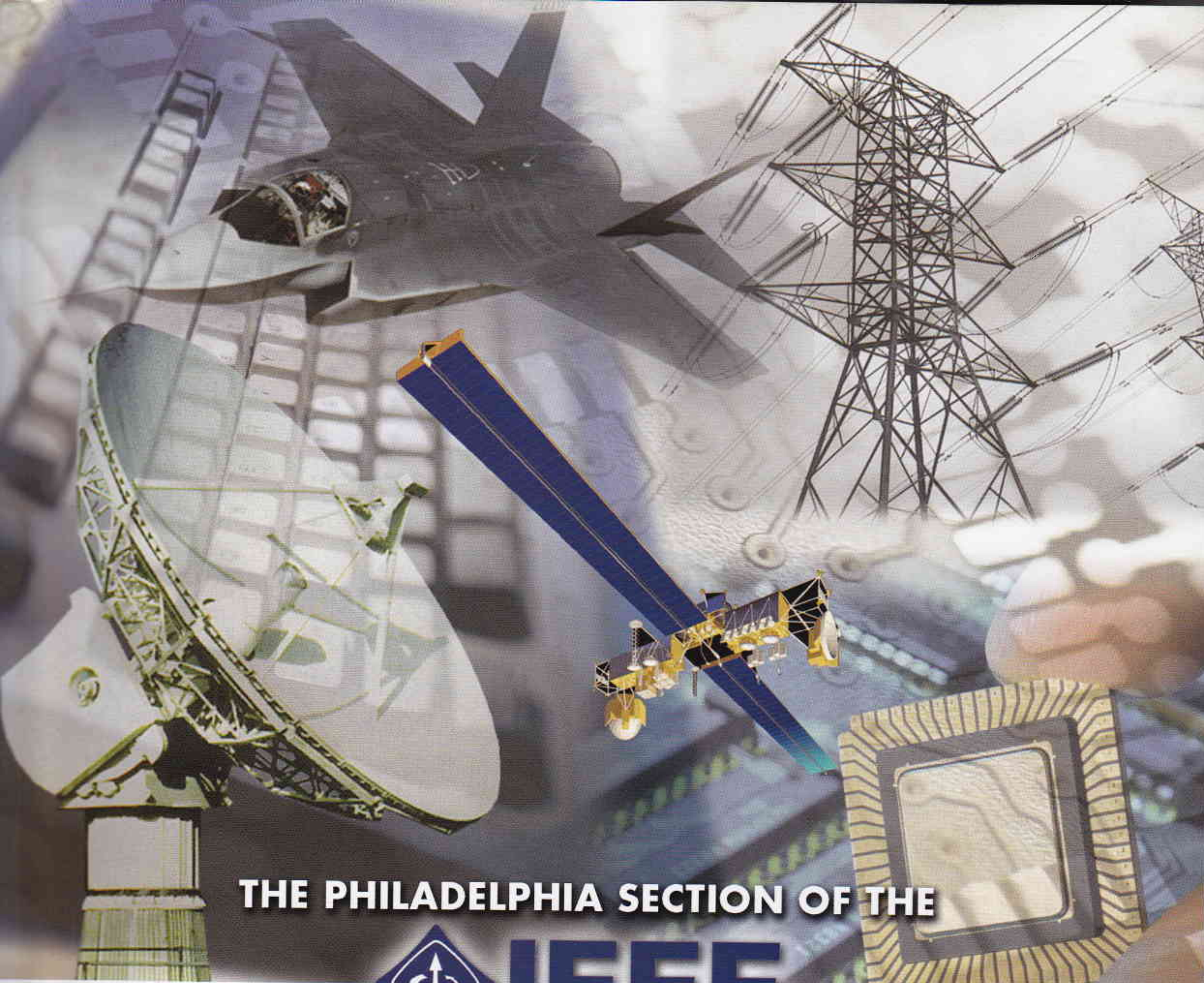


THE PHILADELPHIA SECTION OF THE

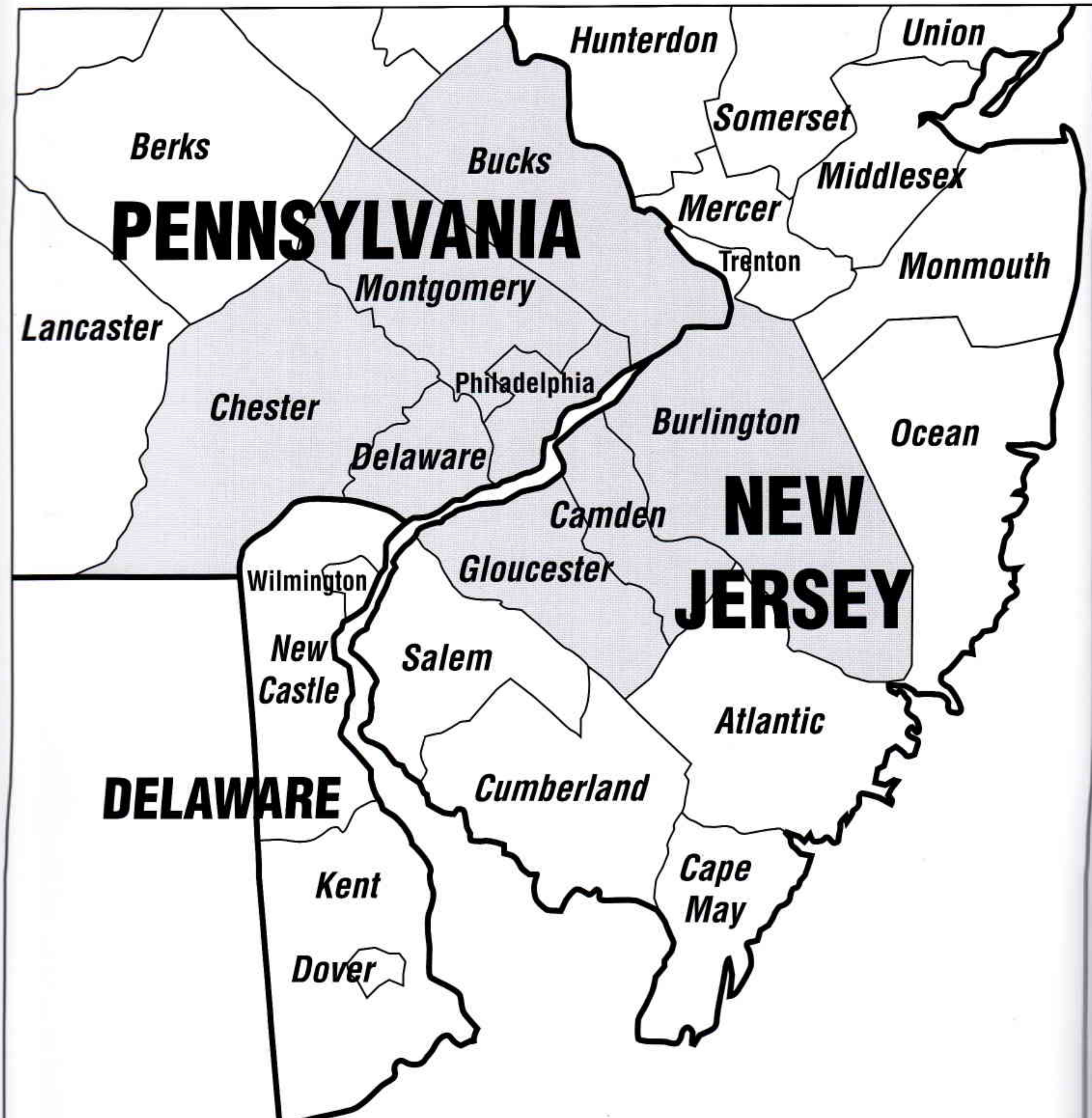
IEEE

The Institute of Electrical and Electronics Engineers, Inc.

100th Anniversary 1903 - 2003

The Development of the Electrical, Electronic and Computer Industries in the Delaware Valley in the Past 100 Years

PUBLISHED WITH THE GENEROUS SUPPORT OF L3 communications LOCKHEED MARTIN



The Philadelphia Section of the Institute of Electrical and Electronic Engineers, Inc.

The territory of the Section, approved by the IEEE Regional Activities Board, consists of Philadelphia, Montgomery, Delaware, Chester and Bucks Counties of Pennsylvania and Camden, Burlington and Gloucester Counties of New Jersey.

Total population served (as of the year 2000): 5,036,646

IEEE PHILADELPHIA 1903 2003

100 Years Remembered

IEEE in the Delaware Valley from 1903 to 2003

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TABLE OF CONTENTS

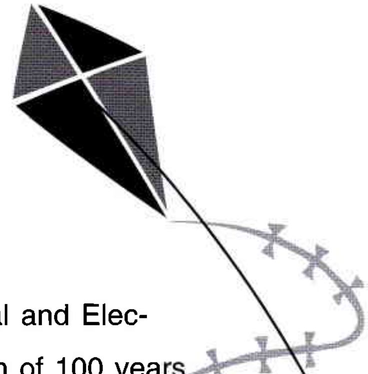
TABLE OF CONTENTS (CONTINUED)

ARTICLE DESCRIPTION **PAGE NUMBER**

TABLE OF CONTENTS (CONTINUED)

ARTICLE DESCRIPTION **PAGE NUMBER**

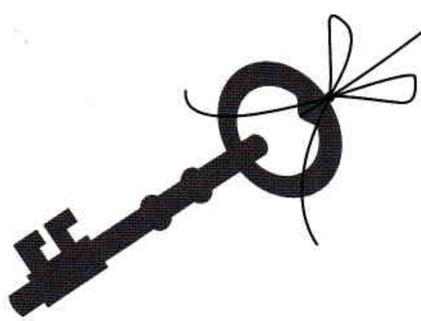
TABLE OF CONTENTS (CONTINUED)



FOREWORD

The Philadelphia Section of the Institute of Electrical and Electronic Engineers (IEEE) celebrated its incorporation of 100 years during 2003. The Philadelphia Section is part of a proud engineering tradition, starting with Benjamin Franklin, a founding father of our nation, who introduced electricity to Philadelphia in the 1740's with an electric machine. The machine was sent from England to the Library Company for Franklin and three associates to investigate electricity. This research was initiated during the winter of 1746-47. The results of the ingenious experiments and devices were described in letters sent back to England where, in 1751, the letters were collected as "Experiments and Observations on Electricity."

In 1752, Franklin conducted his famous kite and key in a thunderstorm experiment, which led to his invention of the practical lighting rod. Perhaps less known is his creation of such electrical terms as battery, conductor, positive, negative, armature and condenser. Benjamin Franklin could be considered the first Electrical Engineer in the colonies, and thus in the Nation. He also can be credited with initiating the proud heritage of the Electrical, Electronic, and Computer Industry in Philadelphia and the Delaware Valley.



IEEE AND THE PHILADELPHIA SECTION
— *Purpose And A Historical Sketch* —

The Institute of Electrical and Electronic Engineers, Inc. is the world's largest engineering society for men and women with a current membership of over 350,000 members. Electrical engineering began as an organized profession in the United States when the changes in our industrial, economic and social life, highlighted by the striking advances in electrical science, culminated in the International exhibition held in Philadelphia in the fall of 1884. On this occasion a small group of men met to set up an organization that was a forerunner of the present-day Institute of Electrical and Electronics Engineers, Inc. (IEEE). The organization was founded under the name of the American Institute of Electrical Engineers.

The Philadelphia Section (or Branch as it was then called) of the AIEE was organized in 1903. It held its first regular meeting at the engineers' club located at 1122 Girard Street with Carl Hering as president. Twenty-eight members and forty-five visitors were present. (Today the Section serves over 6000 members in the Delaware Valley).

As the electric power industry grew, so did the AIEE. However, on May 13, 1912, another branch of the electrical profession, the radio engineers, formed the Institute of Radio Engineers (IRE), which grew so rapidly its membership soon surpassed that of the AIEE. As early as 1922, the AIEE and IRE discussed the possibility of merging. No serious steps were taken until 1961. One year later, the membership of the organizations approved the merger which officially took place on January 1, 1963, under the new name of The Institute of Electrical and Electronics Engineers, Inc. (IEEE).

INTRODUCTION

A Review of the IEEE Philadelphia Section history is a review of the history of the Electrical, Electronic and Computer industry in the Delaware Valley.

The purpose of this publication is to give the reader an idea of the important role Electro-Technology has played in the development of the Delaware Valley Industrial heritage. The IEEE has provided an open forum for industry, academia, and government.

In 2003, during the Centennial Year of the IEEE Philadelphia Section, many of the projects, products, services and achievements that have taken place here in specific areas were reported in four issues of the Section News Letter, the ALMANACK: Electric Power Industry and Rail Transportation (March 2003); Consumer, Commercial & Industrial Products and Communications (June 2003); Computers and Instrumentation (September 2003); Defense and Aerospace (November/December 2003).

This material is included in this publication with some modifications and additions.

New in this publication is a brief history and purpose of the IEEE (The Institute of Electrical and Electronics, Engineers, Inc.) and the Philadelphia Section with a chronology of the available photographs, and a special events photo essay with many familiar faces and events of the Philadelphia Section. It is a scaled-down version of the twenty photo montage posters exhibited at the 100th Anniversary Awards Night of the IEEE Philadelphia Section, held on April 3, 2003, at the Union League.

The IEEE Philadelphia Section would like to express its gratitude to the numerous individuals, companies and institutions for contributing and supplying material for this undertaking. Many of them are listed at the end of this publication.

IEEE PHILADELPHIA SECTION

— The 2003 Centennial Committee —

The centennial committee was formed to record at least some of the many accomplishments for our 100 year anniversary. The committee members were:

Mr. Merrill Buckley Jr. (Chair)
RCA/GE (Retired), Past IEEE President

Mr. Donald C. Dunn
PECO (Retired), Past Section Chair

Mr. Thomas L. Fagan
Gestalt, LLC, Past Section Chair

Mr. Fulvio E. Oliveto
Lockheed Martin, 2004 Section Vice Chair

Mr. Kent Ringo
RCA/GE (Retired), Member Section Executive Committee

Dr. Victor Schutz
Temple University, Past Section Chair

Mr. Donald Schnorr
RCA/GE (Retired), Past Section Chapter Chair

The Development of the Electrical, Electronic and Computer Industries in the Delaware Valley from 1903 to 2003

I. Electric Power Industry in the Delaware Valley

Delaware Valley's electric power industry started in Philadelphia in the late 19th century when many small electric companies began supplying AC power at several different voltages and frequencies. The Philadelphia Electric Company (PECO) was formed from a citywide mandate to eliminate the confusion and inefficiencies. Since this beginning, the electric utility industry has evolved into three companies that serve the IEEE Section's area: PECO Energy (Exelon) in Pennsylvania, Conectiv and Public Service Electric and Gas Company (PSE&G) in New Jersey.

Before the 1960's, any new electric power capacity had to be fossil-fuel based and built along either the Delaware or Schuylkill rivers near population centers. However, the advent of 500 KV transmission freed the industry from this limitation. Examples are Keystone (1967-68) and Conemaugh (1970-71) Mine Mouth generating plants and the Peach Bottom (1974) nuclear generation units, all remote from population centers.

ELECTRIC POWER UTILITIES

PJM (PA, NJ, MD) Interconnection – A Partnership of Excellence

The advantages of interconnecting electric power systems are derived from the diversity introduced in system loading, timing of forced outages and requirements for reserve capacity. Less generation equipment is required and diversity offers economies of scale in the distribution of electric energy.

The original PA-NJ interconnection agreement was signed by PSE&G and PECO. With this 1927 agreement, 210 miles of new 230 KV transmission lines were installed. An integrated management operated the interconnection and the savings were equally split. These savings more than offset the cost of the new transmission.

The pool was expanded to five members in 1956 with the inclusion of Baltimore Gas and Electric Company and General Public Utilities Corporation (GPU). GPU includes the following operating companies: Pennsylvania Electric Company, Metropolitan Edison Company, New Jersey Power and Light Company, and Jersey Central Power and Light Company.

In giant steps, the PJM system was permanently connected in 1962 to the Canada, United States Eastern (CASUSE) Interconnect and to the Interconnected Systems Group (ISG), thereby combining most of the United States and Ontario Hydro from the Atlantic Ocean to the Rocky Mountains. Also, in 1962, PJM installed its first automatic generation control analog computer. During the late 1960's and early 1970's, large-scale digital computers were installed.

In 1986, PJM included 11 investor–owned utility systems in Pennsylvania, New Jersey, Maryland, Delaware, Virginia, and Washington, D.C., serving 7.5 million customers and a population of 21 million. Included as part of PJM are generating unities of several municipal and industrial systems.

By 2004, four large transmission systems will be added to the PJM, more than doubling the generation and people served. The PJM system is the largest control area in North America and is noted nationally for concept, design and operational excellence.

Susquehanna River Hydro-Electric Project – The Conowingo Dam

In 1921, PECO initiated a study to build a hydro-electric dam across the Susquehanna River, in Conowingo, MD. Construction began in March 1926 and was completed in 1928. The initial rating of 252 MW has grown to 512 MW. The concrete dam impounds 150 billion gallons of water and is 4,648 feet long and 96 feet above a solid rock foundation. At that time, this hydro-electric project was second in size only to the Niagara project.

Two 60-mile long 230 KV lines were constructed to a new Plymouth Meeting substation outside of Philadelphia. Two other 230 KV lines were constructed from the Plymouth Meeting substation, one to PP&L and the other to PSE&G. As a result, the Plymouth Meeting substation became the largest transmission substation in the world.

— Continued on Page 2

Eddystone Station – Fossil Fuel

A supercritical P-T system went commercial in 1960 when both of Eddystone station's first two fossil-fueled generating units were constructed for supercritical pressures (P) and temperatures (T). Unit 1 was built to set a new industry generation efficiency standard. In supercritical high P-T, water does not boil but passes directly into a gaseous state. This gas (steam) is superheated and thus increases efficiency, providing more kilowatt-hours per unit of fuel.

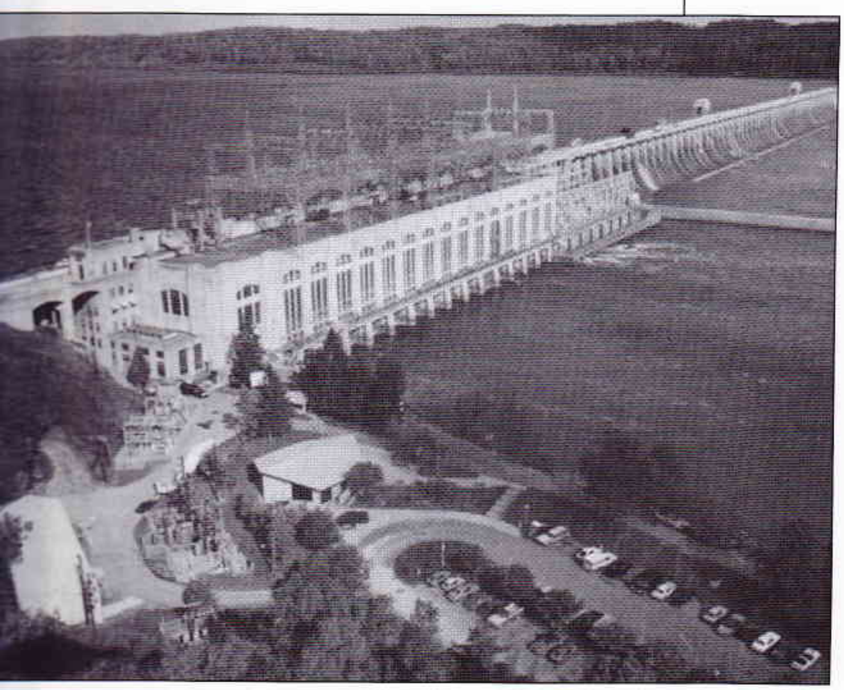
After establishing a fuel rate of approximately 0.6 pounds of coal per Kwhr, Unit 1 was reduced from operating at supercritical because of P-T metallurgical problems. The turbine and boiler suppliers were Westinghouse and Combustion Engineering, respectively.

In 1960, Eddystone was PECO's largest power plant with a project cost of $162 million for the station and $30.5 million for substations and approximately 100 miles of transmission lines. Units 3 and 4 became commercial in 1974 and 1976, respectively.

Keystone Project – Mine Mouth Generation

During 1967-68, over 600 miles of 500 KV transmission lines were constructed within four eastern states to provide for the Keystone and subsequently for the Conemaugh Mine-Mouth generation projects. The Keystone generating station was constructed at the mouth of a coal mine near Johnstown, Pennsylvania, by PECO Energy, PP&L, and Jersey Central Power and Light Company. Its 1700 MW of generation (two units) was supplied to over 30 million people via the 500 KV lines. The $350 million cost was shared by 10 electric utilities. The 500 KV transmission was a commercial first and the voltage level was the nations highest at the time. The Conemaugh station, almost identical to Keystone, was placed in commercial service during 1970-71.

