1877 marked the beginning of district heating in North America, a fact most of our readers are probably well aware of. No doubt much more will be said about it during the coming year, so suffice it to say that two residences, 500 ft (153 m) apart in Lockport, New York, were connected to one boiler by a pipeline . . . and another (not too amazing) new industry was born. Only ten years later, in 1887, district heating was started in Philadelphia, which probably makes Philadelphia Electric Company's steam business one of the oldest. Midst considerable controversy and vicious competition, the 20 or more electric systems (names such as Brush, Maxim, Edison, etc., which were common to all large cities of that era) were being consolidated; but in addition to overhead wires and mysterious underground explosions that sent manhole covers swirling into the air, the problem of disposal of so-called waste or exhaust steam was becoming acute.

Gaining a Foothold

A partial solution was found by extending a pipeline from the original Edison Station at 908 Sansom Street (Fig. 1) to an adjacent property. Later, a six-in. (152-mm) line was installed in the north footway of Sansom Street to supply the Company Office, then located on the northeast corner of 10th and Sansom Streets. Service extensions were taken off this main to several intervening properties. Oddly, during its first 20 years or so of existence, the heating company found itself constantly at the root of some "hot" arguments. Aside from cries of franchise infringements and debates over who owns what, there were accusations of damages. Usually the claims were that the steam lines were melting insulation and causing "shorts" and all manner of grief to the electric and telephone companies. Sound familiar?

Then in 1906, a contract was signed with Jefferson Hospital to supply their entire steam needs, and the

Philadelphia Electric Company found itself in the steam heating business to stay, 24 hours per day, 365 days per year. Steam service was extended to Gimbel Brother's Department Store in 1910, following an earlier agreement to provide them with electric service. This agreement required the Philadelphia Electric Company to operate the department store's on-site boilers. Another major extension was made from the Edison Station to Lit Brother's Department Store in 1921. Fig. 2 shows the distribution system as it existed in 1921.

The Tail of the Dog

Sadly, after some 34 years of life, steam heating had not proven profitable; and, with the boilers at Edison due to be condemned at any time, there was a strong temptation to get out of the bothersome steam business. However, it was rapidly becoming obvious that if the electric business was to grow by obtaining the electrical loads of major buildings, it would be necessary to also furnish them steam, because the customers' prime movers for power generation were steam engines whose exhaust steam supplied their heating systems which were operating below atmospheric pressure.

And so, as was the case in many large cities during the 1920's and 1930's, the development of the steam district heating system was literally dragged along by the burgeoning electric power industry. Never noted for being a profitable business, it none-the-less represented a moral obligation of the Company to continue steam service to its growing list of important customers. In the mid-1920's, rather than shut down the system, a landmark management decision was made to build up the steam business and make it pay. Interestingly, for the year 1975, the steam system revenue now equals 3.4% of the Philadelphia Electric Company total, while the steam plant investment is only 1.3% of the total utility plant.

A New Era

In 1927 the Willow Steam Plant was completed (Fig. 3). This installation was devoted to the generation of steam for district heating only and provided no electric generation. It contained three boilers each rated at 125 000 lb/h, 200 psig/430 F (56.75 t/h, 13.6 atm/221 C). Concurrently a new loop transmission system was begun. The first franchise covering the area east of Broad Street was obtained also in 1927. A second franchise was granted to the Philadelphia Steam Company in 1929 for the territory west of Broad Street. During the period from 1929 through 1932 several large transmission mains, ranging in size from 12 in. (304 mm) to 18 in. (457 mm) were installed. The transmission system as it existed in 1932 is shown in Fig. 4.

