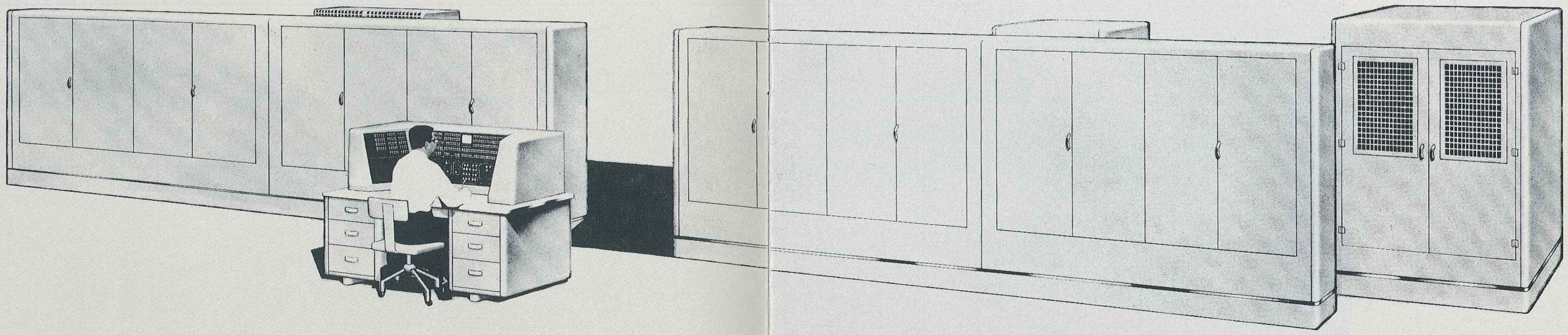
Communications Department, Sperry, P.O. Box 64525, St. Paul, Minnesota 55164-0525.

Engineering Research Associates

The wellspring of Minnesota's computer industry

Published by Sperry
in commemoration of ERA's 40th anniversary



The ERA 1101 computer.

Forty years ago, they were called "giant brains" by the press and "analytical devices" by the U.S. Navy. Their creators referred to them as computers.

These complex calculating machines filled large rooms, incorporating thousands of vacuum tubes and miles of wires connected by hand, and when every component actually worked, the electronic behemoths performed arithmetic functions faster than scores of expert mathematicians.

"Many of those associated with this business believe that the so-called giant brains are ushering in a new era," wrote Robert Turner in the December 1952 issue of *The Minnesota Technolog*. "You have heard this called the Atomic Age, but it seems a good bet that future historians looking back on this period will call it the beginning of the Second Industrial Revolution. Just as the original Industrial Revolution took the load of routine physical labor off men's muscles, this Second Industrial Revolution will take the load of routine mental labor off men's minds. It's happening already, and it's happening fast."

Turner witnessed this revolution daily, for he worked at Engineering Research Associates, Inc. (ERA) in St. Paul, one of the country's original (and Minnesota's first) computer companies. Working primarily on classified projects for the Navy, ERA pioneered many of the earliest and most important computer-related inventions. At a time when other computers worked infinitely better in theory than in actual practice, ERA engineered, built and delivered the most reliable machines in the industry.

ERA's reputation for innovation and quality lives on today through Sperry in Minnesota. Sperry acquired ERA in its 1955 merger with Remington Rand, Inc., and consolidated it into the first Univac Division; a solid core of ERA veterans still works for Sperry. A host of Minnesota-based computer concerns also trace their beginnings to the company. Thanks to ERA, yesterday's giant brains have helped to build today's High Tech Corridor in Minnesota.

History researched, written and produced by Hakala Associates Inc., St. Paul, MN.

Special thanks to the many people who contributed their time and memories in helping us to produce this publication.

ERA advertisement (inside back cover) and photograph (page 17) reproduced courtesy of the Charles Babbage Institute, University of Minnesota.

William Norris.

War II, Parker had headed Northwestern Aeronautical Corporation (NAC) in St. Paul, Minn. The company built gliders for the Army Air Corps. With the war over and the glider market subsequently grounded, Parker was eager for a new venture. His meetings with Meader, then Engstrom and Norris, went well and the Navy reiterated its support. "All I could say was 'Aye, aye, sir,'" recalls Parker.