Eddystone Station



e Conowingo Dam

Muddy Run Creek Project – Hydro-Electric Pump Storage

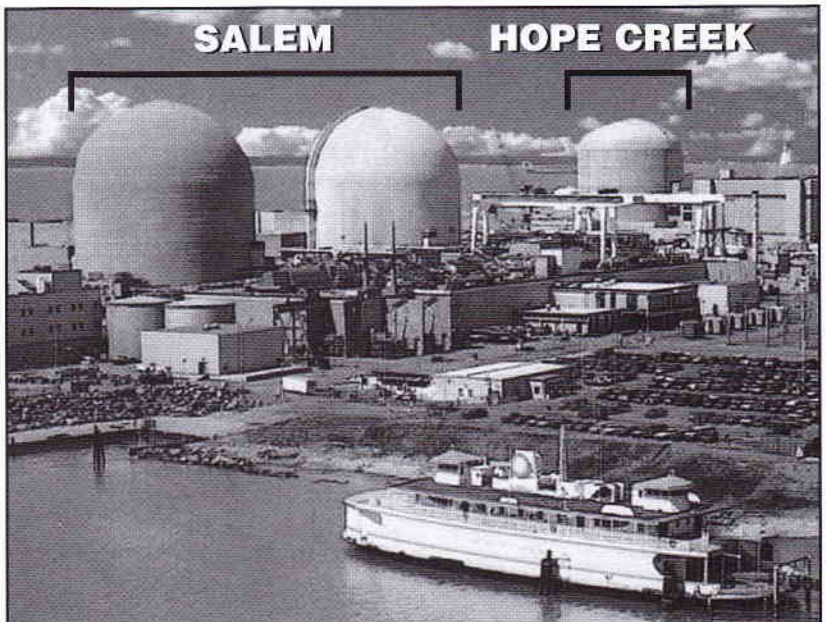
During 1967-68, PECO placed a unique pump storage hydroelectric system in operation. Located on Muddy Run Creek adjacent to the Conowingo Dam reservoir, a dam-reservoir and a 1040 MW generator-turbine system more fully utilized Susquehanna River water to generate electricity. The eight 130 MW generator-turbines can be used either as pumps, during low-cost generation periods to fill the Muddy Run reservoir, or as generators during periods when generation costs are higher, to provide low-cost electricity. Two 230 KV lines connect Muddy Run to the Peach Bottom substation.

PECO Power Control Center – SAMAC

In 1969, the decision was made to install a new digital power control system center at PECO corporate headquarters. This digital system was named SAMAC for system automatic monitoring and control. Similar to the analog control system center before it, its purpose was to keep loads and generation automatically in balance and to communicate with the PJM.

SAMAC monitors the transmission system and develops a strategy for responding to the loss of equipment or transmission line that would cause a system overload. This contingency aid was not possible with the analog system.

For operator convenience, multicolor graphic cathode ray tubes display dynamic graphics and tabular data to aid in determining where and in what magnitude problems exist. SAMAC was replaced in 1993-94 with more modern technology using state-estimating methods, large rear-projection screens and PC monitors to display the transmission system at operator consoles for application programs.



Salem and Hope Creek Power Plants

Nuclear Generation – Four Plants

Nuclear generation has been very attractive to electric utilities because of lower fuel, operation, and maintenance costs and minimal air emissions. In addition, with 500 KV transmission systems, plant locations can be relatively remote from population centers, thus minimizing NRC licensing difficulties. The table on the right identifies nuclear power plants that directly supply the Delaware Valley.

During construction of Limerick 1, a reactor accident occurred at PP&L's Three Mile Island Nuclear Plant near Harrisburg, PA. This resulted in NRC-mandated design changes, including the safe shutdown systems for both Limerick units. These changes significantly increased Limerick's construction costs.

No additional base generation units are being planned by Delaware Valley utilities at this time.

Note that Peach Bottom 1 was an experimental 40 MW helium-cooled nuclear unit. Due to its high operating cost, it was removed from service.

	Peach Bottom	Salem	Hope Creek	Limerick
Location →	Susquehanna River	Delaware Bay	Delaware Bay	Schuylkill River
Units	2 & 3	1 & 2	1	1 & 2
Commercial Operation (year)	Both 1974 2/5/74–12/23/74	1977&1981	1986	1986 & 1981 2/1/86–1/1/91
Rating (Nameplate) MVA per Unit	1231	1130	1067	1231
Reactor Type	BWR	PWR	BWR	BWR
Vendor	GE	Westinghouse	GE	GE
Contractor	Bechtel	UE&C	Bechtel	Bechtel
Owner(s)	Exelon and PSE&G	PSE&G (58%) Exelon (42%)	PSE&G Power	Exelon
Operator	Exelon	PSE&G Power	PSE&G Power	Exelon

THE EVOLUTION OF REAL TIME CONTROL APPLICATION TO POWER SYSTEMS

Throughout the history of the power industry, dependable, real time automatic control for safe, reliable, responsive operation has been a necessary element of power system installations. That

— *Continued on Page 4*

was true at Thomas Edison's first central generating station at the Pearl Street Station in New York, which was placed into operation on Sept. 4, 1882, and generally regarded as marking the founding of the electric power industry. Each of the station's six 100 KW generators was equipped with speed governors.

Speed governors are still required. Such governors throughout the system, together with other controls, are required to reallocate generation changes in order to satisfy individual interconnected area responsibilities and objectives.

Two of the major parameters involved in power systems control are system frequency and megawatt load, the latter applying either to generators or transmission tie lines, or both. Apparatus for making such measurements prior to 1924 was of limited flexibility or precision, or of inadequate applicability to control systems, or far too costly.

Two developments filled the measurement voids for power systems applications and were major factors in stimulating the early work in power systems real time control:

1. The self-balancing potentiometer high torque servo recorder, invented by Leeds (1912).
2. The adaptation of the Leeds self-balancing recorder to a self-balancing AC Wien bridge frequency recorder by Wunsch of Leeds & Northrup (1925).

Conventional practice in power systems operations had been to depend on generator governors to respond to system load changes and to utilize manual adjustments of governor settings on one or more machines to achieve desired distribution of generation between alternative sources. An early central dispatching installation to facilitate such operation was the Philadelphia Electric Company. Recorders showing the generation at each of their four stations, the total system generation and the first Wunsch recorder showing the system frequency were provided at the dispatching center. A transmitting potentiometer slidewire, attached to each station's recorder, transmitted station output by telephone line to a recorder at the central office.

In 1961, the Pennsylvania-New Jersey-Maryland (PJM) 12-company system planned to establish permanent ties north to the New York, New England, and Canada systems and west to the Interconnected Systems Group.

As a result of additional ties it was necessary to install automatic area controls which would utilize the by then well developed frequency based technique for inter-area bulk power transfers. In addition, it was desired to supplement such control with a system that would closely emulate, automatically, the previous manually notifying operating companies of incremental power costs.

The system preformed well over the years. Though now replaced with digital equipment, it has been retained for standby use at the PJM Valley Forge Control Center.

ALTERNATE SOURCES – COGENS AND IPPs

Non-utility owned cogeneration and Independent Power Producer (IPP) generation was encouraged during the 1980s by state legislation requiring such electricity to be purchased by electric utilities. Initially New Jersey's laws required a premium for this outside generation, but subsequently the premium was rescinded. Typical cogeneration sources are refinery plants, using waste gas and natural gas as fuel, and trash-to-steam plants. PECO Energy estimates its system cogeneration at approximately 5%. The Marcus Hook (PA) Sunoco Refinery 760 MW (3 units) cogeneration plant is an example of a large refinery cogen project. After completion in 2004, its excess electricity will be sold through PECO Energy's transmission system. Stone and Webster is providing project engineering and management. An older cogen facility on PECO Energy's system is a 150 MW Philadelphia Thermal plant in Schuylkill station that supplies both electricity and steam.

Conectiv lists trash-to-steam generation at 6.8% of its 2002 energy sources. Despite utilities having little control over electric availability or magnitude, cogens and IPPs can provide additional capacity and thus delay future base-generation construction.

ELECTRIC UTILITY EQUIPMENT SUPPLIERS

Delaware Valley's electric utility equipment suppliers are nationally known innovators and manufacturers of generation, transmission and distribution equipment.

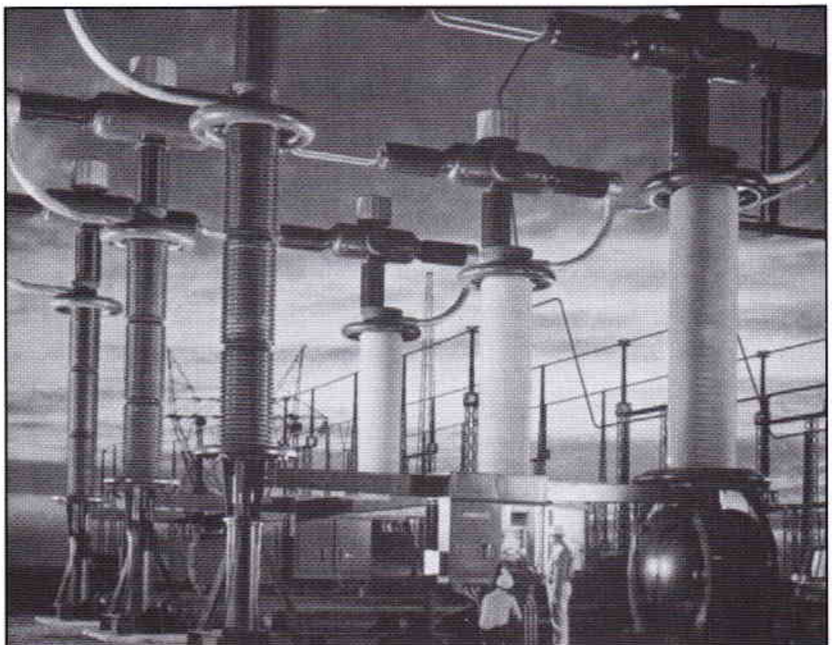
This section describes such suppliers with references to product firsts:

GE – A Switchgear Giant

For over 77 years, GE's Philadelphia area headquarters has been the center of its electric power system design, marketing, and manufacturing of protection and controls equipment supplied worldwide. Its testing facilities include the Skeats High Voltage Lab near the Philadelphia International Airport.

GE's comprehensive line of unique products includes:

- High voltage circuit breakers (Air Blast & EHV oil filled).
- Vacuum type circuit breakers.
- Switchgear equipment for low and medium voltages.
- Miscellaneous power generation support products.
- Protection relays.
- Solid state converter applications.
- Control, using microprocessors, for automation of customer loads: e.g., water heater, air conditioning, substations, etc.



General Electric Air-Blast power circuit breakers.

Honeywell Process Control Division

Honeywell's Process Control division primarily produces instruments for measuring, recording, and controlling manufacturing processes. Its roots date back to an 1859 portable pyrometer invention that measured iron expansion in industrial furnaces. In 1965 the Division was consolidated in Fort Washington and the facility was, at that time, the largest in the world employing more than 2,500 people. Division technological breakthroughs include:

- First digital computer designed specifically for process control.
- A digital control programmer.
- A microprocessor-based control system for any system size and complexity.

The Division's products and services extend throughout the world.

ITE Power Equipment – Brown Boveri Electric, Inc.

With a corporate history dating back to 1888, ITE (Inverse Time Element) was a major supplier of circuit breakers and switchgear. Based in Philadelphia, ITE was a principal supplier for the Boulder Dam project and for US Navy ships during World War II.

ITE's innovative firsts were many, including:

- 1890 – First air circuit breakers.
- 1926 – First vertical compartment circuit breakers.
- 1934 – First segregated phase metal-enclosed bus duct (installed at Boulder Dam).
- 1958 – Kline low-voltage power circuit breaker.
- 1960s – SF_6 gas insulated (cable) system.
- 1960s – 500 KV, 1800 BIL vertical break-switch.

ITE was purchased in 1980 by Brown Boveri and Co., and in 1982 by Gould, Inc. who renamed it Systems Protection Division (SPD).

Leeds and Northrup Company – General Signal Corporation

Leeds and Northrup (L&N) expertise and equipment have played a major role in the development of control applications for electric power systems throughout the world. Incorporated in 1903, the company's history actually started in 1899 when Morris E. Leeds began building laboratory-type electrical measuring instruments. World Firsts include:

- 1912 – First successful, automatically-balanced industrial recorder.
- 1932 – First high-speed electronic recorder.
- 1942 – First centralized load-dispatching system for power plants

— Continued on Page 6

Modern Utility Control Room with L&N Systems Equipment

1958 – "Temtip" expendable immersion thermocouple for measuring molten metal temperatures.

1977 – First combination pH electrode for accuracy and reliable lab or plant performance.

1982 – First domestic optical electrical highway.

L&N's world headquarters is in North Wales, Pennsylvania. In 1978 it merged with General Signal Corporation of Stamford, Connecticut.

Westinghouse Steam Turbine Division – Lester, Pennsylvania

Westinghouse Steam Turbine Division's Lester plant began about 1927 and subsequently became a major supplier of turbines for utility power plants until the 1980's. During the 1950's and 60's, the Lester plant manufactured as many as 40% of the U.S. steam turbines, second only to GE. Also, during that period, the Lester plant had as many as 20,000 employees. In the Delaware Valley, Westinghouse steam turbines were supplied to such base load plants as Eddystone (two 340 MW units) and Salem (two 1130 MW units). Also, the Division provided the turbine-generation for the 40 MW, helium-cooled experimental nuclear unit, Peach Bottom 1. During the 1970's, parts of the Steam Turbine Division were moved to Charlotte and Winston Salem, NC.

During the 1980's, and after acquiring CBS, Westinghouse sold the Division to Seimens. Subsequently the 60-year old Lester plant was closed.

CONTRACTORS AND CONSTRUCTION COMPANIES

Stone & Webster – A Shaw Group Company

Stone & Webster is one of the foremost engineering and construction organizations in the world. Originally founded in 1889 as an electrical testing laboratory and consulting firm, Stone & Webster grew to become a network of companies employing more than 6,000 people worldwide.

Stone & Webster has had a continuing presence in the Delaware Valley since 1972. For most of that time, the local offices have been located in Cherry Hill, NJ.

Stone & Webster provided significant engineering and design services to the fossil and nuclear generating stations in the Delaware Valley including Salem, Hope Creek, Limerick, Eddystone, Cromby and Deepwater.

Recent projects of interest in the Delaware Valley include:

- Richmond Station Static Frequency Converter Facility (11 KV, 25 Hz supply to Amtrak).
- Boiler upgrade project at the Coastal Eagle Point Refinery.
- Marcus Hook Cogeneration Facility (fueled either by natural or refinery gas).

Shaw, the parent company, is headquartered in Baton Rouge, Louisiana, and currently has offices and operations in North America, South America, Europe, the Middle East, and Asia-Pacific. Worldwide, the Company employs more than 20,000 people. Additional regional and project offices are located throughout the United States.

United Engineers and Construction – Raytheon Division

United Engineers and Construction (UE&C) has had an illustrious history since its 1928 founding from the merger of four internationally known engineering and construction firms. Headquartered in Philadelphia, its projects included many Philadelphia landmarks such as 30th Street Station and the Franklin Institute. UE&C expertise extends internationally into the steel, chemical and manufacturing industries and includes projects in public transportation, hospitals, aerospace research, and electric utility facilities. In the Delaware Valley, UE&C designed and constructed power plants, substations and transmission lines. A 1931 example of a PE Company power plant project is the now retired $6.1 million Richmond Generating Station.

RAIL TRANSPORTATION IN THE DELAWARE VALLEY

History of SEPTA

ELECTRIC TROLLEY CARS, introduced in Philadelphia in 1892, reached their apex in 1911 when 4,000 streetcars operated on 86 routes. SEPTA's City Transit division owns and operates 141 trolleys on 12 routes running over 194 track miles throughout the city. The newest trolleys, Light Rail Vehicles (LRVs), put in operation in 1982 have air conditioning, acceleration controls, air suspension and public address systems.

SUBWAY ELEVATED LINES on Market Street opened between 69th and 15th Street in 1907, and extended to 2nd Street in 1908. The original line operated as an elevated between 69th Street and the eastern bank of the Schuylkill River and as a subway east of the river. The subway tunnel was extended from 23rd Street westward to 40th Street in 1955. The Frankford elevated Line was constructed by the City of Philadelphia and opened for service in 1922. This addition provided uninterrupted service between 69th Street and the Bridge Street Terminal.

BROAD STREET SUBWAY opened for service in 1928 extending from Olney Avenue to City Hall. In 1930 the subway extended to South Street, and in 1938 to Snyder Avenue. Northern service was extended to the Fern Rock Terminal (10th and Nedro Streets) in 1956. In 1973 the subway was extended south to Pattison Avenue. The Ridge Avenue Subway Spur was opened in 1932.

TRACKLESS TROLLEYS were introduced to Philadelphia on October 24, 1923, along Oregon Ave. Today SEPTA operates 110 trackless trolleys over five routes, covering 42 miles within the city.

SUBURBAN LINES opened in stages between 1906 and 1917. One of the country's few remaining inter/urban trolley systems, the Media and Sharon Hill Lines, link Upper Darby's 69th Street Terminal and the Delaware Country towns of Media and Sharon Hill.

Railroad Electrification

The New Haven (now a section of Amtrak's Northeast Corridor) was the world's first AC electrified railroad, installing an autotransformer 11 KV, 25 Hz electric traction system, which the Japanese National Railroad adopted many years later, using 50/80 Hz at higher voltages.

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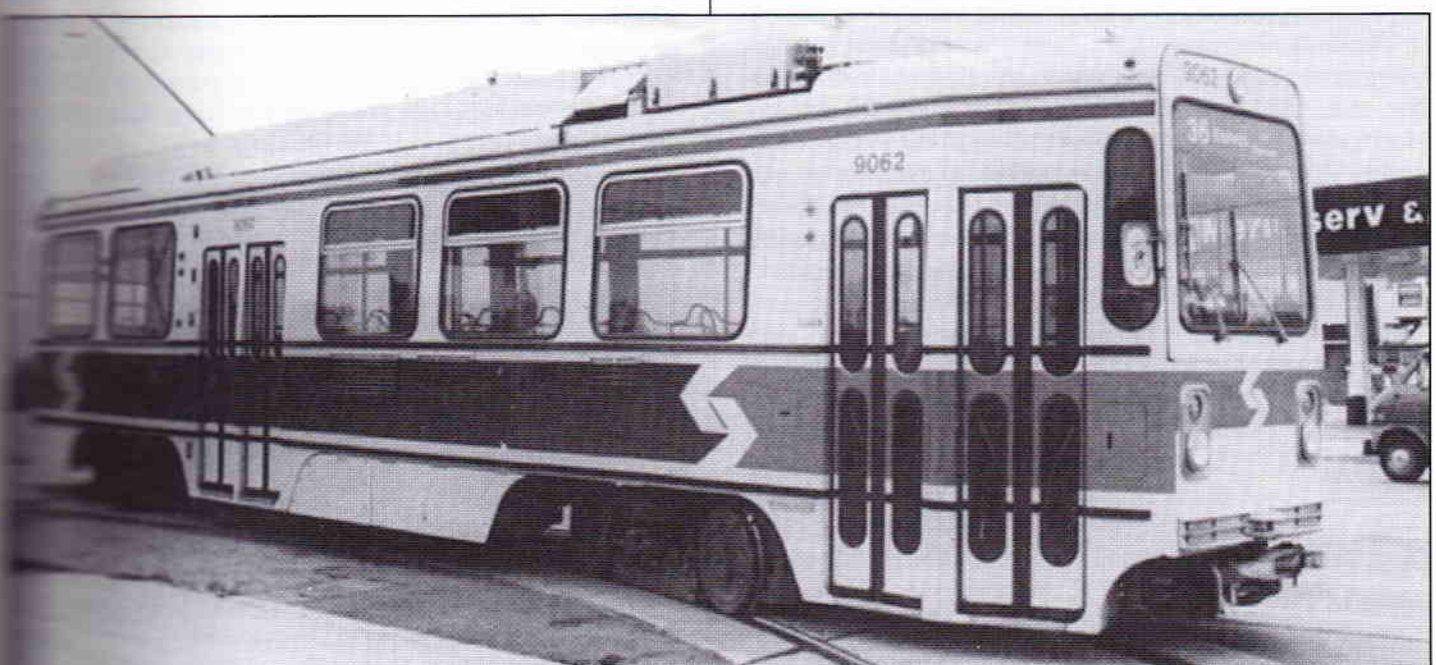


SEPTA's Light Rail Vehicle

— Continued from Page 7

The pioneer electrification in the U.S. was installed before the turn of the century by the B&O and the Pennsylvania Railroad (PRR) in 1895, followed by a Camden to Atlantic City run in 1906.

In 1915, the PRR completed its overhead 12.5 KV electrification between Philadelphia and Paoli on its suburban commuter service and later in 1931 this 25 Hz system was made continuous to New York.

The PRR continued expansion of its electrification with the 1935 electrification extension southward to Washington, DC. The final stage from Paoli, PA and Perryville, MD to Harrisburg, PA was completed in 1938. This final electrification included wiring railroad distribution and storage yards at Washington Potomic Yard and Ivy City, along with Harrisburg-Enola and Sunnyside Yard. The total electrification was 656 route miles and 2,350 track miles.

During the early days of railroad electrification there were no utility company interconnections by high voltage transmission lines and the railroad load at times exceeded the total generation of local companies. In order to provide this large power demand, PRR erected its own high voltage transmission lines. These lines spanned the PRR system at 132 KV (now 138 KV) single phase, 25 Hz, from step-up stations generating this power at 13.2 KV (now 13.6 KV).