Growth and Development

An agreement was signed in 1934 to purchase steam from the former Pennsylvania Railroad which owned and operated a steam plant at its 30th Street passenger

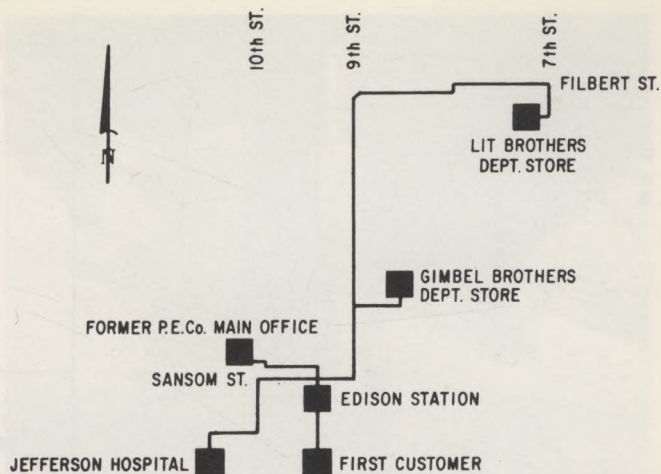


Fig. 2 - Steam distribution system in 1921.

station and coach yard. New customers were added west of the Schuylkill River and were served directly from this plant. In addition to the steam supplied to customers that were served directly from these railroad lines, steam was also purchased through an interconnection that was established between the railroad and the Philadelphia Steam Company systems at 18th and Cuthbert Streets.

The Second transmission loop was completed in 1948 with the installation of 14-in. (256-mm), 18-in. (457-mm), and 20-in. (508-mm) transmission mains. Also, in 1948, two additional boilers were installed in the Willow Steam Plant. These boilers were each rated at 170 000 lb/h, 180 psig/434 F (77.2 t/h, 12.2 atm/223 C). During the

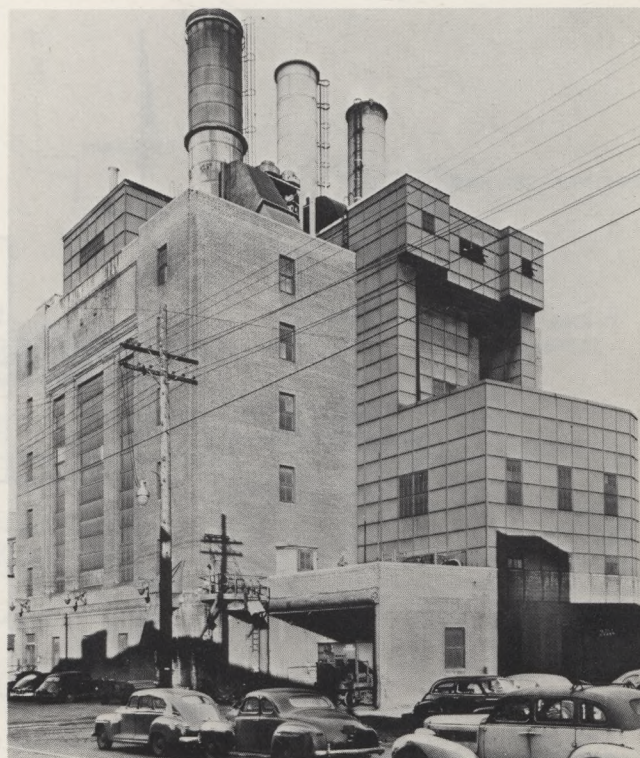


Fig. 3 - Willow steam plant.