In January 1946, a new company, Engineering Research Associates, Inc. (ERA) was incorporated. An investment group led by Parker owned 50 percent; the technical group headed by Engstrom, Norris and Meader owned the other half. Each group purchased 100,000 shares of the new company at $0.10 per share for a total equity investment of $20,000. The Parker group also provided a $200,000 line of credit.

Parker became president of ERA; Engstrom, Norris and Meader, vice presidents. Two CSAW veterans, John Howard and Charles Tompkins, were named directors of development and research, respectively. ERA then opened a small office in Washington. The company hired nearly 40 more CSAW staffers, as well as several veterans of the NCML, the Naval Ordnance Laboratory and the Office of Naval Research, and moved them to Parker's NAC plant in St. Paul. A cadre of active NCML personnel was also stationed at the plant to monitor work onsite.

"I believe we will bring to St. Paul some of the outstanding scientific minds in the country," Parker announced to the press. "We have picked this location because it is felt that this area offers excellent facilities for the type of scientific activity we plan to undertake."

ERA had to first settle the matter of how to obtain work; as an unproven firm, the company did not legally qualify for a major Navy contract. However, NAC, Parker's largely disbanded glider company, did possess the required operating record. Thus it was decided that ERA and NAC would initially share the same management and facilities. A major one-year Navy contract was then awarded NAC by the Bureau of Ships; a smaller one-year contract was awarded ERA by the Office of Naval Research. The practical effect: ERA, a company just born, would borrow the name and reputation of NAC, a company about to die, until it proved itself. A year later, in August 1947, NAC was phased out.

(The process by which ERA was named was no less complicated. According to Norris, the company at one point operated under the name Research Engineering Development Associates. However, what with McCarthyism on the horizon, it was duly observed that the new company's acronym spelled RED; adding the first three letters of Associates only made things worse. The name was quickly changed.)

The company began to recruit engineers and physicists—three to six years experience required—and was particularly successful in hiring graduates of the University of Minnesota. One of them, Irwin Tomash, recalls that of 14 electrical engineering classmates who graduated with him from the U of M in 1943, eight later worked for ERA.

The company's prospects also encouraged Twin Cities natives to return home. Among them was Bill Drake, a Navy veteran who returned after the war to Purdue University to finish his degree in aeronautical engineering. One day, on a campus billboard, he saw an advertisement for ERA, and "the words St. Paul jumped off the wall."

ERA was particularly secretive and, like other recruits waiting for government clearance, Drake was told little about its work. "I was informed that ERA was a new company doing electronics work for government and industry," he recalls. "That's all." The tight-lipped atmosphere of the war years still fresh in their minds, few recruits pushed for further information. Most were just glad to have a job.

A Legacy of Technology

The genealogical tree of Minnesota's computer companies begins with a single root: Engineering Research Associates, Inc. (ERA).

ERA is the state's original computer company and is as old as the computer industry itself. "I don't know the percentage of computer-related jobs in the Twin Cities that are traceable to ERA, but it's a high percent," says Bill Drake, an ERA employee who later formed his own Minneapolis company, Data Card Corporation, of which he is chairman emeritus and a director.

"ERA is the wellspring," adds Bill Norris, who founded the company in 1946 with three others. "In fact, there are many companies not necessarily identified as computer companies that have their origins in technology that was developed by ERA."

ERA was founded in the Twin Cities not as the result of long analysis but because of the presence there of co-founder John Parker's Northwestern Aeronautical Corporation facility. Parker is today retired in Washington, D.C.

"We picked St. Paul because there was a roof there for us," says Norris, the recently retired chairman and CEO of Control Data Corporation. "But it turned out that we couldn't have picked a better spot." The reason? ERA provided a stimulating environment and a close home for many University of Minnesota electrical engineering graduates. "Remember, there weren't that many opportunities in those days, especially locally, for electrical engineers," observes Norris.