PRR also initiated its own signal power transmission facilities. This provided a 100 Hz (+96.7) modulated signal used to provide the locomotive (MU) engineman with signal information regardless of fog or other masking of the distant wayside signal. The coded energy in the rails is also available for wayside signals, eliminating the need for line wires.

This signal power is generated at various substations through motor/generator sets that convert the single phase 25 Hz to single phase 100 Hz (96.7) which is transmitted at 6.9 KV, using space on existing high catenary poles.

Amtrak's Northeast Corridor has used several types of equipment. Many rail fans associate electric train operation with the famous GGI, the first streamlined electric locomotive in the world to pull railroad trains. For many years this locomotive was the world's most powerful with its 12 large drivers and 8 ponies. The GGI has been retired after almost half a century of faithful service and its original prototype (4800) now rests at Pennsylvania's State Railroad museum in Strasburg, PA.

Stone & Webster is providing engineering, design, procurement, construction, and startup services to Amtrak for a 180 MW Static Frequency Converter (SFC) facility, located in Philadelphia, just south of the Betsy Ross Bridge along the Delaware River. This station is designed to supply power to the 25 Hz Northeast Corridor Traction Power System operated by Amtrak between Washington, New York, and Harrisburg. The new SFC station will replace the existing 60 MW Richmond Rotary Frequency Converter (RFC) Station upon its removal from service.

The new $140 million SFC station consists of five identical 45 MVA DC-link static frequency converter volts which convert 60 Hz, 69 KV, three-phase power to 25 Hz, 138 KV, single-phase power for a total station capacity of 180 MW. Each of the five converter units comprises the following major equipment:

- 1 – 60 Hz four-winding input transformer.
- 2 – six-pulse bridge thyriator controlled rectifiers.
- 1 – de-link including smoothing reactors and filters.
- 8 – four-quadrant GTO thyriator pulse-controlled inverters.
- 2 – 25 Hz five-winding output transformers.

This SFC station is the largest of its type in the world.

II. CONSUMER, COMMERCIAL & INDUSTRIAL PRODUCTS AND COMMUNICATIONS

VICTOR TALKING MACHINE CO.

The Delaware Valley was instrumental in developing one of the most popular home entertainment devices during the last 100 years: the phonograph. Invented in 1877, the original phonograph utilized an elongated cylinder type record. In May 1888, the circular disc, horizontal record began to evolve with the demonstration of Emile Berliner's "Gramophone" phonograph at the Franklin Institute, 15 South 17th Street, Philadelphia (now occupied by the Atwater-Kent Museum).

Sequentially this recreational music standard evolved from manual to electric motor operation, 8" records at 78 RPM, to 12" records at 33-1/3 RPM and from mono to stereo.

The phonograph's main components are (1) a free-swinging tone arm, (2) a revolving turntable holding the record, (3) a pickup cartridge which changes vibrations from the records into electric waves, (4) an amplifier which strengthens these waves, and (5) a loudspeaker which changes the waves into sound.

The following is a brief history of the phonograph evolution:

In 1877, German-born inventor Emile Berliner, sold a telephone invention to Alexander Graham Bell. This invention brought Berliner professional prestige and provided him with financial security to pursue an alternative approach to the cylinder type phonograph. Berliner investigated etching sound as a horizontal pattern on a metal disc coated with an acid-resistant material. During recording, the vibrating diaphragm caused the stylus to remove

Continued from Page 8 —

the acid-resistant material from the sound trace on the disc. After an acid-etching process, the disc was used as a master to make stampers for the production of duplicate records in a soft material that hardened when cooled.

Berliner discs provided several advantages over cylinders: ease of duplication; a groove which guided the sound box, eliminating the need for a propelling mechanism; hard groove walls which provided louder reproduction and longer wear; and ease in storage and shipment. However, the process produced extraneous noise. The walls of the grooves were rough due to the etching procedure. Berliner named his hand-propelled reproducing instrument the "Gramophone" and demonstrated it at the Franklin Institute in May 1888. It was not until 1893, when a satisfactory method of producing a stamping matrix for hard rubber records was developed, that Berliner felt he could offer the Gramophone for sale.

In 1895, a group of Philadelphians headed by Thomas S. Parvin set up the Berliner Gramophone Company of Philadelphia as a manufacturing unit. Berliner's basic disc phonograph patents were held by the U.S. Gramophone Company. The Company's operations were at 1026 Filbert Street and the recording studio at 424 South 10th Street in Philadelphia. The hand-propelled Gramophone could not maintain constant pitch while it played, until a satisfactory spring motor was developed by Eldridge R. Johnson in Camden, New Jersey. This motor operated at uniform speed, could be regulated, was quiet in operation, and inexpensive to use. Between 1896 and 1900, almost 25,000 motors were made. From 1896 to the summer of 1898, Johnson made motors, sound boxes and metal parts, and delivered completed instrument to Berliner Gramophone.

In August 1900, Leon F. Douglas joined with Johnson to form the Consolidated Talking Machine Company. The first recording was made at the 10th Street studio in Philadelphia in May 1900. The new Johnson recording process was used for making the record matrices and an improved Gramophone was introduced. The "His Master's Voice" painting of Nipper by Francis Barrat, which had been purchased by the Gramophone Company Ltd. In England and copyrighted in the U.S. by Emile Berliner, was used in Consolidated's catalog and advertising. Nipper and the improved Gramophone were to become one of the most widely used and recognized trademarks in the world. (You can still see it from the Benjamin Franklin Bridge, on an old RCA building in Camden.)

His Master's Voice

In December 1900, the trade name "Victor" was introduced for instruments and 7" (177.8 RPM) records.

By the fall of 1901, Johnson's disc records had made serious inroads on wax cylinders, which had been recognized by the trade and the public as the standard of quality. Now all large and influential music houses accepted the Victor machines and records. The Victor Talking Machine Company was incorporated on October 3, 1901. Instruments were assembled in the four-story factory at 120 North Front Street in Camden. The recording laboratory remained at Berliner's 10th and Lombard location in Philadelphia. Records were pressed by the Duranoid Company, until the Camden operation at 23 Market Street began in 1902.

Victor's record catalog consisted mostly of military bands such as Sousa's, banjo soloists like Vess L. Ossman, recitations, and comic songs. There was no classical music or artist of any stature. Ten classical records made in Milan with Johnson's improved recording process on April 11, 1902, were an artistic and commercial success. They were regarded as the first completely satisfactory Gramophone records yet made.

The new sensational tenor, Enrico Caruso, was signed to an exclusive contract by Victor. His voice complemented the acoustic recording and playback processes. Caruso's first American recordings were made on February 1, 1904. The enclosed-horn talking machine, the "Victrola" was introduced in 1906. It sold for $200 and was an immediate success. The matrix and shipping departments were moved from Philadelphia to Camden and the Victor cabinet factory was constructed along with a new building for executive offices and recording laboratory.

Victor's artist roster during the period of 1910-1913 included George M. Cohan and Al Jolson. Dance records were much in demand. Entry of the United States into World War I in April, 1917, had a great impact on the company; some notable firsts in recordings were made during that year. Symphony orchestra recordings of the Philadelphia Orchestra under Leopold Stokowski were made in October 1917. In November, Victor made Jascha Heifetz's first recordings. A new studio, housed in the former Trinity Baptist Church, gained renown because of its pipe organ and fine acoustics.

The phonograph industry had introduced little basic technological innovation to improve its product. Victor

— Continued on Page 10

— Continued from Page 7

Photo courtesy of Frederick O. Barnum III

Enrico Caruso, the world's most famous opera singer, signs his first contract with Victor, and makes his first Victor recordings in the Company's first recording studio: Room 826, Carnegie Hall, New York City on February 1st. His contract with Victor validates the high quality of recorded music and sets the standard for all other artists and musicians to follow.

(Photo caption courtesy of Frederick O, Barnum III, author, His Master's Voice in America.)

ad not completely ignored e possibility electrical cording, but effort was rdly up to challenge. Electrical cording periments e conducted in 1913, g an electromagnetic rding head making ordings radio and rophone ces. The oach was y trial and .

December 1924, electrical recording improved ustical yback ment was onstrated mden for the technical staff. Both Victor and Colum- btained rights from Bell Laboratories, for electrical ding and the re-entrant horn acoustical playback m.

n February 2, 1925, the new recording equipment was ered. The first popular artist, electrical recording was on March 16, by the Mask and Wig Club Male Quar- d Orchestra of the University of Pennsylvania. A num- of new recordings, including "March Slav" by the delphia Orchestra, were chosen for demonstration of Credenza Orthophonic Victrola, a hand-wound, stic talking machine with re-entrant horn. Management ed 10,000 instruments to be built. A total of 19 other ls were introduced in 1925 to be followed by 24 more 26. Victor had signed with RCA for radio chassis and ical playback apparatus. One of the most elaborate ls, dubbed the "Orthophonic Victrola - Orthophonic ola and Radiola," could play records acoustically or ically, contained an eight-tube superheterodyne radio, ad a list price of $1,000. The new instruments and dings received wide public acceptance.

June of 1926, the Philadelphia Orchestra made its f many world standard recordings, at the Academy of Music. In December 1926, Eldridge Johnson sold his interest in the Victor Talking Machine Company to a group of bankers. On March 15, 1929, the Victor Talking Machine Company was acquired by the Radio Corporation of America as a manufacturing facility. The merger with RCA enabled Victor records to weather the lean depression years better than any other recording company.

The decline of the longstanding phonograph's popularity began in the 1970s with the increasing use of magnetic tapes, and finally in the 1990s, with the compact discs (CD) player with laser pickup.

RCA— A HISTORICAL PERSPECTIVE

The Early Years

It has often been said that the story of the Radio Corporation of America outlines the larger story of the era of radio broadcasting. Peculiarly enough the company was not organized with radio broadcasting in mind, although it is significant that the man whose name is so closely associated with the history of RCA and who for many years was its active head, David Sarnoff, had clearly visualized the possibilities of radio broadcasting service and even "electric tuning" long before broadcasting made its first appearance.

1929

World-renowned trademark of His Master's Voice, featuring Nipper, the fox terrier, listening to a talking machine/ phonograph, joins the Radio Corporation of America when it purchases the Victor Talking Machine Company, Camden, NJ on March 15th for $154 million. At the time of acquisition, the Victor Company has grown to a 58-acre complex, containing 31 buildings with over 2.5 million square feet of floor space. Cumulative sales (1901-1929) include over 8 million Victor Victrolas ($413 million) and over 600 million Victor Records ($272 million).

(Photo caption courtesy of Frederick O. Barnum III, author, His Master's Voice in America.)

Continued from Page 8 —

...y new system for reproduction of recorded ... designed, developed, and introduced on January ... RCA Victor Division, Camden, NJ: a 6 7/8-inch ... vinylite phonograph record and fast-changing ... Production of 25 million units in 1949 doubles to ... units in 1950. This is the world's first 45-rpm ... record and player.

... courtesy of Frederick O. Barnum III, author, His Master's Voice in ...

... RCA's first year (1919-1920), attention was ... almost exclusively on communications, but in ... the first rumblings of what was soon to become a ... boom began to be heard. RCA entered this ... on July 2. 1921, when a one-day broadcast was ... from a temporary station at Hoboken, N.J., on the ... of the Dempsey-Carpentier fight. Just prior to ... of broadcasting, RCA had given thought to fur... radio amateurs reception and transmission appa... The line of amateur apparatus was expanded as ... as possible to include home broadcast receiving ... and RCA now entered the merchandising field ... and Westinghouse as manufacturers.

... 1925 a receiver was sold with accessories permit... be operated from alternating current. In the same ... electrodynamic loudspeaker debuted.

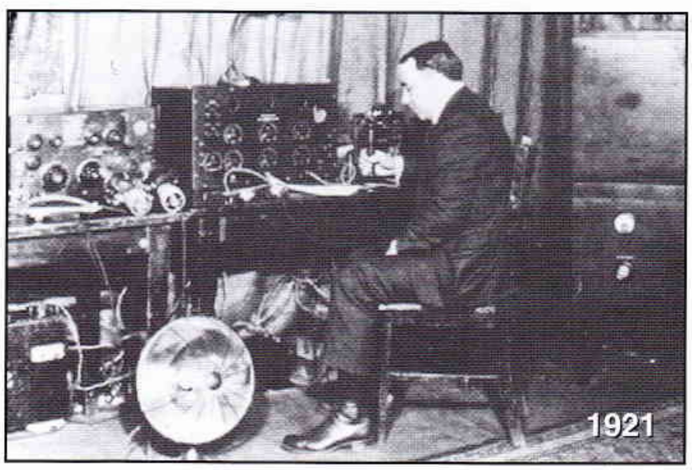
... Victor Talking Machine Company at Camden had ... affected by the growth of radio and had not ... particularly successful in its attempts to enter the ... In order to obtain manufacturing facilities, RCA ... the Victor Company, including the manufacturing plant, the phonograph business, and the Victor dog trademark. RCA also took over tube manufacturing from GE and Westinghouse. In 1929, the RCA Communications Company was formed to take over all the business in transoceanic communications.

In 1930, RCA completed the consolidation in the RCA Victor and Radiotron companies of all facilities of research, engineering, manufacturing, and sales of RCA products, which included phonographs and records. In 1932, the Photophone business was taken over by the RCA Victor Company. (The RCA Photophone Company had been organized in 1928 to supply the motion picture industries with a system for recording sound on film.)

The final step toward an independent RCA took place in 1932. In 1934 the tube business was augmented by the purchase of certain patents from the De Forest Radio Company. In 1935, the manufacturing and merchandising business was further consolidated by the merger of the RCA Radiotron and RCA Victor Companies.

In 1938, RCA was in transition from a radio communications concern to a broadly diversified electronics organization with a growing interest in such new fields as radar, television, and airborne electronics. In April 1939, seven years of intensive research, engineering development and field testing by RCA culminated in the introduction, at the New York World's Fair, of the first public television service.

In 1946, the aluminized picture tube was developed, which provided twice as much brightness, with no increase in power needed. This process became standard in all picture tube production throughout the industry. The development of the Vidicon, a miniature pickup tube with a photoconductive surface, in 1949 pointed the way to smaller television cameras in industrial and educational applications.



RCA's first broadcast station began operating on December 15, 1921, in Roselle Park, NJ. In 1926, RCA and its associates integrated a complete broadcasting service and formed the National Broadcasting Company.

— Continued on Page 12

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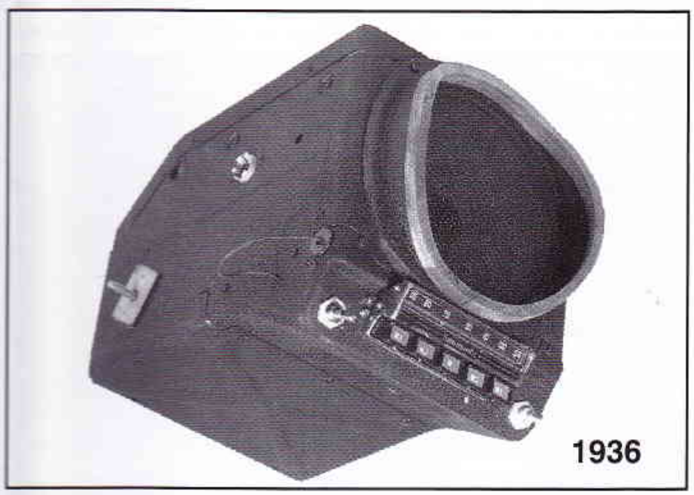
Radiola 17, the first AC radio.

RCA's Major Milestones from 1906 to 1953 are listed below:

1906 First Victrola produced.
1931 RCA invents Velocity or Ribbon microphone, which becomes broadcasting industry standard.
1936 RCA begins production of first factory-installed automobile radio for Buick.
1937 RCA demonstrates first microwave scanning radar capable of identifying and locating moving ships.



The RCA Manufacturing Company, Camden, NJ begins selling radios to General Motors for factory installation into Buick automobiles. This is the first factory-installed automobile radio in the United States.

(Photo caption courtesy of Frederick O. Barnum III, author, His Master's Voice in America.)

1939 David Sarnoff introduces television to the American public at the NY World's Fair.
1940 RCA develops and demonstrates first practical electron microscope.
1941-1945 RCA produces 5.5 of the 10 million radio proximity fuses used in World War II.
1941-1945 RCA produces first miniaturized airborne video surveillance systems and TV guided missile systems for U.S. in World War II.
1949 RCA designs, develops and introduces the world's first 45-rpm phonograph record and player.
1953 FCC approves the RCA all-electronic compatible color TV system as the industry standard in the U.S.

Black and White Television

The official inauguration of television service was the harbinger of a new era in mass communications, but it required a keen eye to see in the actual event the shape of the nationwide television service we know today. It was an extremely limited service, covering only the New York metropolitan area, and operating on the "experimental" basis authorized by the Federal Communication Commission. Programs emanating from the NBC transmitter atop the Empire State Building were viewed on a relative handful of 9-inch direct view and 12-inch reflection-type receivers produced at Camden, N.J., for sale in the New York area.

RCA President David Sarnoff introduces television (developed by Dr. Vladimir Zworykin and his staff in Camden, NJ) to the American public when he is televised on April 20th by NBC during the dedication of the RCA Exhibit Building at the World's Fair in New York. This is the world's first televised news event.

(Photo caption courtesy of Frederick O. Barnum III, author, His Master's Voice in America.)

[illegible] from Page 12 —

[illegible] before the iconoscope cameras in front of the [illegible] at the World's Fair on April 20, 1939, David [illegible] announced the beginning of regular television ser[illegible] NBC. And he added:

> [illegible] we add sight to sound. It is with a feeling [illegible] humbleness that I come to this moment of [illegible] the birth in this country of a new art so [illegible] in its implications that it is bound to affect [illegible]... *This Miracle of engineering skill which* [illegible] will bring the world to the home, also [illegible] a new American industry to serve man's [illegible] welfare...."

[illegible] during 1946 that RCA Victor placed the first [illegible] television sets on the market. The Basic Model [illegible] named 630TS with a ten-inch picture tube. Mar[illegible] a price of $375, the 630TS' economy, reliability [illegible] quality swept into immediate popularity. The [illegible] first quantity produced and marketed receiver, it [illegible] equivalent of the "Model T." As much as [illegible] single factor, the 630TS was responsible for the [illegible] of television in American homes during [illegible] World War II years.

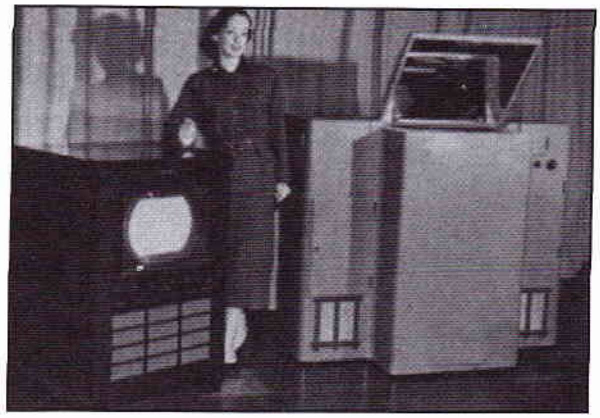
[illegible] RCA developed the TK 10 — the first com[illegible] and White image orthicon TV Camera — fol[illegible] development in 1954 of the TK-40 — the first [illegible] color TV camera. The most noteworthy [illegible] in 1945 was the TK-76, the first self-con[illegible] quality portable television camera for electronic [illegible]

[illegible] Television

A[illegible] commercial television system expanded, [illegible] undertook an energetic postwar program [illegible] color television research and development. [illegible] mechanical techniques offered promise in terms of early commercial advantage, RCA decided, soon after the war, to strive for an all-electronic color system fully compatible with black-and-white. Outstanding progress was achieved at RCA Laboratories during 1947 and 1948. Several demonstrations were held showing a color system employing three kinescopes, and combined with an optical system to present a composite color picture.

In 1949, the FCC scheduled a series of hearings to consider, among other matters, the establishment of standards for color television transmission. At issue were two

[illegible] examine five types of tri-color TV picture [illegible] by RCA. L to R: Edward W. Herold, Dr. [illegible], Dr. H. B. Law, and Dr. V. K. Zworykin.



Illustrating progress in development of receivers for RCA color television system: right, research model demonstrated to FCC, October 10, 1949; left, developmental model demonstrated December 5, 1950.

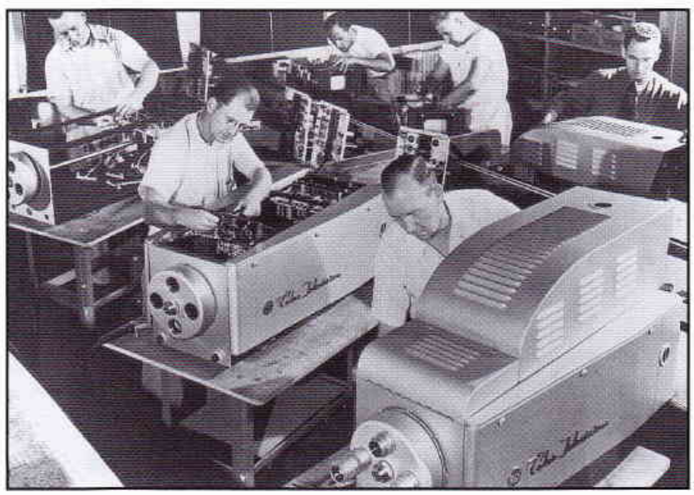


Photo courtesy of Frederick O. Barnum III

On December 17th, 1953, the FCC approves the RCA all-electronic compatible color television system as the industry standard in the US. RCA Victor Division, Camden, NJ begins manufacturing color television transmitters, receivers and antennas for both studio and field use. These are the first mass-produced color television broadcasting systems in the US.