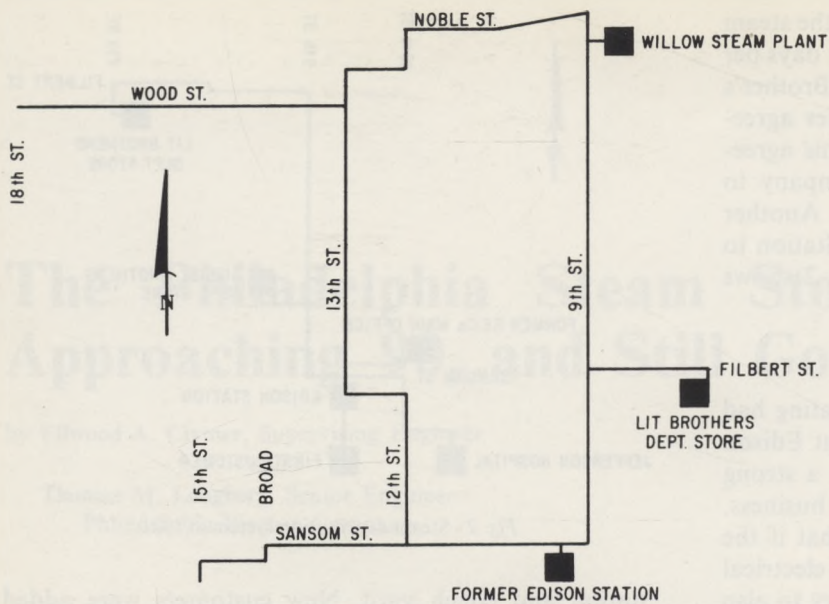


Fig. 4 - Steam distribution system in 1932.

1930's and early 1940's the Company leased three private plants to provide additional capacity for peak loads during the heating season.

In 1938 high-pressure boilers and a topping turbine were installed in Schuylkill Station. In subsequent years older low-pressure turbines, which used the exhaust steam from the topping turbine, were being used less and less. Hence, the Company found itself with an excess of 250-psig steam capacity. At this time it was decided to install a 24-in. (610-mm) line from Schuylkill Station to the center city loop transmission system. With the advent of this 24-in. (610-mm) line, Schuylkill

Station became the primary source of steam for district heating, due to its minimum cost. Fig. 5 shows the transmission system as it existed in 1950. It had by this time become of age, and was at last earning a profit.

The 1950 decade saw the introduction of steam into the buildings comprising the Penn Center development, the installation of a sixth boiler at Willow Station, the construction of a new Edison Steam Plant (Fig. 6) at the site of the former Edison Station at 908 Sansom Street, and the availability of bleed steam for district heating from a high-pressure turbine at Schuylkill Station. In 1951 the Philadelphia Steam Company was merged into