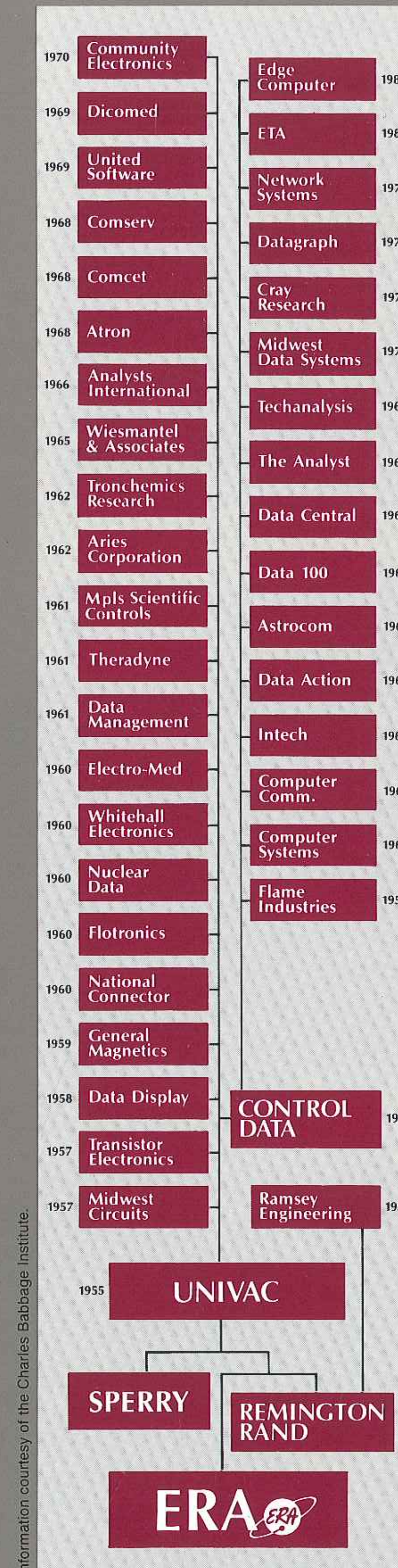
ERA's life as ERA lasted less than 10 years (founded in 1946, purchased in 1952 by Remington Rand, which merged with the Sperry Corporation in 1955, then consolidated with other RemRand divisions into Sperry's Univac Division) but its legacy is widespread and very alive. Several spinoffs from the Univac Division took place between the late 1950s and early 1960s, and later spinoffs from those spinoffs, and so on.

Perhaps the best-known of these are Control Data, founded in 1957 by such ERA veterans as Norris, Drake, Frank Mullaney, Seymour Cray, Bob Kisch, Bill Keye and Arnold Ryden; and Cray Research, founded by Cray in 1972.

Among the other spinoffs started by ERA personnel are: General Kinetics, Inc., founded by Walter L. Anderson and Robert Gutterman; Ramsey Engineering, founded by John Riede and later joined by Jack Hill; Engineering Products Assoc., founded by Bill Butler; and Data Products Corp., started by its now retired chairman Irwin Tomash.

Why did so many ERA veterans start their own successful companies? "Looking back, it's easy to see how so many individuals came out of the ERA experience as entrepreneurial doers," says Drake. "It was a time in which you thought you could do it—and you didn't know enough to know you couldn't—and so more often than not it worked. We'd tackle anything."

Thanks to ERA, Sperry and hundreds of other computer companies in Minnesota and across the country are still doing their share of tackling.



"What we were doing was completely new. We had to come up with our own answers. There was no one else to consult with."
—Art Kotz

The company was initially funded by cost-plus-fixed-fee contracts that called for the performance of tasks to be specified periodically by the Navy. Its major contract (under NAC's name) called for the development of special-purpose data processing equipment and specialized communication devices. Its smaller contract was for research studies, consulting services and training programs, primarily for recruits not yet cleared for classified work.

In simpler terms, ERA was a problem solver. For example, the Navy was interested in high-speed digital devices that would perform several tasks. These included the embedding or extraction of alphanumeric messages, sorting or hunting for patterns, and storage and retrieval of voluminous amounts of data. ERA's job was to solve these specific problems by sifting through an extensive, and often unapparent, set of solutions.

"We were presented with a choice of many physical techniques," says Arnold Cohen, one of ERA's top engineers. "We had a lot of preliminary work to do in the laboratory, checking out the feasibility of this technique, testing the properties of various solid materials, testing various alloys."

"What we were doing was completely new," adds Art Kotz, an ERA senior lab technician. "We had to come up with our own answers. There was no one else to consult with."