(Photo caption courtesy of Frederick O. Barnum III, author, His Master's Voice in America.)

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Photo courtesy of Frederick O. Barnum III

RCA Commercial Electronic Systems Division, Camden, NJ produces the TCR-100 video tape cartridge recorder/player for the worldwide television broadcasting industry. The TCR-100 is the first videotape recorder/player to automatically air pre-recorded commercials, promotions, station identifications and other segments. Each pre-recorded segment could be between 20 seconds and three minutes in length. RCA Camden, NJ receives an Emmy Award for this technical achievement in 1974.

(Photo caption courtesy of Frederick O. Barnum III, author, His Master's Voice in America.)

competing systems — a non-compatible mechanical color system and an all-electronic compatible color system advocated by RCA.

As the hearings progressed the research staff of RCA Laboratories, supported by engineering groups at the tube plants at Harrison, N.J. and Lancaster, PA, moved with full speed to the development of the final basic element in the compatible system—a single tube capable of producing pictures in full color. The result of this extraordinary effort, demonstrated publicly in March 1950, was the tricolor kinescope, one of the outstanding achievements in early postwar electronics. In the words of General Sarnoff, "Measured in comparison with every major development in radio and television over the past 50 years, this color tube will take its place in the annals of television as a revolutionary and epoch-making device... As the master key to practical color television, it is an outstanding development of our time."

The most important development by far to RCA in the years 1958 to 1962 was the emergence of color TV as a new industry and public service of massive and mounting proportions. By 1961, there occurred—finally—the long awaited color break-through. One by one, TV receiver manufacturers abandoned the sidelines and entered the ranks. By the following year, nearly every major TV manufacturer was actively marketing color, and industry volume reached $200 million. RCA shared in the late 1960s boom in broadcast equipment sales resulting from the conversion of TV stations to color and the launching of new stations. One product was the TCR-100 Video Tape cartridge recorder/player. First placed in service in 1971, the system ushered in a major change in television broadcast operations.

In 1974, RCA introduced the TR-600 Video Tape Recorder, which took advantage of the increasing emphasis on cost effectiveness by incorporation into its design capabilities formerly offered only as accessories. In 1981, RCA Broadcast Systems, Camden, N.J., introduced the Hawkeye, a portable color TV camera and recorder, which produced a new flexibility in electronic news gathering by making field production by a single person a practical reality.

Photo courtesy of Frederick O. Barnum III

RCA Broadcast Systems, Camden, NJ introduces the Hawkeye, a portable color TV camera and recorder, which provides new flexibility in electronic news gathering by making field video production by a single person a practical reality. This is the first compact, broadcast-quality color TV camera and video tape recorder in a single, hand-held unit (first camcorder). For this technical achievement, RCA Camden, NJ receives another Emmy Award.

(Photo caption courtesy of Frederick O. Barnum III, author, His Master's Voice in America.)

Broadcast Communications

Television and radio broadcasting is so much a part of the present-day scene in the United States and round the world, that one could easily overlook that it is still developing and growing. Major changes in techniques and services provided have occurred and still more changes are visible. Using cameras, recorders and switching or mixing equipment, programs are put together from live input material. In most cases today, this process is done ahead of time and the total program is recorded. The process of preparing recorded program material is called production or teleproduction (for television).

Broadcasters compete vigorously to be first with a newsbreak and so want to minimize the time delay from

...from Page 14 —

...pictures at a news scene until finished material is ...for airing. There has been a trend to doing news ...ically," using television cameras and videotape ...ers. Called "electronic news gathering" or "electron-...alism," it provides greater immediacy, better qual-... on-air, and lower cost of operation. Electronic ...alism led to a special category of equipment opti-...for portability, flexibility, ease of operation, and rea-...e performance. RCA's electronic journalism ..., the TK-76 was very successful.

...above is an aerial view of the Gibbsboro ... in the early 1980s. The facility was closed in ... when RCA closed its Broadcast Systems Division. ...courtesy of Frederick O. Barnum III, author, His Master's Voice in ...

...dcast Antennas

To provide a larger and more modern home for its Broadcast Systems' Antenna Assembly and Test Operation, RCA Camden, NJ purchased ... acres of land in Gibbsboro, NJ in 1954 and built a new ...ity there in 1957. Continually expanded over the next ... years, the Gibbsboro Test Facility (lower right photo on page 13) was the largest of its kind in the world. Among the products produced here was the 351.5-foot, 363-ton antenna for the World Trade Center in New York City, which, upon its completion in 1979, became the world's largest multiple TV-radio broadcast antenna (accommo-...ing 10 TV and 15 radio stations simultaneously).

...crowave Relay Systems

The pioneer development of the microwave radio relay system by RCA was started in Camden, N.J., in 1943. It was the first in the world to employ microwave frequencies in multi-hop service. It used the new techniques and components developed for 10 cm radar. The circuits operated originally at 3 GHz but were later shifted to 4 GHz. A 10 MW Western Electric reflex klystron was used as the transmitter and was cavity stabilized. Antennas for transmission and reception were 1-meter-diameter parabolic dishes. A double FM modulation method was used to provide multiplexed voice audio program, and teleprinter channels within a base bandwidth of 150 kHz.

Forestry-type towers, about 35 meters high and spaced 50 to 60 km apart, were used at the relay stations at Bordentown, Ten Mile Run and Woodbridge, New Jersey. The terminals were at Building 8 of RCA, in Camden, and at the Western Union Telegraph Company, 60 Hudson Street, in New York City. The Camden Terminal was later moved to a Western Union location on the Merchants National Bank Building at city Hall Square, in Philadelphia. This New York to Philadelphia circuit was made part of the New York-Washington route of Western Union, and handled commercial traffic on an experimental basis for extended periods, beginning in 1945.

After the commercial success of this radio relay system was demonstrated to the great satisfaction of Western Union, RCA took a contract from the latter and built equipment for a triangular route of 23 relay stations with terminals at New York City, Pittsburgh, and Washington, D.C. This project extended from 1946 to 1948. The equipment was used commercially and continuously by Western Union for over 20 years. Some of the RCA apparatus was donated by Western Union to the Smithsonian Museum after its retirement from service. It is historically significant as the first microwave radio relay equipment in a commercial system in the world.

Many other systems of lengths up to 5,000 km were built by RCA to this same or improved designs. The worldwide use of microwave relaying for wide-band services has followed this pioneer work by RCA.

Transmitters

With the purchase of the Victor Talking Machine Company, Camden, NJ on March 15th, 1929, the Radio Corporation of America was able to consolidate all its radio and television research, engineering and manufacturing into a single location for the first time. Personnel from Radio Corporation of America, New York, NY; General Electric Company, Schenectady, NY; and Westinghouse, Pittsburgh, PA combined forces in Camden for the development of radio and television broadcast and receiving equipment for commercial and government customers. For the next five decades, RCA Camden dominated the worldwide commercial broadcast equip-

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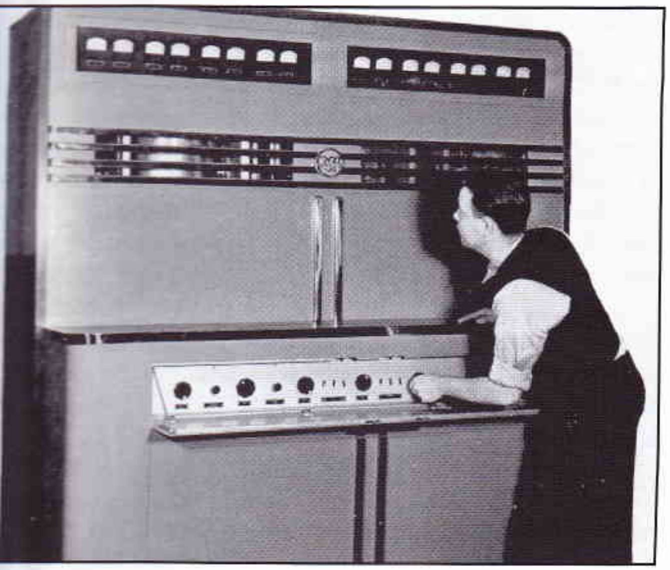


ctured here is the TT-1A television broadcast transmitter, ilt at RCA Camden in 1938 and first sold to the mmercial industry in 1939.

oto caption courtesy of Frederick O. Barnum III, author, His Master's Voice in erica.)

ent market, manufacturing studio cameras, audio and eo tape recorders, microphones, audio and video consoles, telecine equipment, antennas, and transmitters for io and television stations around the globe.

nage Orthicon

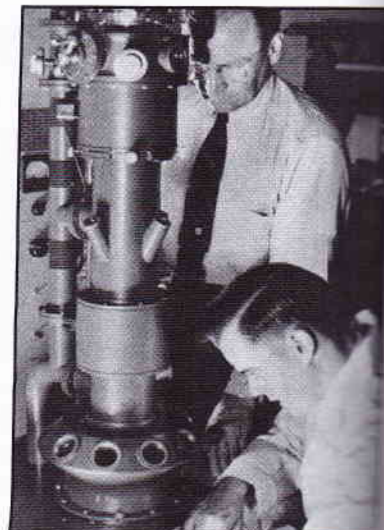
A highlight of wartime research in optics and television was the development of the image Orthicon, started at Harrison in 1941 on the s of much earlier work and completed at Princeton. a sensitivity 1,000 times greater than that of the Iconoe, it provided in wartime, a versatile pickup device for ary television systems. For postwar television, it meant oletely flexible operation in the studio or in the field.

Co-inventors of the image orthicon for TV cameras, Drs. Albert Rose, Paul K. Weimer, and Harold B. Law, are shown with first model in 1945.

Dr. George A. Morton (left) and Dr. John E. Ruedy with intensifier orthicon camera tube which can see in surroundings completely dark to the human eye.

Electron Microscope

In 1962, RCA manufactured and delivered its 1000th electronic microscope, assembled on the same production line in Camden that completed the first commercial instrument nearly a quarter of a century earlier. The microscope attains magnifications of more than 200,000 diameters. This first practical electron microscope enabled researchers to study viruses, such as influenza, for the first time.



Electron microscope with Dr. V. K. Zworykin (standing) and Dr. James Hilier, its developer, November 1940, in Camden, NJ. Hilier's design vastly improved the objective lens in 1947.

ATWATER KENT MANUFACTURING COMPANY

The origin of the Atwater Kent Manufactu Company dates to 1896, when a young A. Atwater Kent dropped out of Worcester Technical Institute in Massachusetts to start his own business in his father's machine shop. Kent manufactured and sold small electrical items. In 1902 Kent traveled to Philadelphia on a business trip and decided upon the city as the site of his new company. The Atwater Kent Manufacturing Works opened in a rented loft at 48 North Sixth Street.

— Continued from Page 16 —

manufactured electrical products including batteries and inter-communicating telephones. In 1906 Kent developed an ignition system for automobiles that integrated a series of weak sparks into a single hot spark. The Unisparker, as it was called, soon became the industry standard. The company's success caused the company to move to a larger facility in the Germantown section of the city in 1912. By the late 1910s Kent's company was exclusively making electrical parts for automobiles. During World War I, U.S. government contracts were awarded to the company to produce optical gun sights and fuse setters.

In 1921 the company received an order for 10,000 headsets. Kent realized that with some retooling his company would be in a position to capture part of the growing market for radios. In 1922 Kent produced his first radio components and in 1923 his first complete radios. By 1924 the company had outgrown its Stenton Avenue campus and moved to a new $2 million plant on Wissahickon Avenue. This plant, constructed in sections, would eventually cover 32 acres. (The Roosevelt Boulevard Expressway goes between the two buildings of this plant, which was occupied by the U.S. Signal Corps in the North building, and Bendix in the South building during World War II. After the war, Philco occupied the South building, and the Veterans Administration occupied the North, and it still does today.)

In 1925 the Atwater Kent Manufacturing Company became the largest maker of radios in the nation. Supporting the manufacture of radios was the "Atwater Kent Hour," a program broadcast throughout the country in the mid-1920s. The show featured top entertainment, including [illegible] and Ray, and became one of the most popular and acclaimed regular radio programs of the era. In 1929 the company reached its peak performance with over 12,000 employees manufacturing nearly one million radio sets. The plant itself was considered an architectural sensation and received hundreds of visitors annually.

At this time Kent downplayed the table models for which the company was known and focused on more expensive cabinet models. But he had misjudged the buying public. By 1931 the country was in the midst of the Great Depression. Because of the general economy and competition from other manufacturers, the average cost of a radio had been reduced from a high of $128 in 1929 to [illegible]. Those companies that concentrated on more affordable models, such as Philco, soon captured the market. With declining sales the Atwater Kent Manufacturing Company closed in 1936. When he died in 1949, Kent held 93 patents for improvements in automobile ignition systems and electronics.

Editor's Comments: *I remember hearing that Atwater Kent did not want to abide by Franklin Roosevelt's National Recovery Act (NRA of those days) that restricted industry from repressive labor practices, so he just shut down and retired to Hollywood and held parties for starlets.*

PHILCO — A PHILADELPHIA COMPANY

In the spring of 1892, the forerunner of Philco began in Philadelphia as the Spencer Company to manufacture and sell carbon arc lamps.

Later in 1892, the company changed its name to Helios Electric Company. Fourteen years later the company entered the electric storage battery business under the name Philadelphia Storage Battery Company. The Philco name first appeared in 1919 as the trademark on batteries for electric automobiles, trucks and mine locomotives.

The next major product was a rectifier known as "socket Power" that enabled radios to be plugged into AC mains instead of having to use batteries.

Radio

When the invention of alternating-current vacuum tubes made the rectifier obsolete Philco decided to manufacture radios in 1926, and within a single year, had sold 96,000 radios. It quickly became one of the "big three" radio manufacturers along with The Radio Corporation of America (RCA) in New Jersey and Zenith Corporation, which was based in Chicago.

Philco Cathedral Radio – 1930

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Philco's popular Baby Grand lines of radios were among the ornate "cathedral" or "beehive" wooden radios that the reader may have admired in old or nostalgic movies. Despite the depression that followed the twenties, radio sales actually improved. The company decided that prices could be scaled down by incorporating Ford's auto assembly line techniques.

After equipping the plant for mass production, Philco became the leading radio manufacturer in the world.

Part of Philco's success as a radio manufacturer was the 1930 purchase of Transitone, a pioneer in the development of car radios in the United States. With that, Philco began to pioneer in most of the significant auto radio developments of the time.

In 1934, Philco introduced the first telescopic rod antenna and also offered ignition suppression, circuitry and electronic components. Philco sold 1,250,000 high fidelity radios as compared to RCA's 500,000. In 1940, Philco developed and introduced the first car radio in the world incorporating permeability tuning, a standard of the industry until the mid 1980s.

Television

In the early 1930s, Philco started experimenting with television, and for a while financed the experiments of Philo T. Farnsworth. In 1927, Farnsworth ...s the first person to develop a working electronic televi...n apparatus. By 1937, Philco was demonstrating an ...erimental 441-line television system which utilized a ...mirror-in-lid type television receiver, designed to rival ...A's 12" RR-359B.

...On June 28, 1932, W3XE (later WPTZ), the experi...tal television station of the Philco Corporation, first ...t on the air. It was housed and operated in the Philco ...t at C & Tioga Streets, Philadelphia. Its transmitter ...located in Wyndmoor, PA.

...n September 16, 1941, the station was granted its ...al commercial license. WPTZ was one of the first ...ns in America to receive a commercial license from ...CC.

...uring 1939, regular program service began on W3XE, ...became the first affiliate of the NBC Television Net...n the Philadelphia area with approximately 150 televi...eceivers in use. The majority of these sets were in the ...s of television manufacturing company officials, sta...ecutives and a small number in public places. Films ...cal studio shows comprised the program schedule. ...nting experimental broadcasts by the FCC was ...n practice at that time, as television took its first ...e steps in New York City, Schenectady and ...lphia. Viewers in those cities bought several thou...ts to watch the limited schedule of programs transmitted by pioneering broadcasters who jumped at the opportunity to go to commercial television broadcasting. WPTZ, Philco Corporation's station in Philadelphia gravitated to sports to fill airtime.

Receivers were placed in such Philadelphia locations as country clubs, popular restaurants and taverns, store windows and advertising clubs. There, each Saturday afternoon during the fall, the public could see a Penn football game, become acquainted with television as an entertainment vehicle, and potential clients could learn about it as an advertising medium. WPTZ televised the Penn games right through the war years.

In 1940, the company officially changed its name to Philco Corporation.

On October 5, 1940, when there were about 700 sets scattered throughout the Philadelphia area, Philco broadcast the University of Pennsylvania's Quakers football victory over the University of Maryland at Franklin Field. It was the first game of an 11-year series. WPTZ, Channel 3, was the first in the country to carry a complete football schedule—all the Quakers' home games. Even as the war halted the production of television sets and prevented the medium from spreading to other parts of the country, Philco's Saturday afternoon telecasts continued to a tiny universe of receivers. In the emerging world of televised sports, Philco's Philadelphia station was a pioneer without peer.

During the war, Philco stopped the manufacturing of consumer products and changed its operations towards communication receivers for the military, radio receivers for tanks and aircraft, radar, ammunition, artillery fuses and industrial storage batteries.

When the war ended in 1945, Philco went back, full force, into the business of selling refrigerators, air conditioners, and home and car radios.

In May 1946, WPTZ carried its first commercial. In 1948, the company entered the television receiver business and advertised a 61-square-inch black and white set, about the equivalent of a 7-inch screen, at $349.50. The following year the company was producing black and white receivers at a rate of 800,000 a year and was having trouble filling orders.

Philco became a very popular brand of TV sets and marketed a wide variety of models that incorporated many technical advances, from tubes to circuits to cabinet design.

In 1953, WPTZ was sold to Westinghouse. From 1948 to 1955, Philco made many innovations in becoming a popular television manufacturer during the post-War television boom. Philco marketed a wide selection of televisions. These sets incorporated many advances in picture tubes, transistors, set portability, and cabinet design.

By the late 1950s, Philco began suffering from the declining market for TVs. With Russia's Sputnik, the first satellite launched in 1957, the space age had a futuristic influence on the design of everything from cars to vacuum

Continued from Page 18 —

consumers. Philco's design department decided to try to stimulate its TV sales by styling the Philco televisions away from the traditional square or rectangular shapes. The engineering department contributed by making the wide-deflection picture tubes and printed circuits making it feasible to separate the viewing screen from the bulky receiver chassis. This space age line was called "Predicta."

During the 1950s, Philco had been a major force in the color TV development with many important patents. Philco, RCA and others successfully created a color system that was compatible with the black and white system. This, after Congress declared the CBS Color-wheel system to be the first, but short-lived, color standard.

Components and Computers

After 1947, Philco manufactured receiving tubes, black and white picture tubes, and transistors at its plant in Lansdale, PA. The first Philco-Ford car radios were manufactured there in 1964.

Predicta

Safari

Philco produced the first all transistorized portable TV called the Safari and introduced in 1959 which you can see at *http://www.radiolaguy.com/PhilcoSafari.htm.*

Ford Steps In

On December 11, 1961, Philco was purchased by Ford. It was renamed Philco-Ford Corporation in 1966. Ford used the company to develop auto electronics, including radios and cruise controls for their vehicles.

The purchase helped make Philco one of the world's most diversified electronics companies, including sophisticated aerospace tracking systems and artificial satellites, refrigeration, air conditioners, home entertainment products, automotive electronic controls, and car radios. Also, the original NASA Mission Control Center in Houston was designed and built by Philco-Ford.

In December 1975, the Lansdale plant audio engineering group moved to nearby Blue Bell, PA and to Willow Grove, a northern suburb of Philadelphia, in 1978. In 1994, a brand-new manufacturing organization formed what became known as Ford Electronics and Refrigeration Corporation, or FERCO for short.

In August 1980, the car radio-engineering group, based by then in Willow Grove, moved to Dearborn, Michigan, home of the Ford Motor Company. Corporately, Philco no longer exists, but the Philco brand name is still carried by several different companies and holding groups throughout the world.

THE FRANKLIN INSTITUTE

In 1824, thirty-four years after Ben's death, Philadelphia's Franklin Institute was founded for science education and research. Its provision for free instruction to young men led to the first Philadelphia public high school (Central High), and soon after to institute sponsorship of Pennsylvania's first engineering and architectural schools. The success of the industrial exhibitions begun, in 1824, led to the Franklin Institute Science Museum opening in 1826, at 17 South 7th Street in Philadelphia (now occupied by the Atwater Kent Museum), and moving in 1934 to 20th and Benjamin Franklin Parkway. The intent of the Science Museum was to increase understanding of science and technology through exhibits that demonstrate basic scientific principles and phenomena and to motivate students to pursue careers in these areas by offering special programs such as science fairs, student seminars, lectures, and science workshops.