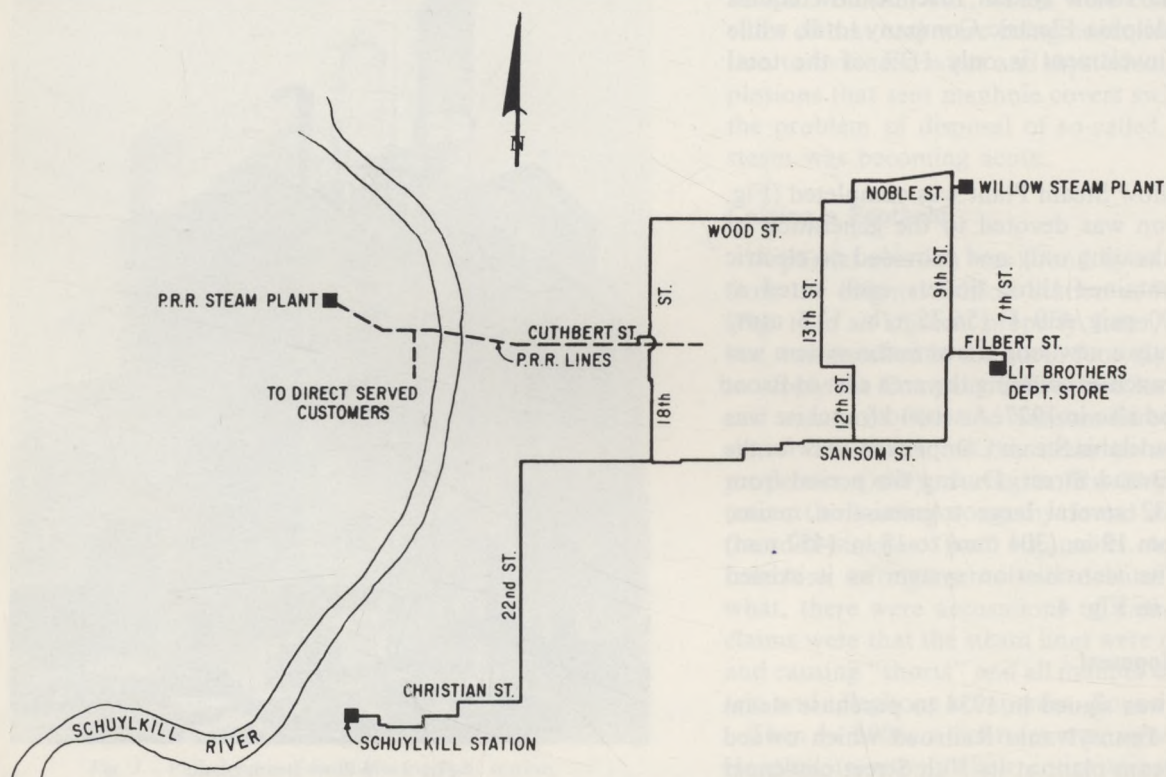


Fig. 5 - Steam distribution system in 1950.

The Philadelphia Electric Company. The last major installation in this booming decade was the 20-in. (508-mm) line to the University of Pennsylvania. This line required a river crossing, and it was installed inside a 1100-ft (335-m) long, 15-ft (4.6-m) diameter cable tunnel which lies some 50 ft (15-m) below the bed of the Schuylkill River.

In the 1960's, major extensions were made into specific City areas such as Independence Hall and Society Hill sections in the older part of the City, also the University City Science Center area in West Philadelphia. In 1968 our agreement with the former Pennsylvania Railroad was terminated, and the railroad's 30th Street plant shut down. At this time, we purchased and rehabilitated the two 18-in. (457-mm) lines in the railroad's steam chamber. These two steam lines extend more than one mile (16 km) eastward from the 30th Street plant to existing and former railroad properties in the center of the City. Two additional boilers were added to the Edison Steam Plant in 1968 and 1971

The steam generating capacity of Schuylkill Station was increased by 440 000 lb/h, (200 t/h) with the installation of two package-type boilers in 1968 and 1969. The capacity was again increased in 1975; however, this time the line capacity out of the station had to be increased, hence a new 24-in. (610-mm) line between the station and the center city transmission loops was placed in service in December, 1975. The present transmission system is shown in Fig. 7.

Improving Technology

The last 15 years have seen a constant effort to develop an improved conduit system, using new

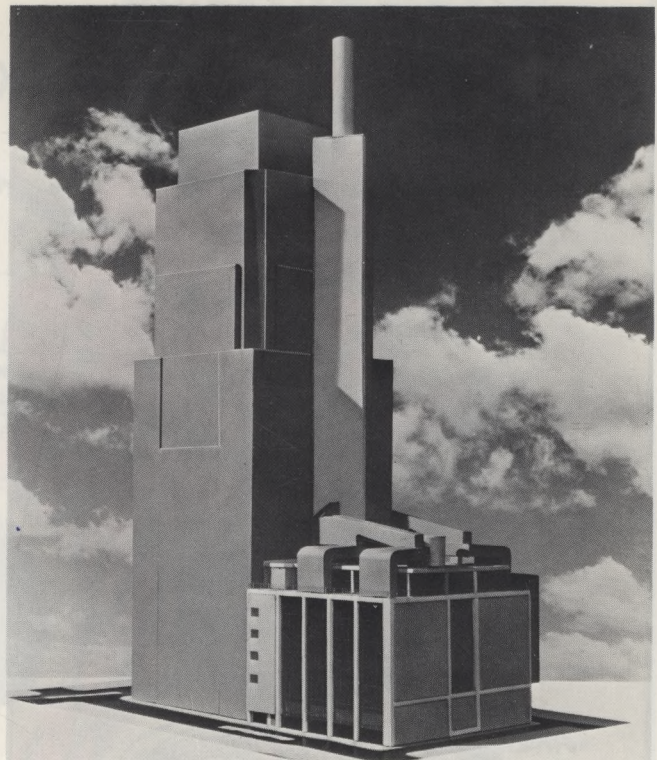


Fig. 6 - Model of Edison steam plant and adjacent office building.