That was true. At the time of ERA's founding, only about a half a dozen digital machines, electromechanical or electronic, were operating or under construction in the United States. They were huge machines, with thousands of vacuum tubes and miles of wires, and assembled in a way that only the originators could understand. Lab results were rarely replicated elsewhere.

John E. Parker. (In the background is a picture of a U.S. Army glider made by his former company, Northwestern Aeronautical Corporation.)

Like other computer pioneers, ERA engineers struggled with unreliable vacuum tubes, testing and hand-soldering each connection. They adapted existing equipment to new and unintended uses, in many cases inventing their own re-wired motors and transformers. "Our work was classified, so we didn't talk about it with anyone, even our families," says Drake. "But then computers were so foreign, so specialized that nobody would have understood what you were talking about anyway."

As such, one of ERA's earliest tasks was to compile a report, "High-Speed Computing Devices," later published as a book that became the definitive study of the infant state of computing. ERA personnel were given access to government reports and met with others involved in computer research for the government. This group included John von Neumann, the renowned mathematician at the Institute for Advanced Study at Princeton University, and John Mauchly and J. Presper Eckert, creators of ENIAC, the first electronic digital calculating device.

These exchanges lent credence to a growing but rarely voiced belief within ERA that it was near the head of the technological pack. And the company, so reliant on government work, began to at least think in terms of commercial computing possibilities.

In the spring of 1947, ERA hosted a symposium for the communications engineers of several airlines. The purpose was to demonstrate computing applications for a seat reservation system, later put to use by TWA. During the symposium, Cohen introduced two terms that would become commonplace in the computer industry: volatility and non-volatility.

Despite such events, ERA never forgot its primary customer. In August 1947, the firm was assigned by the Navy to Task 13, the design on paper of a general-purpose, stored-program computer. Task 13 carried the highest of Navy classifications; except for those engineers working on the computer's logical design, no one else at ERA knew even the smallest detail about the project.

The Navy kept ERA busy. By the end of its first fiscal year, October 31, 1947, the company reported revenues of $1.5 million and a profit of $34,000. Employment had jumped from 145 to 420. But long-term debt had also increased to $330,000. Kotz recalls that at the first stockholders meeting several disgruntled engineers voiced to Parker their concern about ERA's progress.

"There were many problems to deal with, most having to do with lack of capital," says Parker, "and it was a constant job keeping everyone happy. I looked upon the company as a symphony orchestra in which a few strings would break now and then. I was just trying to keep the melody going."

A month later, at the National Electronics Conference at Harvard University, ERA made its first presentation at a national meeting: a report on magnetic drum storage by John M. Coombs, director of development engineering. ERA engineers returned from the conference with renewed confidence. "We felt like we were in pretty good shape relative to the state of the art," Cohen recalls. "Everybody else was groping around the same way we were."


Howard Engstrom.


Ralph Meader.

ERA engineers Irwin Tomash, left, and Arnold Cohen discuss an early computer design at 1902 West Minnehaha Avenue.

According to Tomash, the problem of data storage was, in those early days, the central issue in computer development. "Every possible kind of physical phenomenon was examined," he says. "There was electrostatic storage, storage using capacitors, paper tape, punch cards, magnetic and tubes—vacuum tubes and, later, specially built cathode ray tubes."

ERA quickly turned its attention to magnetic storage. The concept was hardly new—magnetic recording had been invented at the turn of the century—but ERA transformed it into the most practical and low-cost of data storage techniques. "The technique of magnetic recording, whether on tapes or disks or drums, shares the property of nonvolatility," explains Cohen, "in that information remains intact whether the power source is on or off. The information is also alterable. That combination is unique."

The company's research began, Kotz recalls, by gluing cast iron shavings to the inside of a cylinder (or drum) and magnetizing the shavings. As the cylinder was rotated, engineers discovered that with an oscilloscope probe they could read positive and negative impulses (a natural binary storage system) along tracks on the cylinder.

ERA engineers next glued strips of magnetic tape to the drum. "There was nothing wrong with that," says Cohen, "except that the ends of the tape curled up a little bit around the splice." So Sidney Rubens and other ERA engineers—Jack Hill, Robert Eulberg, Robert Perkins—called on friends at 3M and bought a bottle of their latest preparation: a magnetic liquid used to coat 3M tape. The liquid was then spray painted on the drum. The result was a smooth, even coating and improved performance.