In the Fels Planetaruim, a Zeiss projector and other instruments project images of celestial phenomena on the stainless steel dome ceiling. The observatory, on the museum roof, is equipped with two large telescopes. The Franklin Institute included 250,000 volumes and more than 5,500,000 U.S., British, and Swiss patents and was one of the largest collections of scientific and technical information in the nation. Franklin Memorial Hall, with its marble statue of Benjamin Franklin by James Earle Frayer, is a national memorial to Franklin.

The research laboratories adjacent to the museum provided facilities for more than 300 scientist and behavioral specialist. Research areas included aerospace, applied physics, applied sciences, chemistry, electrical, mechanical and nuclear engineering, operational research, materials science and engineering, and science information services. The Bartol Foundation Laboratories, in Swarthmore, conducted studies in physics, cosmic rays and astronomy.

The Institute's annual Medal Day Awards encourage scientific research by providing scholarships for achievement. Recipients of the Franklin Medal, its highest honor, include Thomas Edison, George Mascair, Niels Bohr, Orville Wright, Albert Einstein, and Enrico Fermi.

— Continued on Page 20

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UNIVERSITY OF PENNSYLVANIA

Systems Engineering — A Formal Beginning

Before World War II and ever since, Systems Engineering has been practiced in the Bell Laboratories, and during World War II the field of operations research became prominent. It became evident to a few engineers that operations research was in most respects a part of systems engineering.

After several experimental seminars on "systems engineering and operations research," the Moore School of the University of Pennsylvania organized, through a national committee, a Workshop in Systems Engineering. This was held in 1959 on campus, with representatives from more that 50 institutions in attendance. There were extensive talks of what constituted the elements of systems engineering and examples of major applications. This workshop had a profound effect, with numerous specialized courses and, finally, a curriculum in the undergraduate sense and a specialty in the graduate sense becoming broadly available.

It is believed that the Moore School graduate seminars which preceded the workshops, were the first university courses in systems engineering, and that the workshop started the growth in systems engineering courses and curricula which exist in abundance today.

As an aside, we might mention that the workshop was attended by an officer of the Ford Foundation, and it was from his discussions with members of the Moore School staff at the time, that talks were initiated which led to a $3 million Ford Grant for Engineering at the University of Pennsylvania.

Chest Radiograph

From 1925 to 1943, Professor Charles Weyl, Moore School of Electrical Engineering, University of Pennsylvania, and several of his colleagues, worked on problems related to the making of X-ray films of the chest. There were elements of systems engineering in the project, although that name had not yet gained popularity.

What follows is a summary of an effort to improve apparatus and techniques for making and using X-ray films of the chest. The work was supported by the American Lung Association, several insurance companies, and by manufacturers of X-ray equipment.

The chief objective was to find out how to produce X-ray films of the chest that would display as accurately as possible signs by which physicians could diagnose diseases of the lung. Although there was no specific cure at that time for tuberculosis, accurate knowledge of the progress of the disease from physical signs and particularly from X-ray films was essential to decisions as to how to treat each patient.

Weyl's first contribution was the development of the pulse relay, which was designed to cause the X-ray exposure to be synchronized with a particular phase of the cardiac cycle. For this work, Professor Weyl was awarded the Edward Longstreth Medal, by the Franklin Institute, in 1930. This pulse relay was initiated by the pulse in the carotid artery. A time delay was inserted so that the X-ray exposure occurred in diastole, i.e., when the heart and vessels were nearly stationary. The use of the pulse relay produced stereoscopic films taken in the same phase of the cardiac cycle; all parts of the chest were perceived in three dimensions with minimum blurring (unsharpness).

It became clear about 1932, that a major objective should be to find out how physicians in hospitals and tuberculosis sanitoria were producing X-ray films of the chest, what were the physical characteristics of those films, and how the equipment and exposure techniques could be modified to improve the quality of the films This required the design and construction of portable equipment to measure high voltage, X-ray tube current, and other technical factors, and particularly to measure radiographic results without excessive exposure of individuals to X-rays.

It was found that each of the several areas in the chest corresponded in photometric density to the density beneath a particular thickness of aluminum, regardless of the wide variations produced by the several different techniques. Therefore, it was not necessary to make chest films in each hospital or sanitorium; exposing the aluminum ladder provided the key information as to the density and contrast chest films made at that institution.

Work on chest radiography in the Moore School came to a conclusion early in the Second World War, when staff members chose to participate in activities directly related to that war. Furthermore, the basis for the production of high-quality chest films had been established. Finally, thanks to antibiotics, and other developments in biology and medicine, tuberculosis is no longer a major problem. Such is the fast-changing face of science and technology.

Continued from Page 20 —

TELEPHONE COMMUNICATION — BELL TELEPHONE AND AT&T

Invented 126 years ago, the telephone has evolved considerably. Even now, the cell phone has further revolutionized communications with its mobility. The following is a brief history of the telephone's evolution in the Delaware Valley.

In 1877, Thomas E. Cornish, a Philadelphia electrician, returned from Boston with Alexander Graham Bell's newly invented telephone and the thought of a new communications business. Cornish obtained rights to form The Telephone Company of Philadelphia, and the first two telephones in the state were installed in his home and in a Chestnut Street appliance shop. In the summer of 1877, he employed two former telegraph company men to install the first Philadelphia switchboard from which he ran iron wire lines to three potential financial supporters. (Alexander Graham Bell and a group of patent owners had begun the leasing of telephones, and granting licenses throughout the country.)

On February 11, 1915, Bell of Pennsylvania launched one of the first transcontinental long distance services.

Initial efforts to expand the infant telephone business, were filled with hardship and adventure. The telegraph company considered the building of a telephone plant an infringement of its prerogatives, and persuaded city officials to refuse Cornish permission to string wires. His workmen were arrested, and he was warned to quit or be driven out. Cornish persisted and founded the first Philadelphia exchange. In 1878, the first telephone directory made its appearance, listing 23 subscribers. On September 18, 1879, The Bell Telephone Company of Philadelphia was incorporated and Cornish elected president. At that time, the telephone directory contained 420 subscribers.

Meanwhile, the telephone was also being introduced in other Pennsylvania cities. In 1880, Horace A. Clute of Western Union was licensed by the American Bell Telephone Company as its agent for eight nearby counties. He immediately devoted his full time on the development of the telephone, which then had 75 subscribers. In 1882, a charter was issued for "The Southern Pennsylvania Telephone Company." By then, parts of New Jersey had been added to Clute's original territory.

The climax to a series of mergers from the late 1800s and early 1900s occurred in 1907 when the Bell Telephone Company of Pennsylvania, serving most of today's Central Area, was formed from the Bell Telephone Company of Philadelphia and the Delaware and Atlantic Telegraph and Telephone Company of Pennsylvania. The Lehigh Telephone Company, with headquarters in Allentown, consolidated under the Bell banner in 1930.

In September 1945, the last direct competing telephone system in the country, the Keystone Telephone Company joined Bell ending the customer irritant of having two or more competing telephone companies serving the same city or town.

In 1881, Bell of Pennsylvania began recording technological break-throughs. The placement of the first underground cable, using a wooden box for conduit, was recorded as a major event.

Two years before the legendary blizzard of '88, the first toll lines linking Philadelphia to New York opened. Three years later Pittsburghers could call Philadelphia, but not without a trek to the telephone office to place their calls because only local telephones were within the reach of home sets.

Invention of the repeater—an amplifying device to boost voice signals—made the spanning of increasingly greater distances by telephone possible. Repeaters were first used commercially in the Bell System on a toll line near Pittsburgh in 1904. Transcontinental service began in 1915, with the completion of the first call between Philadelphia and San Francisco.

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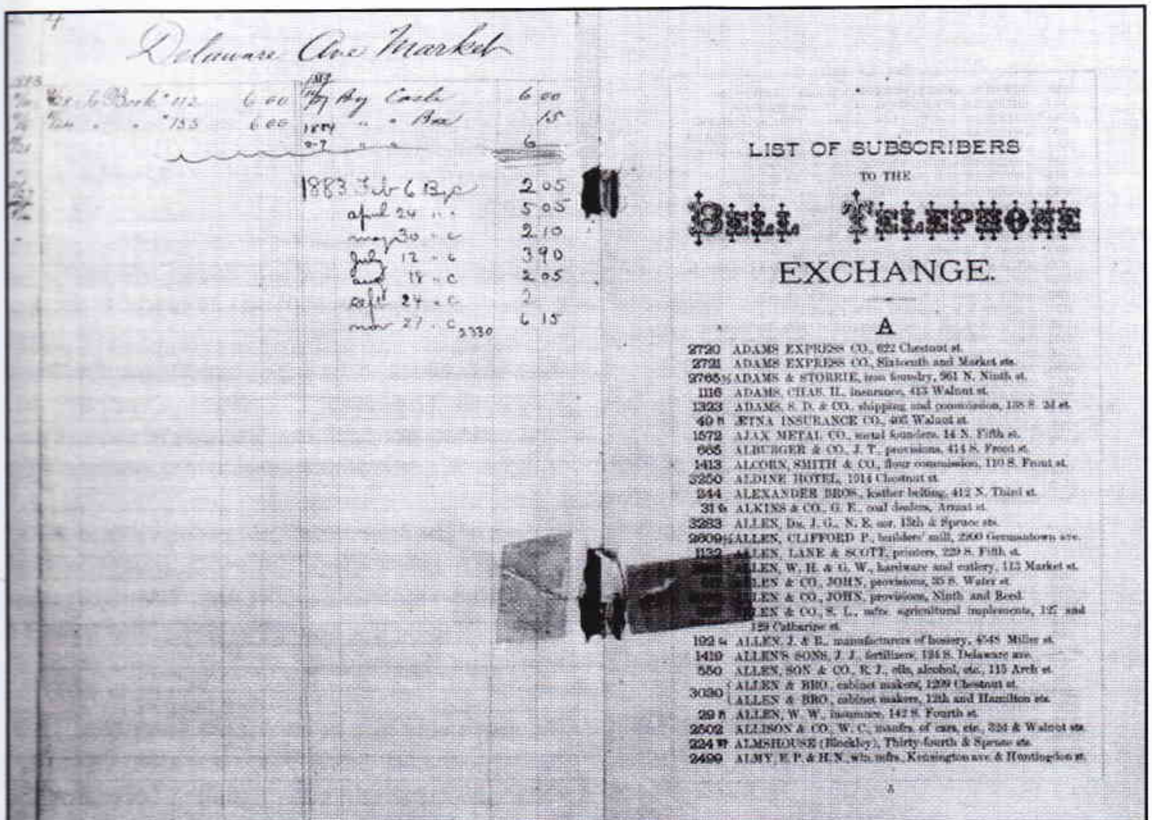

Early phone books had the space to lead two lives. This one doubled as a ledger.

from Philadelphia to Geneva, Switzerland. Bell System's 1967 trial of the Centralized Records Business Office in Upper Darby and the first commercial exchange offering of Picturephones see-as-you-talk service in Pittsburgh in 1970 were efforts whose time was yet to come.

During the '60s, electronic switching, its most costly research and development project, began to bear fruit. Bell of Pennsylvania was committed to this new technology that promised undreamed of service and economic possibilities. The company launched its move into the electronic age in 1967, with the cutover of the first Electronic Switching System (ESS) in Philadelphia's Germantown office. Bell System's phase-out of panel equipment was completed in 1978. In 1977, the fourth ESS, a solid-state super switcher with an hourly call processing capability of 550,000 calls, was installed in Wayne and Pittsburgh as joint Bell-Long Lines operations.

In the summer of 1965, the pioneer Traffic Service Position System (TSPS) office opened in Philadelphia to make operator service calls dialable by customers, and replace the switchboards of yesteryear with the pushbutton operator consoles of tomorrow. The 1970 Philadelphia debut of the TSPS was first of many TSPS conversions across the state. They streamlined the handling of operator-assisted calls and made possible the centralization of operator services in fewer more efficient locations.

The last half of the 20th century saw the breakup of the AT&T Company and the introduction of the cellular phone. It has been said that Bell created the telephone and Theodore N. Vail created the telephone business. Certainly the personality and personnel policies of Vail helped to build the telephone company's reputation as "a good place to work."

In 1906, independent telephone companies in Hazelton and Allentown introduced a primitive form of customer dialing. It was the addition of the dial to candlestick sets that spawned a communications revolution in the 1920s. In 1923, machine-switching panels, designed to serve big cities, were installed in Philadelphia's Sherwood office.

In 1925, creation of Bell Telephone Laboratories as the research and development resource for Bell companies, triggered a string of technological firsts for Bell of Pennsylvania and provide the fast-growing company with improved ways of working and serving its customers.

In 1943, Bell cut over the newly developed No. 4 toll switching machine in Philadelphia. In 1948, Bell System's most advanced switching-machine, the No. 5 Crossbar, was installed in Media. It was also the first equipped Automatic Message Accounting system.

In 1956, an Automatic Call Distributor went into service for the first time anywhere at West Chester. From 1958 through 1962, the Conshohocken Accounting office served as the proving ground for the use of large-scale computers for billing and maintaining customer records. The first Electronic Data Processing (EDP) bills were mailed to customers in 1960.

In 1966, a big telephone jump across the Atlantic took place when the first direct dialed long distance call was made

— Continued from Page 22 —

MEGGER — SCIENTIFIC AND ENGINEERING INSTRUMENTATION

For over 100 years, the Biddle Company, now a division of AVO International has been the premier provider of electric text equipment and measuring instruments for electric power applications. Originally, the James G. Biddle Co., its worldwide-know equipment band names include Multi-Amp, Biddle, and Megger. Its diverse testing products provide for cable fault location, protective relay testing and on-line monitoring of substation equipment.

Prior to 1962, Biddle was located within Philadelphia, but it then moved from 1211-13 Arch Street to facilities in Blue Bell, Montgomery County, and is now located in Norristown. Subsequently, a high-voltage testing laboratory was added for testing up to 1,000 KV ac.

Corporate development of Biddle included many mergers and buy-outs. In 1888, Biddle joined the 28-year old James W. Queen & Company, which manufactured and imported scientific and technical equipment. Queen & Company included other future innovators, such as Arthur Thomas, F. J. Stokes, and Morris E. Leads. In 1895, Biddle formed his own company that, through many ownership changes, has continued by name to the present. Initially, the business was for importing and reselling scientific and engineering instrumentation primarily from Europe. Most sales were for instruments, but also including X-ray, radio, and battery equipment. In 1910, Mr. Biddle became the American distributor of the English introduced "Megger" tester. World War II caused Biddle to start manufacturing this tester from 1942 to the present. After the war, product innovation became a way of life and

Transformer Turn Ratio (TTR) Test Set

Delta 2000 (Capacitance & Dissipation Factor) Test set

Biddle products began to dominate the imports.

In 1988, the James G. Biddle Company was purchased by AVO International, Ltd., and in 1990 AVO was purchased by T.B.G., Inc.

Subsequently, the division name was changed to "Megger." The following company innovations and product introductions identified by Mr. Biddle and by his staff, have had major impacts on scientific and engineering instrumentation:

- Likely the first X-ray tube used in the U. S. imported from Germany and sold to Westinghouse.
- The first portable insulation tester Megger sold in the U.S. was imported from England.
- The first centrifical and chronometric tachometers used in the U.S.
- Introduction of state-of-the-art, precision, electrical instruments and standards with Germany the most important source.
- In 1957, it manufactured the first commercially available capacitive discharge device for power cable fault location. This technique is now used throughout the world.
- In 1951, it made available the first Partial Discharge Detector, vital to the electric power and aerospace industries.
- It was the first American company to produce and sell very-low-frequency, high-voltage test sets for cable and generator testing.
- It was a pioneer in the design of resonant high-voltage power supplies. It patented and introduced the first parallel resonant test sets.
- It introduced the first partial discharge free test terminations using deionized water — now in worldwide use.
- It was a world innovator in introducing an insulation test system using a micro-computer to automatically perform sophisticated measurements.
- It pioneered an electronic instrument to measure extremely low resistance with relatively heavy current.

— Continued on Page 24

— Continued from Page 23

- It introduced a range of products for measuring the quality of power transformers, ranging from portable to factory test systems.

TECHNITROL

Based in Philadelphia, Technitrol, in Trevose, PA, is now a world-wide manufacturing company of electrical components, electrical contacts and assemblies and other precision-engineered parts and materials for manufacturing in the data networking, broadband/Internet access, telecommunications, military/aerospace, automotive and electrical equipment industries.

Technitrol has two business segments: (1) Electronic Components Segment (50%) is engaged in the design, manufacture and sale of a variety of passive magnetic-based components for leading manufacturers of electronic equipment; and (2) Electrical Contact Product Segment (50%) is the world's leading producer of electrical contact and contact assemblies for markets such as appliances, automotive, commercial and industrial machinery.

Technitrol, at its Allegheny Avenue plant in Philadelphia, in the '80s and '90s (before the Document Counter and Dispenser group was sold to G&D America, Inc.) developed and manufactured highly sophisticated currency dispensers and document counters for the global market. Currency dispensers assist bank tellers and are used in ATM machines the world over. Speeds of 1000 U.S. bills per minute, can be counted by one machine; others can count 750 documents per minute. Even in the '80s, 24 bills in up to four denominations could be dispensed in about 4 seconds.

VISHAY INTERTECHNOLOGY

In 1962, Dr. Felix Zandman, the current Chair or the Board and Chief Executive Officer, a physicist, founded Vishay, in Malvern, PA, to develop and manufacture "Bulk Metal" foil resistors.

In the 1950s, Zandman received patents for photo stress coatings and instruments used to reveal and measure the distribution of stresses in structures under life load conditions, such as airplanes and cars. That led him to the development of ultra-precise and ultra-stable foil resistors that continue to provide performance far beyond any other resistor available.

In the '60s and '70s, Vishay established itself as a market and technical leader in foil resistors, "PhotoStress" products, and strain gages. In the '80s, Vishay expanded into high volume resistors by growth and acquisitions (Dale Electronics and others). In the '90s, it expanded into the high-volume capacitor market by major acquisitions including Sprague Electric, Roederstein, and Vitramon. Since 1997, Vishay is also in the discrete semiconductor market. Lately, it acquired other leading manufacturers of passive components and transducers.

Today, Vishay is a $2 billion (sales in 2002) global company with a blue-chip customer base such as IBM, Intel, Samsung, Siemens, Nokia, Sony and many others. Vishay sales in 2002 were 38% in Asia, 31% in Europe, and 31% in the Americas.

BROADCAST CHANNEL 3

Philadelphia's Channel 3, celebrating its 70th anniversary in 2002, was first granted permission to operate as experimental station W3XE in 1932, but actually had begun experimenting with the new medium as far back as 1928. Since then, Channel 3 — Philadelphia's first television station and NBC's first and largest affiliate — has continued to be an innovator in news and entertainment, but it is now part of CBS.

As an experimental station in 1932, Channel 3, then operating out of the Philco plant at C & Tioga Streets, lived up to its label. Founded by Philco, the station first broadcast into the homes of 100 of the company's employees, mostly engineers. As the Philco engineers tinkered with the new technology, the station aired employee talent shows and travelogues to check the quality of the broadcast signal.

But it wasn't long before the staff began toying with the station programming as well. In 1939, W3XE telecasted the first college night football game, Temple University versus Kansas, and the following year started regular telecasts of the University of Pennsylvania home games, which it continued until 1951. That same year, the station became NBC's first affiliate, broadcasting network shows into an estimated 150 homes. Channel 3 continued to break new ground by broadcasting 60 hours of the 1940 National Republican Convention, the first major coverage of a national political conclave and the first "remote" telecast locally. The signal was sent to the station's tower, then located in Wyndmoor, PA to Princeton, NJ, and on to the Empire State Building in New York City from which NBC broadcast it nationally.

In 1941, the station gained commercial status under the call letters WPTZ-TV, the first commercial television station to be licensed in Pennsylvania by the Federal Communications Commission and the second in the country.

Throughout the 1940s, Channel 3 continued to develop both its station and the medium. In 1941, the station brought viewers the first telecast of Philadelphia's annual

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Drummers' Parade, and in 1942, produced and broadcast the first soap opera nationally, *Last Year's Nest*.

In 1946, Channel 3 got its first commercial sponsor, ARCO (the Atlantic Refining Company), which sponsored Penn football. But it was Gimbel Brothers that became the nation's first "full-show" sponsor that same year with *All Eyes on Gimbels*. Local actress, Jane King, hosted the first half of the show, demonstrating the department store's products, and Uncle Wip, probably the first kiddie show host locally, introduced a company of talented youngsters who sang and danced.

But it wasn't until the early 1950s, when the television set started to become a fixture in many homes, that television programming really took off locally. Channel 3 was the forefront then, too, giving TV its first celebrity, Ernie Kovacs. Kovacs' early programs for NBC, *It's Time for Ernie*, in 1951, followed by *Ernie Kovacsland*, and *Kovacs On The Corner*, originated WPTZ-TV's Philadelphia studios.

The 50's also saw significant pioneering in children's programming. Australian Lee Dexter made his *Bertie the Bunny* character an enchanting and popular fixture in children's TV along with characters Sir Guy, the Wily Fox, and Fuzzy and Gussy.

In June 1953, Channel 3 became an NBC owned and operated station. NBC acquired the station through an exchange of broadcast properties with Group W. and, in February, changed WPTZ-TV's call letters to WRCV-TV.