materials and latest techniques in the construction field (see 1966 IDHA Proceedings). After years of using an analogue network analyzer, a digital computer model was employed some years ago and is now a primary tool for fast, accurate system planning. In 1975 the Philadelphia Electric Company's System Automatic Monitoring and Control (SAMAC) was used to gather data from the

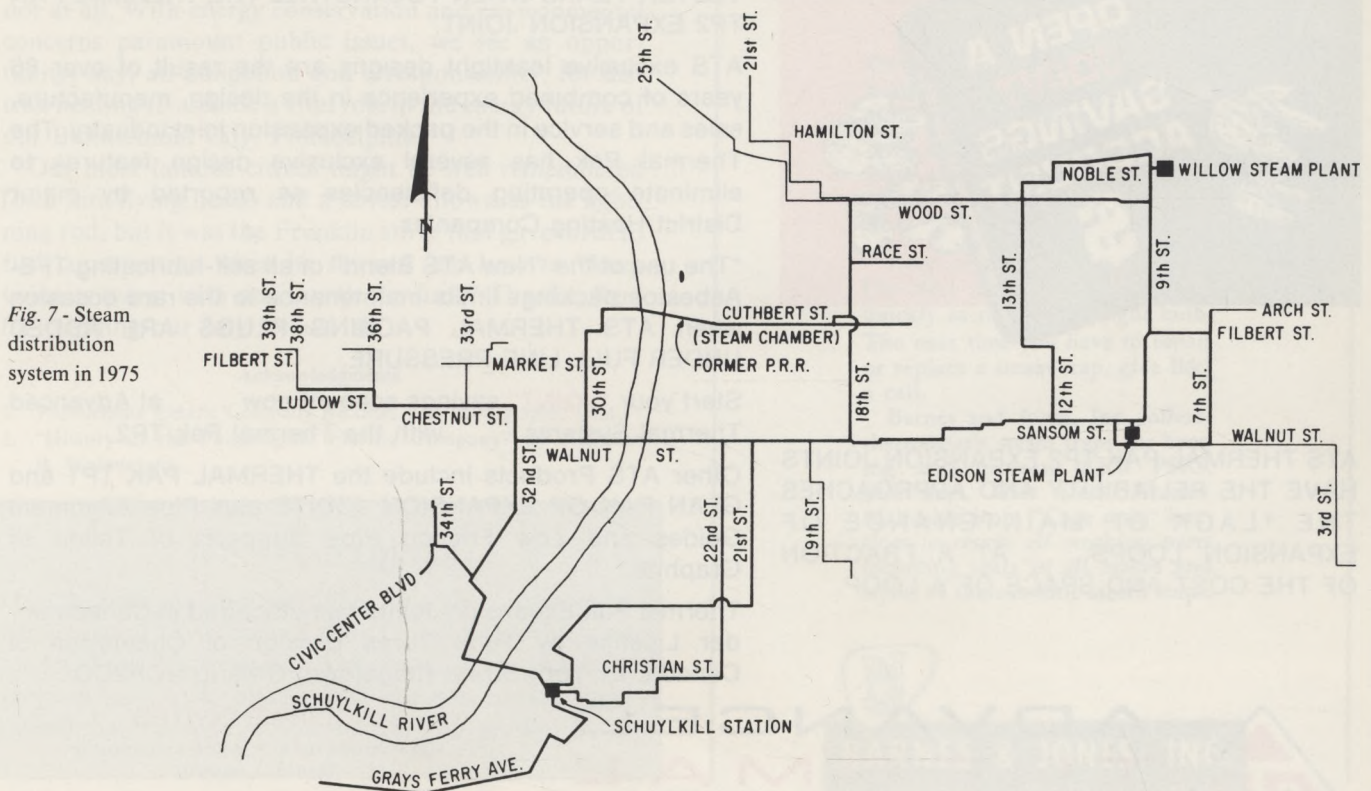


Fig. 7 - Steam distribution system in 1975

steam distribution system for a more efficient operation of the system (this was discussed in a paper at the 1975 Annual Meeting). Considerable time has been spent with the City of Philadelphia in recent years to develop a practical refuse/energy/steam project. Progress in this area will be reported on at the 1976 Annual Meeting.

Where We Are

Today our system is the second largest in the United States of America, as reported in our IDHA Statistics. We enjoy a good load factor due to considerable process and air conditioning load. Our combined steam/electric operations continue to yield good results, and our high-load density is an important advantage.

We are again encountering economic difficulties, this time due to rising fuel costs, high interest rates, a flattening of real estate developments, regulatory lag, and the entire host of problems that plague most utility businesses. Although representing a minor part of the Philadelphia Electric Company's overall business, there is just the same, an effort being made to keep the system profitable and viable. But competition is strong from the electrical