ERA magnetic drums were utilized in two special-purpose calculating machines—code-named Goldberg and DEMON—delivered to the Navy in 1948. The magnetic drum also played an important role in ERA's successful Task 13 computer design for the Navy. Approved by the Navy in March 1948, and under the direction of Hill and Frank Mullaney, ERA began construction of the Navy's most classified computer, now code-named "Atlas."

ERA's prowess by now had come to the attention of IBM, which collaborated with the smaller company on a system design exercise. Two important drum patents resulted, but under the terms of the contract, reports Cohen, the patents were awarded to IBM with no mention of ERA.

Clearly, ERA's magnetic drums were the elite of the industry: systems ranging from 2 to 34 inches in diameter and able to store a million magnetic marks which could represent decimal numbers, letters and other forms of information. As a result of experiments in 1948 by Cohen, Bill Keye and Arnold Hendrickson, information on ERA's drums could also, for the first time, be selectively altered without rewriting or erasing the entire drum.

The magnetic drum epitomizes what was indisputably ERA's greatest talent: start-to-finish engineering. "That practicality was always ERA's strength," says Tomash, "not so much the invention of new things but making them work." Adds Drake: "We were good finishers, from concept to design to construction. Not many computer companies, especially research-oriented companies, could say that in those days."

Much of the impetus for ERA's finishing kick came from the Navy, which closely monitored activities in St. Paul. NCML's rules were sometimes annoying to the engineers, who were required to obtain special waivers whenever they wished to alter what they felt to be a faulty wiring pattern. "There was always an argument about waivers," recalls Cohen with a knowing smile.

Because of the classified nature of ERA's work, the Navy also insisted on a high degree of compartmentalization. ERA personnel knew only about the one aspect of each project on which they worked. This approach, implemented in case of a security breach, sometimes led to a duplication of effort.

But the Navy did encourage—rather demanded—quality. "In retrospect, their tradition for discipline served ERA very well in the early years," says Cohen. "Our work became much more reliable"—so reliable that while failure times of other electronic computers were documented in minutes, the failure time of ERA's machines was measured in hours.

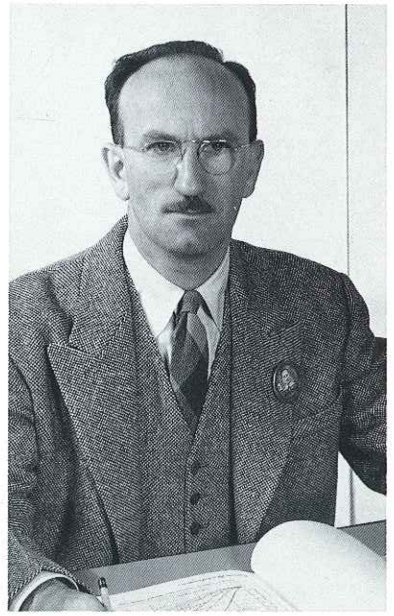
"The Navy was oriented to maintenance, to quality in an adverse environment," says Tomash. "At a time when other scientists and Ph.D.s were building computers in laboratories by hand, with wires everywhere, not being able to move the computer anywhere else, much less take it apart, we were taught to think in terms of modularity, plug-ins, chassis, reliability, alternate sources of power. The Navy was very influential in that regard."

The NCML was also supportive. Observes Russ Headley, then an ERA technical writer: "But for their support, I'm not so sure how far we'd have gotten. They literally sold the Navy users on several projects, one good example being the Atlas."

The Navy's confidence was rewarded. The Atlas I computer (the I was added after design work had started on a more powerful successor, Atlas II) was delivered to Washington, D.C. in October 1950. "It's my belief that Atlas I was the first American stored-program electronic computer to be delivered—delivered in finished, working condition," observes Cohen.

The classified computer, a 24-bit machine with magnetic drum and 2,700 vacuum tubes, ran 24 hours a day, with 10 percent of that time for scheduled maintenance. In its first 500 hours of operation, Atlas I required only 16 hours of unscheduled maintenance. "That kind of performance," remembers Headley, "was absolutely unheard of."