In June 1965, Channel 3 took on the call letters KYW-TV as Group W once again assumed ownership of the Philadelphia station. Until that time, KYW-TV had been operating in Cleveland and with its move to Philadelphia, the popular station took with it *The Mike Douglas Show*, the first live syndicated program to originate in Philadelphia.

But all of Channel 3's innovation hasn't been in entertainment. In 1968, KYW-TV pioneered the *Eyewitness News* format, which is now used throughout the country. This concept allowed reporters to deliver their own stories, a revolutionary development since, in those days, all stories were prepared by the station anchormen. The revolution goes on today as Channel 3's new anchors break new ground in the cable industry.

Today, Channel 3, located on historic Independence Mall, can reach into millions of homes — a figure that would have been incomprehensible to the Philco engineers tinkering with 100 sets in their living rooms. And although empoyee talent shows are gone forever, W3XE's great experiment continues every day as its grandchild, Channel 3, goes on breaking new ground in broadcasting.

AYDIN

The former Aydin Corporation in the Philadelphia area owned three product companies in the late sixties and early seventies: Aydin Controls, Aydin Monitor Systems and Aydin Vector. Aydin Controls eventually spawned Aydin Computer Systems and were both concerned with computer display terminals and graphics systems. Their products served primarily the utility industry in control rooms and plant monitoring.

Aydin Monitor Systems, and Aydin Vector provided telemetry products and systems for aircraft, spacecraft, and missile test programs of U.S. government agencies and prime contractors. They were operated as independent entities by Aydin Corporation until being combined as Aydin Telemetry in the late 90's. Aydin Telemetry was subsequently acquired by L3 Communications Corporation and became a part of L3 Communications Telemetry East division in Bristol, PA.

Aydin Monitor Systems specialized in ground based aerospace PCM telemetry products and systems for reception and processing of telemetry transmitted by aircraft and spacecraft. Aydin Vector designed and produced telemetry products for integration into airframes, spacecraft, and missiles. Both divisions were prime suppliers to most major manned and unmanned space programs, and many aircraft and missile test programs.

THRESHOLD TECHNOLOGY —

Leader in Voice Recognition

Threshold Technology, Inc., headquartered in Cinnaminson, NJ, near Philadelphia, was founded by Thomas B. Martin and Marvin Herscher, in May 1970, and is the technological and industrial leader in the new and promising field of electronic speech recognition.

Threshold pioneered the development and manufacture of successful systems, which have proved both reliable and cost effective in various applications at some of America's largest corporations.

Incorporated in 1970, Threshold became publicly owned in early 1972. In October 1973 Threshold and EMI Limited, a billion-dollar London-based international electronics and leisure conglomerate, established a joint United Kingdom Co, EMI Threshold Limited, which markets and services Threshold systems in Europe.

For many years, people have sought a way to control machines to, "tell a machine what to do." Since the computer became an integral element of business and indus-

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try, scientists and engineers the world over have been seeking a way to "talk to the computer," to speak information directly into its memory for storage, computation, subsequent print-out and use.

Voice communication has been viewed as the ultimate step towards simplifying the dialog between humans and machines. Historically, the mode of our communication with machines or computers has been determined by the operational requirements of equipment. Controlling machines required learning either the "language" or the machine or the manipulation of special dials or keys in the proper sequence under a rigid format. Any deviation from this unnatural machine language produced errors, which were not easily recognized. Now, however, that problem has been solved.

Threshold Technology, Inc. manufactures and markets recognition systems, which for the first time allow one either to "talk" information directly into a computer, with no intermediate keying or hand-written steps involved, or to control electro-mechanical systems with voice commands.

Differential Analyzer

III. Computers and Instrumentation

— COMPUTERS —

UNIVERSITY OF PENNSYLVANIA

Differential Analyzer

The Moore School had been involved in the computing field for at least 10 years before the ENIAC (Electronic Numerical Integrator and Calculator). In this time it built small machines, but its outstanding production was the construction in 1933-35 of the differential Analyzer, which was a machine about 50 feet long and contained 14 integrators. It was an analog machine, based primarily on a development of Vannevar Bush of MIT, and carried out many analog operations. It was originally intended to help with non-linear equations of Moore School research. At the time it was built, the Moore School of Electrical Engineering had virtually no funds for the project but great good fortune matched the idea to the times (curiously, since it was 1933-35) and a machine of about $200,000 value was achieved in 1935.

Only two other machines of this type existed, one at MIT, the other at the Army Aberdeen Proving Grounds in Maryland.

When World War II came along, the capacity of the Differential Analyzer at the Ballistic Research Laboratories at Aberdeen, was exhausted with calculating mostly firing tables for artillery projectiles. The Moore School's Differential Analyzer came to its aid, which was running around the clock. Lt. Herman H. Goldstine supervised the Aberdeen Proving Grounds Contract. He later sold the Army Ordinance the idea of an electronic trajectory computer, which the Army subsequently named the ENIAC.

ENIAC — Computer Development at the Moore School of Electrical Engineering

By J.G. Brainerd, LF '69

The ENIAC, which was conceived, developed, designed and built entirely within the Philadelphia section, and specifically in the Moore School was the world's first large-scale digital electronic general-purpose computer. The history of its inception and creation has been

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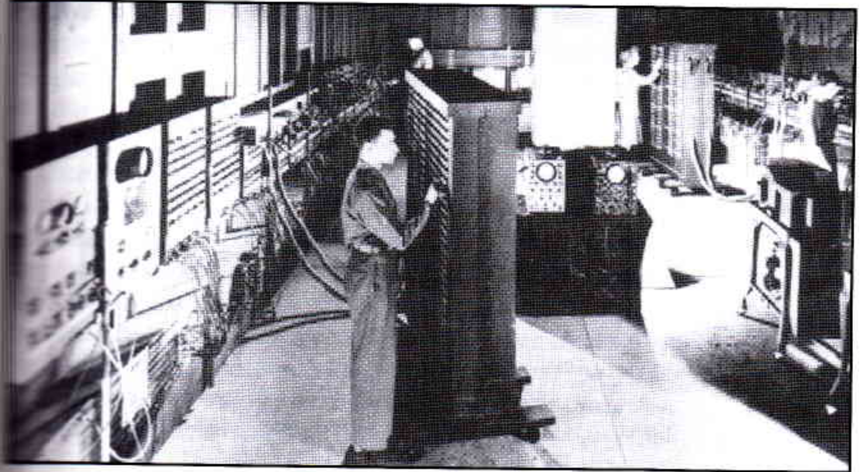

ENIAC Computer

told in many articles and books, and the ENIAC has become a matter of historical importance. To summarize extremely briefly: a stimulating memorandum was written by John W. Mauchly (Assistant Professor), given to J. G. Brainerd (Professor and supervisor of other war research projects), and then discussed with Lt. Goldstein (liaison officer with the Army Ordnance Department, stationed at the Moore School), who effectively sold the idea to two superior officers. The result was that the University submitted a formal proposal and was awarded a contract for the R&D work.

Under the contract the project was the responsibility of the University, and within the University, by agreement of two responsible officers, Brainerd was placed in complete charge of the project, a position, as he afterwards said, he would not have taken if he did not know that he could transfer J. Presper Eckert, a brilliant instructor and graduate student, to the new project.

The ENIAC project began June 1, 1943, and the machine was dedicated February 1946. It was a huge affair containing 18,000 vacuum tubes, almost four times that number of resistors, and it had a frame about 80 feet long arranged in the form of a U. ENIAC required environmental cooling and several technicians around the clock just to replace the vacuum tubes.

The first paper ever written about large-scale electronic digital general-purpose computers was the description of the ENIAC, which appeared in February 1946 in The Pennsylvania Gazette, the Penn Alumni magazine. The first article of potential application of large computers to business problems was written by Adolph Matz, Professor of Accounting in Penn's Wharton School, and appeared late in 1946 in a professional accounting journal. That paper had an interesting short history in that it was rejected originally as too ephemeral, but apparently the publicity which accompanied the dedication of the ENIAC, changed the editor's mind.

The Moore School went on to build a second computer, the EDVAC, which was larger mathematically, but far smaller and more efficient physically, and had stored memory. It was not, however, the second of the big computers because Maurice V. Wilkes, Professor at the University of Cambridge, England, finished his EDSAC sooner. The EDSAC was a machine for which Professor Wilkes set up a project immediately after visiting the Moore School.

Later, the Moore School produced the plans for the UDOFT (Universal Digital Operational Flight Trainer) under the direction of Professor Morris Rubinoff. At the time, this was the most flexible such device ever designed. It opened the field to training with groups of planes simultaneously, rather than with just one. The UDOFT was built by a commercial organization to the Moore School plans.

ENIAC weighed 30 tons, and occupied 1,500 square feet of space on the first floor of the Moore School. It was capable of performing 300 multiplications per second. By contrast, the fastest electromechanical devices at the time could only do one multiplication per second.

John W. Mauchly

Abstracted from an interview by Marian F. Fegley

John W. Mauchly

The circumstances which shape our lives, are varied, often curious. One might often wonder what inspired the great inventions that changed the course of many lives. John W. Mauchly related his story of one such invention, ENIAC, the first all-electronic computer, as the attainment of a long sought goal. Many factors had combined to inspire him to build a calculating machine which would do more and do it faster that any equipment than known It did not happen in a flash, but

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quired years of working toward the goal despite much discouragement from others This work continued even after e ENIAC was completed.

John Mauchly attended public school in Washington, C., where his father was head of the Section of Atmospheric Electricity of the Department of Terrestrial Magnetism of the Carnegie Institute of Washington from 1913 until s death in 1928. As a high school student, John would ccasionally help take measurements in his father's office.

With the encouragement of a high school teacher, he pplied for a scholarship at the Johns Hopkins School of ngineering. After two years in the School of Engineering, e abandoned his Maryland State scholarship and was ccepted as a New Plan student in physics. Under this an, he mixed graduate and under-graduate courses. In 932, he earned his Ph.D. in electrospectroscopy without opping for a bachelor's or master's degree.

He remained at John Hopkins as an assistant in hysics for another year, after which he was named professor of physics at Ursinus College.

Statistics began to draw his attention. First, he used statistics for a new problem, comparing his students with those other American colleges and universities. Standardized ests, which were constructed and measured statistically, ere available. Statistical studies and analyses were not enerally applied to physics or chemistry in those days.

A second-hand oscilloscope purchased by Mauchly as used by physics students during the day, but at night as used to put together circuits to count pulses to make n electronic calculator. The idea seemed rather obvious to r. Mauchly, as it was similar to the method then used to ount cosmic rays. Thus the idea of an electronic calculaor was conceived as Mauchly and his student assistants rocessed some of the mass of geophysical data. He elieved that all one needed was suitable inputs from keyoards or punched cards and outputs to punched cards or rinters. He also realized that to be really useful, the equipment must be able to store information and remember a et of instructions on what to do with the numbers.

About this time, he built an analog computer with 12 nput knobs and one output knob. This was used to anayze the tide in the atmosphere as it's affected by the sun and the moon. Calculations which required 20 minutes using a desk calculator could be done in 2 minutes with he analog computer and a reading meter. The results ooked interesting, but so much more data needed to be analyzed before truly significant results could be obtained.

About 1940, Dr. Mauchly believed that he had to get the electronic computer program started. Since Ursinus College did not have the funds for such a project he considered industry, government service, and other academic institutions. At the same time, he sought opportunities to learn more about calculating instruments already in existence or proposed. He spoke freely of his ideas hoping for both support and suggestions.

A graduate course on the theory of design of computing instruments at the University of Pennsylvania attracted his attention because of Penn's differential analyzer. When Penn offered a summer defense training course in electronics in the spring of 1941, he was quick to apply, knowing that those completing courses would be considered hired in a defense industry.

He went to Iowa State College (now Iowa State University) to see Dr. John V. Atanasoff, who was building a computer (far from completion) with the help of graduate students. While there, he heard that he had been accepted for Penn's summer course. Dr. Atanasoff and Mauchly had met at an American Association for the Advancement of Science meeting over a year earlier where Mauchly had presented a paper in which he mentioned his idea for an electronic computer.

Since the laboratory work for the course was about the same as that which the Ursinus professor assigned to his senior physics students, he spent much of these periods discussing with the laboratory instructor, J. Presper Eckert, Jr., the possibilities of building a computer. Upon completion of the course, Mauchly was offered and accepted a teaching position at Penn's Moore School.

The Moore School's differential analyzer was being used by Army Ordinance to supplement its twin at Aberdeen Proving Grounds. Both were hard at work for the Ballistic Research Laboratories, calculating firing tables of the path along which projectiles travel when fired.

When Lt. Goldstine, who was supervising the Aberdeen Proving Grounds contract at the Moore School, learned about Mauchly's ideas, he was fired with enthusiasm and asked Mauchly to submit a development proposal to the Army.

The proposal was made in early April and a contract for research into an electronic trajectory computer with the Ordinance department of the U.s. army became effective July 2, 1943. Mauchly and Eckert set to work on the design with a team of 12 engineers. The computer they designed was not like any previously described in print. It was essentially a repetition of may common parts which would accept decimal numbers, give decimal output, and provide a decimal storage device. Every bit of circuitry was built to operate on the "all or none" principal. Many design principles were established at the start. Mauchly said (before his death), "I think of Eckert as being one of the first people who deserve the title of reliability engineer." The actual value of resistors and the performance of vacuum tubes available in 1943 varied widely. Dr. Eckert designed the circuits so circuit performance would be independent of circuit current.

In December of 1945, the monstrous machine was completed. The electronic numerical integrator and calculator, dubbed ENIAC by Army Ordinance, had a half million parts and over 18,800 vacuum tubes of only 10 types, 60 kinds of resistors, and 30 kinds of capacitors.

Continued from Page 28 —

In mid-February 1946, various news media carried the announcement that the ENIAC, an electronic computer, had been invented by J. W. Mauchly and J. Presper Eckert, Jr., and built at the Moore School.

The ENIAC, which required about 3 ms for a multiplication, or did 5000 additions a second, promptly made relay calculators obsolete from the scientific viewpoint for they had a top speed of about 10 additions per second. During its first months at the Ballistic Research Laboratories, for a typical week of actual work, ENIAC was equal to 500 human computers working 40 hours with desk calculators. It was anticipated that this rate would double or triple as the operators gained experience. While designed primarily to calculate trajectories, the ENIAC was modified during the building to enable the machine to calculate a very wide class of problems. It had two major limitations: its storage capacity was at most 20 numbers (of 10 decimal digits each) and the instructions had to be set up through a slow manual process of wire plugging or switch setting.

Although the ENIAC did not have a large storage device, the 1945 report gave a clear recognition of both the problems and the advantages to be gained through the availability of such a device. Actually the realization that this was needed and could be included came in 1944. This was a crucial point as the ENIAC design was well underway. As there was so much skepticism about its ability to function as proposed, work was continued on the original design. The ideas were recorded and later incorporated in the EDVAC, built at the Moore School, the UNIVAC designed by Eckert and Mauchly and subsequently produced by Remington Rand, and the smaller BINAC.

The application for a patent on the ENIAC was the longest ever filed up to that time, June 1947. No one in the patent office was then qualified to examine it. The patent was issued 17 years later, nearly 8 years after ENIAC had been dismantled following 10 years of continuous operation at Aberdeen Proving Grounds.

J. Presper Eckert, Jr.

John Presper Eckert, Jr. was co-inventor of the mammoth ENIAC computer in 1945. Working under an Army contract in World War II to automate artillery calculations, Mr. Eckert and Dr. John W. Mauchly designed a computer with more that 18,000 vacuum tubes that received instructions through hundreds of cables resembling an old time telephone switchboard.

The 30-ton Electronic Numerical Integrator and Computer (ENIAC) was assembled at the Moore School. It could complete in 30 seconds a trajectory calculation that took a clerk 20 hours. Stacks of punched cards provided the data, which at times included work for the Manhattan Project.

John Presper Eckert, Jr.

Although ENIAC resembled a scene from a 1950's science-fiction movie, its flashing pink lights, clicking switches and miles of cables hid a design remarkably similar — in concept, at least — to modern computers.

Mr. Eckert is credited with having solved the thorny problem of reliability by running the delicate vacuum tubes, which failed often, at low voltage and avoiding brittle solder connections by relying on hundreds of old-fashioned plugs. By rearranging the plugs and their cables, the computer could be reprogrammed to solve a wide variety of problems.

J. Presper Eckert, Jr., as he preferred to be known, was born in Philadelphia. He earned a bachelor's degree at the Moore School and joined the faculty shortly after graduation.

In 1943, he earned his master's and began collaborating with Dr. Mauchly on solving the problem of compiling the ballistics tables that artillery officers use to aim their guns.

For centuries artillery officers labored over those calculations, and a small error could be disastrous. Many variables, including wind, humidity, target elevation, distance and shell weight, made the calculations extremely complicated and caused the Army to issue volumes of hand-compiled tables.

Mechanical calculators helped, but the Army spent much of World War II looking for a way to avoid recalculating thousands of tables whenever even small changes were made to the artillery.

In addition, the Manhattan Project severely strained even the most accurate mechanical calculators, which were Rube Goldberg Devices that used motors, generators, photoelectric cells and vacuum tubes. ENIAC, not unplugged until 1955, was the answer to both problems.

Mr. Eckert retired from Unisys in 1989, but continued to be a consultant.

Mr. Eckert, who obtained 87 patents, received an honorary doctorate from the University of Pennsylvania in 1964. In 1968, President Lyndon B. Johnson awarded him a medal for his work as co-inventor of the computer.

— Continued on Page 30

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Grace Hopper

Commodore Grace M. Hopper, USNR – Official portrait photograph, taken 20 January 1984.
Photographed by James S. Davis

Rear Admiral Grace Hopper was a mathematician, computer scientist, systems designer, and the inventor of the compiler. Her outstanding contributions to computer science benefited academia, industry, and the military. In 1928, she graduated from Vassar College with a B.A. in mathematics and physics and joined the Vassar faculty. While an instructor, she continued her studies n mathematics at Yale where she earned an M.A. in 1930 nd a Ph.D. in 1934. Grace Hopper is known worldwide or her work with the first large-scale digital computer, the lavy's Mark I. In 1949, she joined Philadelphia's Eckert-Mauchly, founded by the builders of ENIAC, which was uilding UNIVAC I. Her work on compilers, and on makng machines understand ordinary language instructions, ead ultimately to the development of the business lanuage, COBOL. Grace Hopper served on the faculty of e Moore School for 15 years, and in 1974 received an onorary degree from the University.

CKERT-MAUCHLY COMPUTER ORPORATION

Soon after the ENIAC development, Drs. Eckert and Mauchly formed the Elecnic Control Company, which subseently became the Eckert-Mauchly mputer Corporation. In 1949, this npany completed a computer led BINAC (Binary Automatic Comer), which was believed to be the t machine to be programmed by ernally stored instructions. signed for scientific applications, AC was built under contract to the throp Corporation, California.

The development of BINAC ved as a test vehicle of plans Eckert-uchly had formulated for the UNIVAC®I (Universal Automatic Computer). UNIVAC I was the world's first, general-purpose commercial computer able to handle a wide variety of applications.

An alpha-numeric machine, UNIVAC I made extensive use of peripheral equipment — card reader, magnetic tape units and printer. Another significant feature was that it was able to simultaneously read new information, compute information just read and record the output results.

Data and program instruction were all stored in a mercury delay line memory. Information could be recycled in the line in the form of acoustical pulses. After pulses traversed the length of the mercury, they would be read and automatically introduced again to the beginning of the line. This process could go on indefinitely while needed information could be accessed as fast as 200 ms.

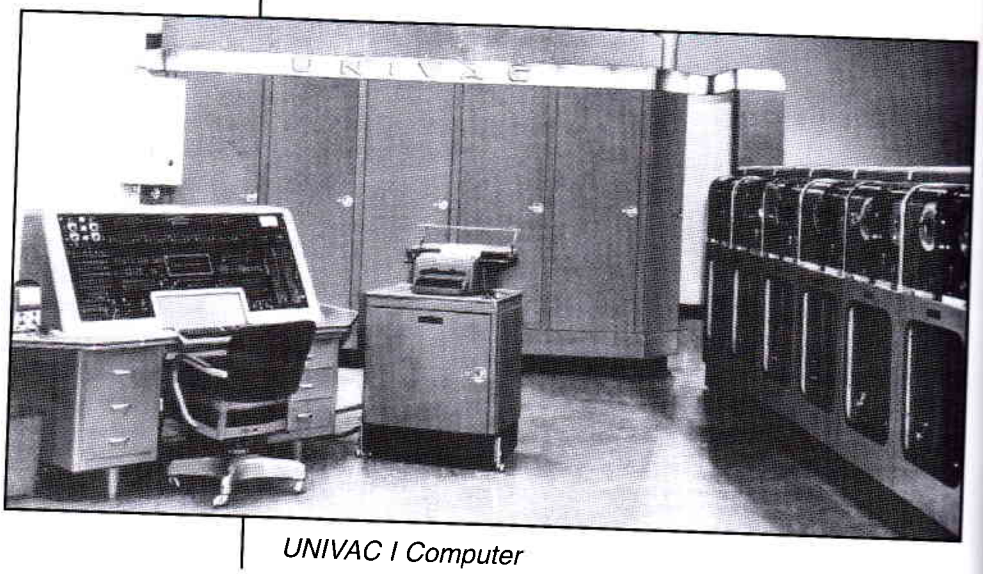
REMINGTON RAND

The Eckert-Mauchly Computer Corporation was acquired by Remington Rand, Inc. in 1950, and work continued on the UNIVAC I development. The first UNIVAC I was supplied to the United States Bureau of the Census in March 1951.