business, particularly due to growing nuclear and hydro base. Yet, the same moral obligations recognized by the management of 1927, exist today and then some. But the business somehow has always overcome adversity, and that can probably be said of the whole industry, certainly in the United States at least.

Where Are We Going

The outlook for our district heating operation might even be stronger right now, than ever before in its almost 90 years of existence. Old, indeed; not sleepy, not at all. With energy conservation and environmental concerns paramount public issues, we see an opportunity, nay, an obligation and a responsibility, for district heating to assume a vital role in the energy future of our Bicentennial City, Philadelphia.

Our most famous citizen might be well remembered for a kite flying fiasco and a device known as the lightning rod, but it was the Franklin stove that gave birth to fuel conservation when he showed 'em how to "keep twice as warm with one-fourth the fuel." Thanks, Ben, for pointing our way for us! *

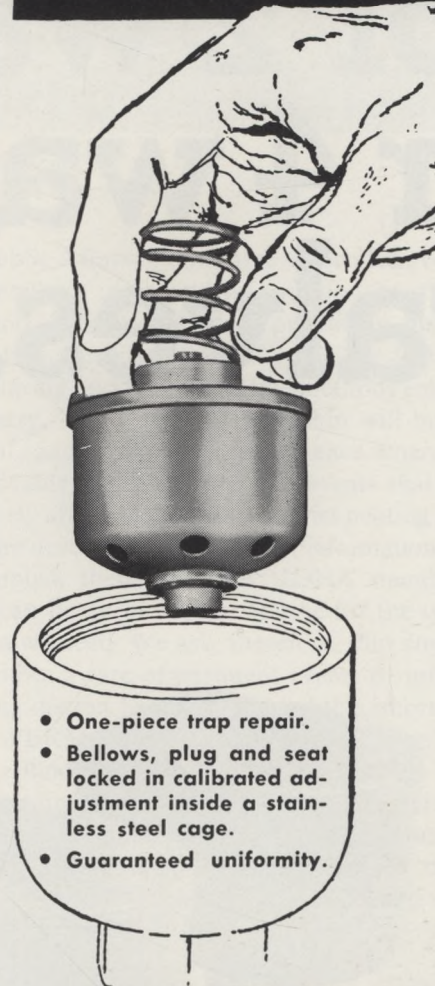
Acknowledgments

1. Philadelphia Electric Company Records, and Photographic Unit.
2. "History of the Philadelphia Electric Company" by Nicholas B. Wainwright.

1975 PROCEEDINGS

Due to some mailing difficulties this year, some members may not have received their Proceedings which was mailed from Pittsburgh in February. If you have not received your book, please notify the Association Headquarters and a copy will be sent to you promptly.

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