The UNIVAC I central processor weighed 16,000 pounds and used more than 5,000 vacuum tubes. It could perform about 1,000 calculations per second.

UNIVAC I became famous for its use in predicting the outcome of the 1952 Presidential election — the first time a computer was used for this purpose. The computer predicted that Eisenhower would defeat Stevenson by 438 electoral votes to 93. The actual count turned out to be very close to this — 442 to 89 in favor of Eisenhower.

In 1952, Remington Rand made a second acquisition in the data processing field by purchasing Engineering



UNIVAC I Computer

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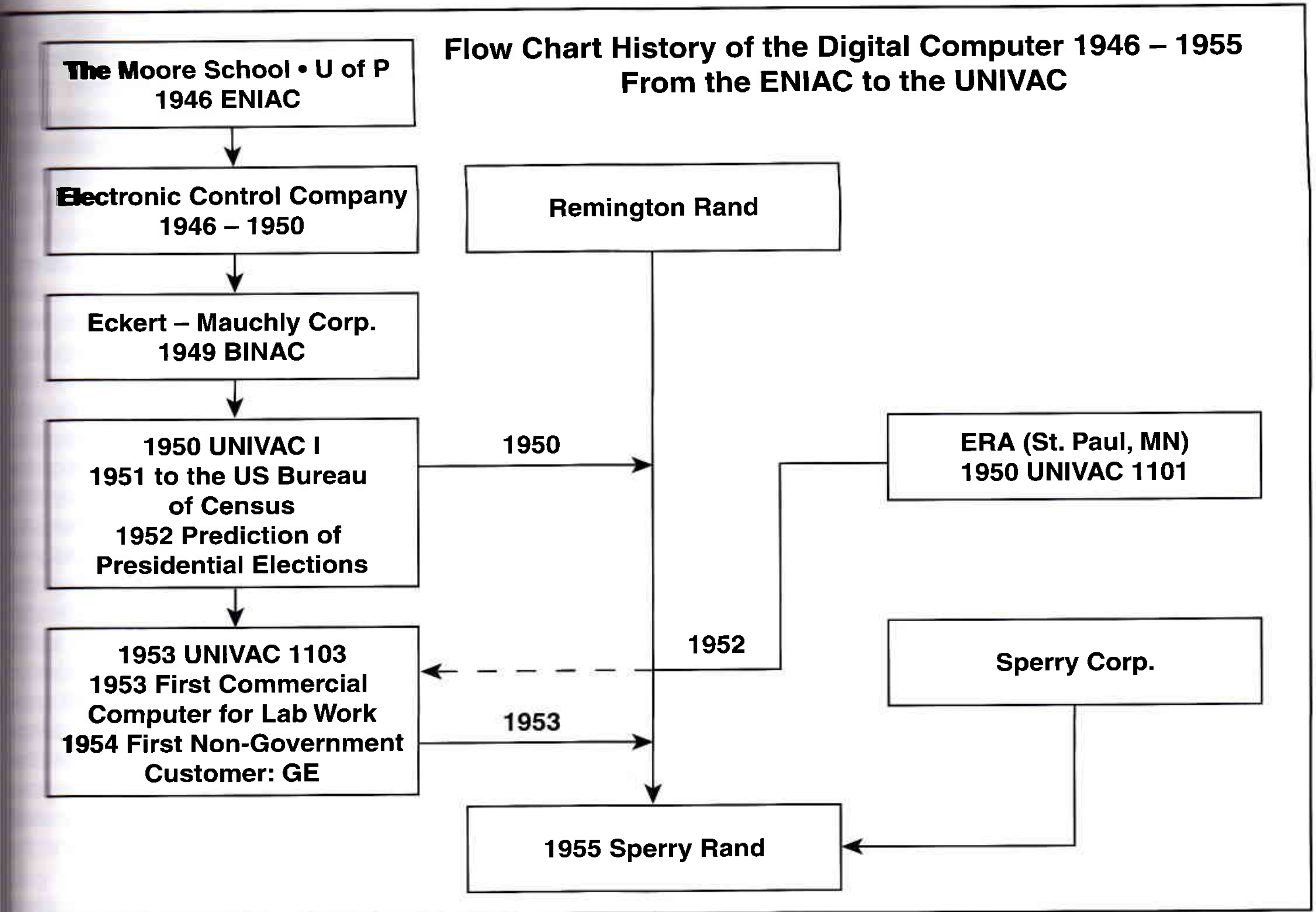

Research Associates (ERA) of St. Paul, Minnesota. ERA consisted of a group of mathematicians and engineers who, during World War II, had been active in the development of electronic cryptographic equipment.

After the war, ERA entered the data processing field and, in 1950, delivered the first scientific computers in the United States to the U.S. Navy and Georgia Institute of Technology. Later known as the UNIVAC 1101, these machines were markedly different from the UNIVAC I.

In contrast to the UNIVAC I's mercury delay line memory, the UNIVAC 1101 stored programs and operating data on the surface of a rotating magnetic drum. This early work with magnetic drums proved to be an invaluable experience for subsequent development of on-line, real-time systems.

The 1101 is believed to be the first electronic computer that was used in a real-time, on-line mode. It was directly connected to the wind tunnel at the Wright-Patterson U.S. Air Force base in Dayton, Ohio. This analog information recorded by sensors in the wind tunnel was converted to digital form, transmitted to the computer, processed by the computer, converted again to analog form, and fed back to the wind tunnel to help control and adjust its performance.

In 1953, the 1103, an improved version of the 1101, was produced. (See the ENIAC to UNIVAC Flow Chart above.) This was the first commercial computer to be delivered to a customer with coincident current magnetic core storage. The UNIVAC 1103 was 2,000 time faster than the 1101.

During the early 1950's, following the installation of the Bureau of Census UNIVAC I, computers started to move out of the laboratory and into the business world. In 1954, the first system delivered to a non-government customer went to General Electric in Louisville, Kentucky.

SPERRY RAND CORPORATION

In 1955 Remington Rand and Sperry were consolidated to form Sperry Rand. Univac became a separate division of Sperry Rand in 1962. The division name was changed to Sperry Univac in 1973, and the corporate name to Sperry in 1979. (See Flow Chart on Page 13.)

Simultaneously, there were several facility changes

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ing on during this period of computer development in e Philadelphia area. After leaving the University of Pennlvania, Eckert and Mauchly established their company 1215 Walnut Street. In 1948 they moved to Broad and pring Garden Streets, also in the center city area. In 49 the company moved to Ridge Avenue in North iladelphia. Subsequently, after Remington Rand quired control, the Eckert-Mauchly division was headartered at three separate locations on Allegheny enue in North Philadelphia between 1952 and 1955.

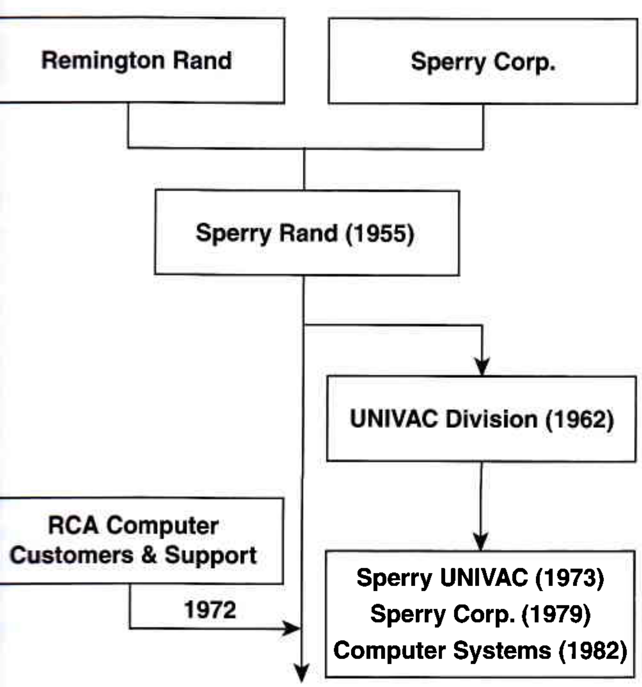
In 1961, a Univac Engineering Center was established Blue Bell, PA, and gradually the company's personnel ere relocated from North Philadelphia. The Blue Bell site came the world headquarters in 1966.

Sperry pioneered many computer advances, originat- or improving upon major historical developments in the ld of data processing. These improvements have anned every generation of computers from those in the a of vacuum tubes, to the introduction of transistors, and er to semiconductor integrated circuits. Main memory evelopments progressed over the years from mercury lay lines and magnetic drums to ferrite cores, plated re and then to integrated circuit technology.

Progress in the development of peripheral equipment pt pace with improvements in the central processor. rough the years, refinements and new engineering chniques produced peripheral equipment with even gher operating speeds and greater capabilities.

With the growth of data communications, production of th the printer and visual display type of remote terminal came a major part of Sperry manufacturing.

Flow Chart History of Sperry Corporation



Another area in which Sperry excelled was the development of real-time computers. The development of the first operational real-time computer originated in 1954 when the US Navy asked Sperry to help in the development of a system that would instantaneously and automatically accept, process, and display vital tactical information in shipboard combat centers. Sperry subsequently designed and built a real-time computer that was known as NTDS (Naval Tactical Data System). One such system, which enables all the fighting and maneuvering of a task force to be coordinated from the bridge of one ship, was installed in the 85,000 ton aircraft carrier USS Enterprise.

The experience obtained in developing the naval system was later incorporated in the first commercial real-time systems introduced by Sperry — the 490 Series of computers.

Real-time systems, which were a prominent part of the Apollo (Man-on-the-Moon) program conducted by the National Aeronautical and Space Administration (NASA), are installed at control centers in the United States as well as on land and ship tracking stations throughout the world.

Sperry computers formed the heart of the NASA worldwide communications network (NASCOM) centered at the Goddard Space Flight Center in Greenbelt, MD. In addition to the NASCOM network, several Sperry 1218 model computers assisted NASA operators in monitoring the astronauts' physical condition on missions, as well as the spacecraft's on-board systems during the six-minute pass over the tracking stations. Other Sperry systems were used in the NASA facilities at Goddard, Slidell, Houston, and the Marshall Space Flight Center at Huntsville, Alabama.

Another NASA project in which Sperry computers played a major role was the Mariner program for the exploration of the planets, conducted by the jet Propulsion Laboratory at the California Institute of Technology in Pasadena. On the Mariner 9 mission, Sperry 1230 computers processed photographs of Mars taken from a spacecraft at distances varying from 76 to 146 million miles from Earth.

In the military area, the Defense Systems Division (DSD) has supplied several Naval Tactical Systems (NTDS) to the U.S. Navy and to warships of other nations in the North Atlantic Treaty Organization (NATO). Micro-electronic computers and advanced computing equipment for the Polaris/Poseidon submarine navigation system and airborne computers for the anti-submarine warfare program are examples of other equipment furnished by DSD to the Navy.

Among other significant Sperry contributions to the nation's defense programs was the provision of more that 160 computers for the U.S. Air Force's Base Level Supply Inventory Accounting system, and the installation of realtime computers for the Defense Department's AUTODIN (AUTOmatic DIgital Network) high-speed, worldwide communication systems.

Early in 1983, the U.S. Air Force awarded Sperry a $520 million contract (in its first stage), known as Project

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Ultra-Phase Four, to update the Base Level Supply Inventory Accounting system.

At that time, this was considered to be the largest single commercial computer order of its kind on record. Among the first non-military applications of Sperry real-time computers were systems supplied for processing airline reservations and for air traffic control by the Federal Aviation Agency.

The ARTS III computed-aided traffic control system, organized around Sperry systems, is generally considered to be one of the best air traffic control advancements.

Beyond the numerous computer systems used in air transportation, Sperry customers represent a diversified range of interests (engineering laboratories, petroleum concerns, geophysical exploration firms, manufacturing companies, banks, savings and loan associations, insurance companies, stock brokerage companies, distributors of financial information, newspapers, hospitals, universities, and state and local government agencies).

Computers from Sperry continually included new technology advances in the state of the art. From such earlier models as the LARC, the UNIVAC II and III, and the Solid State System came many advances incorporated into newer models. The Sperry 1107, announced in 1962, was the first commercial computer to employ thin-film memory. The 1100/20 and 1100/40 systems, introduced in March, 1975, marked the first use of semiconductor integrated circuits in the main processors of large-scale Sperry computers.

Sperry's growth curve took on a new dimension in January 1972, when the company acquired RCA's former computer customers and assumed responsibility for providing hardware and software support to these users in the United States, Canada and Mexico.

This customer base included 1000 computer installations and 500 customers. In addition, about 2,500 professional personnel, formerly with the RCA computer organization, joined Sperry.

Sperry entered the minicomputer market in 1977 by acquiring Varian Data Machines, a subsidiary of Varian Associates, Palo Alto, CA.

In October 1982, Sperry announced its entry into the office systems market with the introduction of the SPERRYLINK™ office system.

To reinforce their technological leadership, Sperry then became active in joint ventures with other companies. Early in 1983, Sperry joined Microelectronics Computer Technology Corp. (MCC), a consortium formed by 12 American companies headquartered in Austin, Texas. MCC's objectives were to share the high costs of research and development, to stay abreast of the worldwide developments in computer technology, and to keep the United States in the leadership position in advanced research.

Headquartered in Blue Bell, PA, the Computer Systems unit of Sperry served more than 15,000 customers in 50 countries.

BURROUGHS

In 1885, at the age of 28, William S. Burroughs filed an application for his first patent, establishing priority for the adding and listing machine. He didn't actually invent the adding machine in the sense that he created it from nothing. (Calculating devices had existed for centuries, at least since the abacus.) He combined existing technologies to build the first practical adding machine, which was manufactured by the newly formed American Arithmometer Company, renamed the Burroughs Adding Machine Company in 1905.

In 1944, Burroughs was awarded an Army-Navy "E" for outstanding achievement in the production of war material, principally the Norden bombsight, which made accurate high-altitude bombing possible and was considered by some military authorities as the single most significant device in shortening the war.

In 1949, permanent facilities for electronic research and development were established near Philadelphia. Three years later an Electronic Instrument Division was established in that city to manufacture and market scientific instruments and electronic memory components and systems.

The emphasis on electronic products resulted in a series of innovative banking and accounting machines called the Sensimatic, which was produced by Burroughs in the late 1940s. In 1950, the company introduced the first Sensimatic accounting machine with programmed control panel, a product considered the greatest advance in accounting machines in 25 years. In 1951, experiments began at the company's research and development center, which were aimed at developing a series of computers specifically for business problem solving.

In parallel with Burroughs development of electronic products for accounting applications, the company expanded its capability for development of larger, multipurpose computer systems. The Burroughs memory system, built in 1952 for ENIAC, the world's first electronic computer, increased the computer's memory capacity sixfold and demonstrated the company's capability in electronic computation.

With the acquisition of several companies in the late 1940s, and early 1950s, Burroughs began to diversify its operations. Burroughs acquired the Electro-Data Corporation of Pasadena, California in 1956. Electro-Data, a leading producer of computing equipment, provided Burroughs with much needed engineering and manufacturing capacity. The same year Burroughs Great Valley Laboratories were opened in Paoli, PA.

Burroughs development of a full range of computer systems progressed steadily. The B 5000, introduced in 1961, was regarded as the most advanced business and scientific computer offered by any manufacturer. It depart-

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ed from traditional concepts of computer design and featured such pioneering concepts as automatic multiprogramming, exclusive use of compiler languages, Burroughs Master Control Program, and virtual memory.

The B 5000 was followed by the more powerful B 5500 system in 1964, as Burroughs began its family approach to computer design. The 500 family served a broad cross-section of data processing requirements in fields such as banking, manufacturing and government.

Burroughs' success at solving business problems took a further evolutionary step in the late 1960s with the introduction of the Series TC terminal computers and the series L mini-computers. As developments in microcircuitry were applied to Series TC and Series L systems in the 1960s and 1970s, the systems evolved from electro-mechanical machines to fully electronic computers.

The early programs to expand Burroughs electronic capabilities also resulted in the company being awarded numerous government and defense contracts. Burroughs computers were used by the United States Navy in its POLARIS program and by the U.S. Air Force in the SAGE, ALRI, and BUIC Continental Air Defense networks. In 1961, Burroughs was named by the Air Force as hardware contractor for the NORAD combat operations computer complex and data display system.

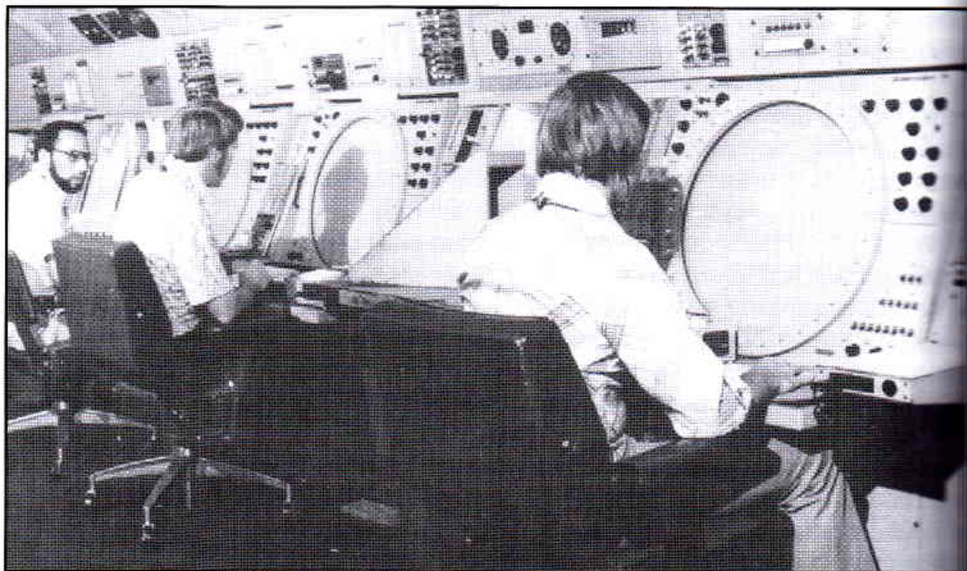
During this time, Burroughs was also an active participant in the U.S. space program. The world's first operational transistorized computer, produced by Burroughs in 1957, was used in guiding the launch of the Atlas Intercontinental Ballistic Missiles. A later version of this computer guided every launch in the Mercury and Gemini programs of manned space flights.

With the completion of the first space rendezvous, made in 1965 between Gemini VI and VII, Burroughs guidance computers had handled more than 300 successful missions without failure, error or delay.

Throughout Burroughs' extensive involvement in electronic research, defense projects, and the space program, the company remained in the forefront of the commercial market by supplying a variety of products for banking and business.

The 1970s saw the further merging of Burroughs electronics and computer development efforts of the previous two decades. The decade also marked Burroughs entry into other areas of information management, principally office automation.

Burroughs Series TC and Series L electronic systems, which had been introduced in the late 1960s, were continually refined for various business applications. These refinements, along with continued electronic developments, led to the introduction of the B 80 series of small-scale computer systems in 1976.



The ARTS II system, manufactured in Paoli, PA for the PAA by the Custom Products Group of Burroughs Corporation, is used to control air traffic at 96 small and medium-sized airports in the U.S.

Burroughs also continued to place strong emphasis on the development of lager computer systems during the 1970s. Following the successful 500 family of computers, the 700 family was introduced between 1971 and the end of 1975.

In late 1975, Burroughs began introducing the 800 family of systems with the announcement of a series of computers designed for medium-to-large-scale applications.

In 1979, Burroughs announced the first models of the 900 family of systems. The 900 models typically occupied half the space and required 50 percent less power to operate than the 800 family models.

The Burroughs expansion in data processing was paralleled by its entry into the office automation market. The company entered the facsimile communications market in 1975. In 1979, the company added an optical character recognition page reader system to this growing range of office automation products, which became an increasingly important segment of Burroughs "total solution" approach to information management.

In the early '80s Burroughs, together with Convergent Technologies, introduced the B 20, a family of powerful microcomputers.

In software, Burroughs introduced a new product called LINC (an acronym for Logic and Information Network Compiler) that actually wrote other programs for a wide variety

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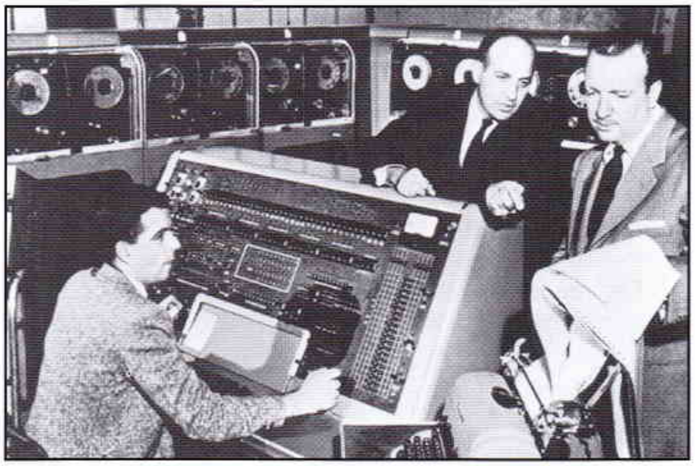
of business situations. Since you didn't have to be a professional programmer to use it, LINC put the power of the computer in the hands of a great many more people.

In 1986, Sperry and Burroughs, two giants of the computer industry, joined forces to form Unisys Corporation. Sperry introduced the 2200 Series, a forerunner of the current ClearPath HMP IX system. In 1989, Unisys introduces Micro A, the first desktop single-chip mainframe computer.



In the 1952 presidential election, the newly developed UNIVAC I computer correctly predicted a landslide victory for Dwight D. Eisenhower over Adlai E. Stevenson. Walter Cronkite, CBS News, right, waited for the UNIVAC's prediction along with co-designer J. Presper Eckert Jr., center. The "giant electronic brain" made its forecast early in the evening. So early that the news media waited to confirm it with the actual vote counts across the nation. UNIVAC co-designer John W. Mauchly was the other half of the dynamic team that first sparked the computer revolution with the development of ENIAC at the Moore School of Engineering at the University of Pennsylvania. Together, Mauchly and Eckert were prime movers in bringing the concept of an all electronic large-scale computer from concept to reality. Philadelphia, known for starting everything from the American Revolution to the Slinky, was the site of development and manufacturing for production of UNIVAC. First order was to the U.S. Census Bureau in 1951.
(Photos courtesy of Unisys Corporation.)

UNISYS

Unisys carries forward the heritage of innovation established with UNIVAC today with the Unisys Enterprise Server ES7000. This is the first computing platform to bring mainframe-class, standards-based computing to the Microsoft Windows environment, providing enterprise-class scalability, uninterrupted availability, flexible resource reallocation, easy systems administration management and customer support that make the concept of the Windows-based mainframe a reality. The Unisys Cellular MultiProcessing server architecture on which the ES7000 server is based is capable of supporting a single 32-processor image of Windows. It was designed in anticipation of the advanced scale-up characteristics of the operating system. For most of the two years since the announcement of Windows 2000 Datacenter Server, the Unisys ES7000 has been the only server platform to take full advantage of the operating system's ability to scale to up to 32 processors.

Soon the word UNIVAC (Universal Automatic Computer) came to mean computer. Other government agencies like the U.S. Navy and large commercial companies like General Electric were soon lining up for a UNIVAC to tackle the challenges of high-volume transaction processing previously done with manual and mechanical means. (Photos courtesy of Unisys Corporation.)

In that brief period of time, enterprises have seen the performance of ES7000 servers reach levels that once could only be achieved by much more expensive UNIX-based systems. More recently, the combined technologies have nearly doubled those performance levels.

Unisys has not only taken advantage of the advanced enterprise-capable features built into the Microsoft Windows 2000 Datacenter Server operating system, it has had a shaping hand in defining their design and engineering their execution. Important examples of mainframe-style capabilities include change management, configuration audits and the ability to reallocate resources within a system to meet unanticipated shifts in workload. Unisys is playing a key role in bringing dynamic partitioning, a critical mainframe capability that enables administrators to move workloads to alternate computing resources without reboots, to the Windows 2000 Datacenter Server.

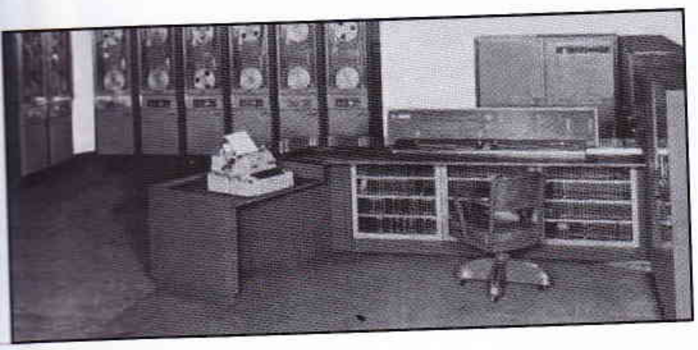
— Continued on Page 36

— Continued from Page 35

PHILCO

Philco was also active in the computers and aerospace industries. The first all transistorized computer was the Philco Transac S2000, developed in the late 1950s at the Philco plant on Wissahickon Avenue. It was an early full "room size" computer that competed with Univac, RCA and others.

The reader can see more details on the computer at: http://foodman123.com/s2000.htm. Philco also developed computers for the military at G&I and later at its new Willow Grove plant.



Philco Transac S2000

RCA

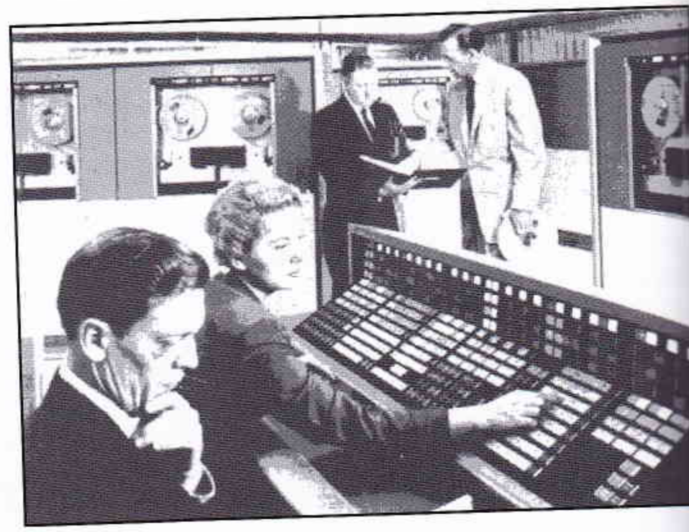
RCA BIZMAC

RCA BIZMAC

BIZMAC (Business Machine), an electronic data processing system containing 27,000 tubes and 67,000 diodes and occupying an area equal to a football field (including the end zones), was built by RCA Engineering Products Division, Camden, NJ. The system, delivered to the US Army Ordinance Tank Automotive Command, Detroit, MI in December, 1956, was the world's largest electronic brain at the time. The $5 million system was placed into operation in October 1957, and it successfully tracked over 100 million tank and automotive spare parts in the Army's worldwide inventory.

RCA Camden

In 1958, RCA launched its major venture into the electronic data processing field with the introduction of the RCA 501, a medium-sized commercial business computer and the first fully transistorized system



RCA 501 Computer

in the industry. By 1960, the Corporation had introduced the compact RCA 301 for medium-size and small businesses, and had announced a coming third entry, the RCA 601, for large enterprises and scientific computation.

In 1959, RCA introduced DaSpan, a computer-to-computer communications system that could span a continent and gather and coordinate vital data from the many plants of a large industrial enterprise.

The same computer-communications know-how made RCA the supplier to Western Union, the prime contractor of an automatic electronic data switching system for the Air Force Control Logistics Network (ComLogNet) linking 350 bases and stations across the country in the world's most advanced communications systems.

Progress in circuit design and system concepts led to a major step forward, in 1964. RCA introduced the Spectra 70 series, the first in the industry of a new third

RCA Computer Center, Cherry Hill, New Jersey.

Continued from Page 36 —

RCA Camden Computer Milestones are tabulated below:

Milestones:	Significance:
1950 — A joint RCA Laboratories-RCA Camden team, sponsored by the US Navy under the title Project Typhoon, demonstrates a computer containing 4,000 electron tubes that evaluates performance of guided missiles, ships, submarines, and airplanes.	The largest and most accurate electronic analog computer built to that date to evaluate performance of guided missiles.
1952 — RCA Camden initiates an intensive $10.6 million R&D program in electronic systems for computing, sorting, filing, and recalling large quantities of data.	Marks RCA's entry into the fledgling computer business.
1956 — BIZMAC electronic data processing system is built by RCA Camden, and delivered to the US Army Ordinance Tank Automotive Command in Detroit, in December.	The world's largest electronic brain at the time. The $5 million system, placed into operation in October 1956, successfully tracks over 100 million tank and automotive spare parts in the Army's worldwide inventory.
1957 — Following the successful delivery of its first BIZMAC a year earlier, RCA produces a second for the New York Life Insurance Company, and a third for the Travelers Insurance Company, Hartford, CT. Each systems covers 25,000 square feet of floor space, is composed of 357 separate units, and contains over 25,000 electron tubes.	The BIZMAC system for Travelers Insurance Company is, at this time, the largest commercial, multi-computer system in the U.S.
1959 — With the advent of solid-state devices and after three intensive years of research in the use of transistors to implement the logic of electronic data processing systems, RCA introduces the RCA 50 business computer.	The world's first all-transistorized business computer.
1959 — RCA introduces DaSpan, a digital communications system that links a central computer with numerous remote stations via telephone or telegraph lines.	DaSpan allows two-way computer-to-computer communications across the entire U.S., providing an efficient and economic means to gather and sort large volumes of data for companies with locations scattered across the country.
1959 — Under subcontract to Western Union, RCA begins development of an automatic electronic data switching system for the US Air Force Combat Logistics Network.	Following installation of systems at five U.S. Air Force bases in February 1963, the network is activated as the Data Communications (DATACOM) Network, representing the keystone in the nationwide Automatic Digital Network (AUTODIN).
1960 — RCA introduces the RCA 301 Computer System for small business applications and the RCA 601 for large enterprises in April.	RCA expands its computer product line, following the success of the RCA 501 (world's first) all transistorized business computer two years earlier.
1963 — RCA introduces the 3301 Realcom business computer, providing data processing, high-speed communications, real-time management control, and scientific computation.	The first business computer to span the full range of data handling capabilities in a single system.
1964 — Continuing engineering advances at RCA Camden leads to the introduction in December of the Spectra 70, a new series of third-generation RCA business computer systems.	The first commercial computer system to use monolithic integrated circuits.

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SPECTRA 70/61

generation of computers. The group initially included four compatible general-purpose computers — two of them employing the first monolithic integrated circuits to be used in the commercial equipment. A fifth model was added in 1965.

Another significant trend was the growing relationship between computers and communications — but in the development of computer-to-computer links and in the use of computers to increase the speed and flexibility of communications.

RCA introduced several advanced terminal devices during the 1962-1966 period for communication between computers and users. Among them were a voice response unit that provided spoken replies to inquiries telephoned directly to a computer, and a self-contained video display unit employing integrated circuitry.

At the end of 1962, the product line consisted largely of the 301 system for medium and small business enterprises, and the larger RCA 601 for industrial and scientific use. In 1963, a versatile new unit, the 3301 Realcom, was added to the line as the first computer designed to span the full range of data handling capabilities in a single system — business data processing, high-speed communications, real-time management control, and scientific computation.

In the same year, a significant adjunct to these systems was introduced in the RCA 3488 mass memory, designed to hold several billion characters and to operate with either the 3301 or the 301.

The Spectra 70/46 was introduced in 1967 and the large-scale Spectra 70/61 two years later to serve the growing market for remote computing systems. These two remote computing systems were the first RCA processors equipped with virtual memory (the main computer memory could be expanded almost limitlessly through a series of auxiliary devices and specially developed software).

However, RCA did not concentrate entirely on remote computing. In 1969, the company marketed a large-scale Spectra 70/60 batch processor designed to handle credit and reservations systems, automate production control, and serve data banks. The following year, RCA introduced a new series of small-to-medium-class computers — the RCA 2, 3, 6, and 7. Two of these new processors also had virtual memory.

Progress was also made in electronic composition systems. The speed of the RCA Videocomp was increased tenfold in 1968, making it possible to set the text of a novel the size of War and Peace in less than an hour. Two later developments further enhanced its capabilities: the ability to set complex line drawings and then position the drawings on a page together with text and the development of a program that enables the system to produce halftone photographs composed of small ideographic characters.

In the second half of 1971, RCA withdrew from the general-purpose computer business. Adverse business conditions, a uniquely entrenched competition, and the need for continued massive infusions of capital led to this decision by RCA.

RCA Princeton (David Sarnoff Research Lab)

RCA Laboratories' research in computer technology dates back to the late 1940's when research in magnetic ferrite materials led not only to the development of shorter television tubes with larger picture area, but also to the development of ferrite memory cores for computers.

In 1947, the Selectron, an electrostatic storage tube with a matrix of 256 small memory elements for computer use, was developed. It was the first binary digital computer memory.

Ferrite Core Memory and Dr. Rajchman.

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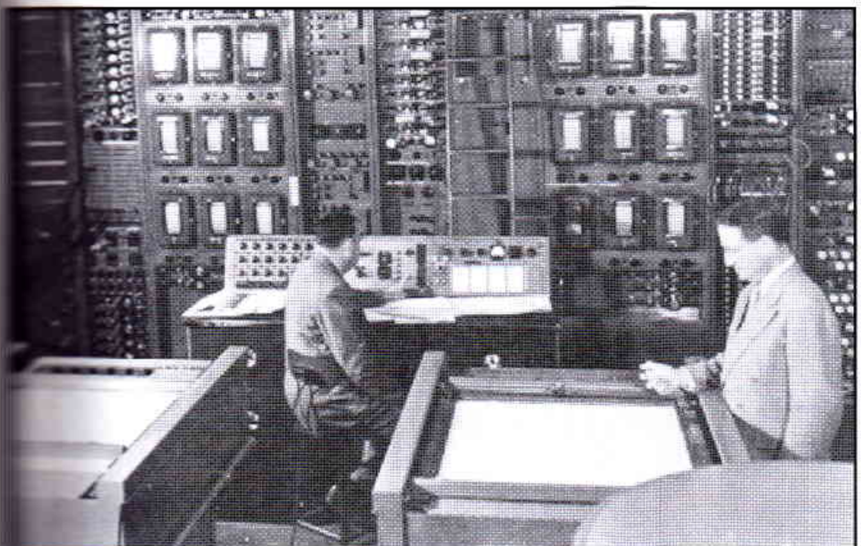

Typhoon Computer

In 1950, the Laboratories built Typhoon, the world's largest and most accurate electronic analog computer, for the U.S. Navy to evaluate performance of guided missiles, airplanes, ships and submarines. It could work out a complex air-defense problem employing a theoretical guided missile in one minute, a record achievement at the time.

The continuing work in computer memories and components, aided by advances in materials technology and solid-state physics, to such developments as (1) the laminated ferrite memory, the highest speed, most compact ferrite memory ever achieved; and (2) the cryoelectric memory, a large-scale memory using superconductivity to achieve its high capacity and high-access speed.

COMPUTER SCIENCES CORPORATION

In April 1959, Roy Nutt and Fletcher Jones, both in their late 20s, formed Computer Sciences Corporation with $100 and a contract from Honeywell to develop a business-language compiler called FACT. Formerly with United Aircraft Corp., Nutt had developed the first widely accepted assembly program, called SAP, and had been a member of the small IBM team that had developed FORTRAN. Jones came from North American Aviation Corp., where he had managed a divisional computer center.

Assembling a small staff of talented people, CSC soon gained a reputation for innovative design and high-quality work. With Nutt providing the technical direction and Jones handling the marketing, the young company prospered. Through its work for numerous computer manufacturers and other large computer users, CSC developed more systems software than any other computer services company in the industry.

CSC went public in 1963, and was listed the following year on the Pacific and American stock exchanges, becoming the first software company to be listed on a national exchange. Five years later, the company again brought new stature to the emerging software/services industry by being the first software company to be listed on the New York Stock Exchange.

CSC has transformed the $100 with which its founders established the company into annual revenues of $11.3 billion and approximately 90,000 employees worldwide.

CSC was built through a long and successful track record in acquisition — 83 companies have been acquired in the last 17 years, with the latest being DynCorp. More than 57,000 experienced professionals have joined CSC through these acquisitions, which were made to add new capabilities, increase resources, and expand global coverage. Additionally, over the years more than 26,500 experienced professionals joined CSC through outsourcing for many of the nation's major firms, adding critical skills and competences.

In the Tri-State area surrounding greater Philadelphia, CSC has a strong and visible presence in Bucks, Chester, Delaware, Montgomery and Philadelphia counties in PA; in Atlantic, Burlington, Cape May, Camden, Cumberland, Gloucester, and Salem counties in NJ; and in Delaware and Maryland.

About 3,000 CSC employees work in these four states, including a major portion in CSC's Federal Sector providing service and support to national, state and local governments. Additionally, CSC provides services to many major clients around the United States from these locations, especially in data centers in Wilmington and Newark, Delaware.

CSC's major organizations have worked on projects throughout the Tri-State area, from Web access center design and implementation planning for Children's Hospital of Philadelphia to providing maintenance, repair, improvement and operations services for all federal government property at the Defense Supply Center in Philadelphia. CSC has provided remote claims processing and MIS services for Christiana Care Health Plans. CSC was also responsible for the managed care software for Independence Blue Cross, the region's largest health insurer. Additionally, in the Wilmington area, E.I. DuPont de Nemours Co. — DuPont — which has 20 strategic business units, has been a major CSC client for years.

Recently the Army's Logistics Modernization Program (LMP), designed and developed in Moorestown, NJ, was deployed to several locations throughout the united States to include Tri-State locations: the Army's Communications

— Continued on Page 40

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and Electronics command at Fort Monmouth, NJ; Tobyhanna Army Depot in PA; and a portion of the Army's Soldier, Biological, and Chemical Command located in Philadelphia.

The Army Materiel Command (AMC) took a giant step in the Army's transformation process with this first deployment of the LMP for the first 4,000 users in the Tri-State area and several other locations throughout the United States.

AUERBACH

Auerbach Corporation for Science and Technology was founded in July 1957, by Isaac L. Auerbach. The company's subsidiary, Auerbach Associates, Inc., was the first computer consulting company in the United States, if not in the world. It was spearheaded by Auerbach and two of his associates, Arnold B. Shafritz and Paul Winsor III, all of whom left the Burroughs Defense Space and Special Projects Group, in Paoli, which they created by successfully applying advanced computer technology to real-time defense projects.

Auerbach Associates became world renown for its creativity and unique computer system architecture and digital communication systems design. These people were one of the country's earliest and foremost leaders in the application of computer technology and programming to online, real-time systems. Examples of their innovations can be identified in system projects such as air traffic control, airline reservations, air defense systems, store and forward data communications and industrial control.

Another of the parent company's subsidiaries, Auerbach Publishers, Inc., was the first company dedicated to publishing updated loose-leaf information about computer hardware, software and systems, and the management of computers and communications.

GESTALT, LLC

A relatively new software/information systems company has been operating within the Philadelphia Section for the past eight years with offices in King of Prussia, PA, and Camden, NJ. The 93 employees specialize in developing middleware for "Interoperability." This middleware ties together legacy systems with new systems and allows for data base collaboration. For the Defense Department, Gestalt ties together multiple Command & Control systems, as well as tying Command & Control systems to Simulations. **In 2003, Gestalt received three prestigious awards: The 2003 IEEE Philadelphia Section Corporate Innovation Award, the AIAA Project of the Year Award, and the NDIA Enterprise Integration Award.** The USAF Electronics Systems Command, credits Gestalt with saving their training budget by a factor of four through the use of their middleware. A new US Army CECOM Contract calls for Gestalt to develop a "Coalition Translation Gateway," which will tie together German Command & Control and Simulation Systems with US Army Command & Control and Simulation Systems as well as the US ONESAF Simulation Test Bed. Other coalition partners will be added in 2004, and Gestalt's methodology is being proposed for use by the US Army for Coalition Interoperability.

MOS TECHNOLOGY

In August 1974, a team of engineers at MOS Technology in the Valley Forge Corporate Center in Norristown began the design of a revolutionary new NMOS 6502 microprocessor that became the heart of the first Personal Computers from Apple Computer and Commodore Business Machines. Also, this same microprocessor was used in the first video game machines from Atari and Nintendo. The first samples of production chips were sold for $25 in the St. Francis Hotel in San Francisco during the Wescon Conference held in September 1975.

In 1996 at the Comdex Conference in Las Vegas, Nevada, in celebration of the 25th anniversary of the introduction of the microprocessor, the 6502 was honored as the first of seven microprocessors "because they were seminal in nature and incredibly innovative for their time". In short the 6502 was honored for its contribution to the Information Technology industry. The 6502 was the heart of two of the most valuable electronic system markets — the first high volume PCs and video game systems. Two of the 6502 designers, William D. Mensch, Jr. and Charles I. Peddle accepted the award given to the 6502 microprocessor.

In addition to the 6502 microprocessor the MOS Technology 6522 Versatile Interface Adapter (VIA) was used as the mouse interface in the Apple Macintosh Personal Computer.

William D. Mensch, Jr., who was born in Quakertown, worked at Motorola as one of the designers of the 6800 microprocessor. He went to MOS Technology in 1974 where the 6502 was designed. After leaving MOS Technology in 1977, Mr. Mensch went to Arizona where he worked at Integrated Circuit Engineering, a consulting firm. In 1978 he formed his own company, The Western Design Center, Inc. (WDC) in Mesa, Arizona, where he created the CMOS W65C02 microprocessor, which was used in the Apple IIc and IIe as well as the W65C816 used in the Apple IIgs and Super Nintendo. Mr. Mensch holds 22 patents in microprocessor and microprocessor system design. In 1991 and again in 1996, Mr. Mensch was honored by the Microprocessor Forum as one of ten pioneers in the microprocessor industry. He was inducted into the Computer Hall of Fame in 2002.