Jack Hill, one of ERA's senior engineers.



Dr. Sidney Rubens, ERA staff physicist.

ERA maintained a small research and liaison headquarters in Arlington, Va. (and, later, field offices in San Antonio, Salt Lake City and Dayton). But it was at 1902 West Minnehaha Avenue, on a streetcar line in St. Paul's Midway district, where the majority of ERA's workforce (nearly 700 by the early 1950s) engineered its pioneering breakthroughs.

Once occupied by the American Radiator Company and Parker's NAC, the facility was huge—140,000 square feet—and cavernous, with large skylights. "There were more sparrows than people in that place," recalls Robert Patterson, an ERA engineering director.

To hear ERA veterans tell it, the building was too cold in the winter (when coats and mittens were common garb) and too hot in the summer (when shorts and no shirts were in fashion). Fly swatters and rat poison were standard issue and the roof leaked. The barn was dirty, dusty and drafty. "It was rather breezy," says Cohen with a laugh, "which caused a phenomenon that George Hardenbergh, a fellow engineer, described as the self-emptying ashtray."

(The building's decor finally proved too much for a strict Navy captain, who one day surprised the ERA engineers with a white-glove inspection. The area, of course, failed and work was halted while it was scrubbed down.)

As ERA grew and more employees were hired, a maze of labs and offices, separated by paperboard partitions, sprang up within the facility. Adjacent to the main plant were two smaller buildings, one housing the Navy office and cafeteria and one containing the guards and personnel office. A wire fence surrounded the entire complex.

Security was tight. Access into some areas required special clearance; major projects were protected by armed guards. On one occasion, recalls Patterson, a small fire broke out inside the plant. When the fire department arrived, the guards, who had apparently not been informed of this development, refused to let them in. The firemen eventually made their way to a back entrance, broke in and extinguished the blaze.

Finances were likewise a chaotic affair. If ERA was long on vision, it was often short on cash. "The company ran on a shoestring," says Drake. "It was always a matter of frantic finance." Last-minute runs to the bank on Friday afternoon were common, and yet the unanimous recollection is that ERA employees were always paid on time.

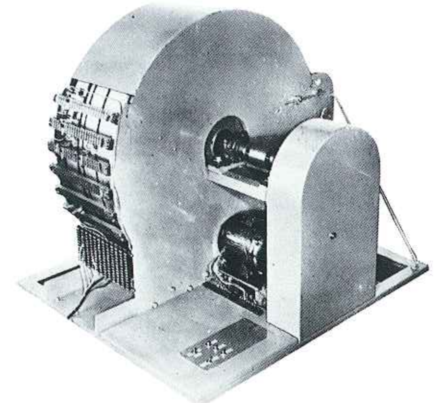
Within these colorful confines there existed a spirit, not atypical in the post-war years, of enthusiasm and energy, of discovery and imagination. "It was a combination of very, very good people operating in a time of exploding technology in an environment that fostered, rather than discouraged, people to be confident," says Drake. "You were allowed to fall on your butt and you were expected to get back up. And you always strived for quality first." Adds Norris: "The atmosphere was very conducive to motivation."

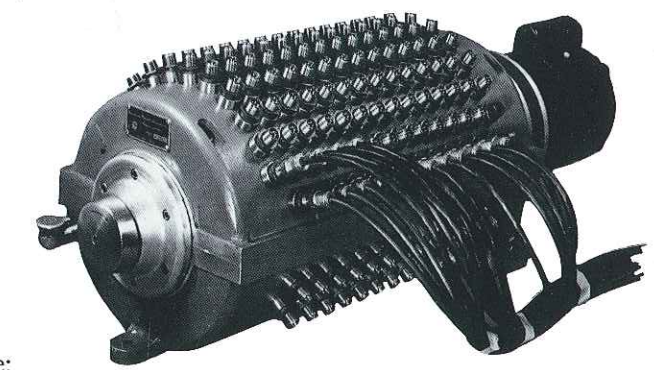
"It was fun," says Earl Joseph, an ERA engineer. "We were a bunch of engineers having fun." It was a particularly gifted bunch. "ERA had many of the most brilliant people, the brightest minds around," adds Dick Clover, who handled ERA contracts. "They were the company's greatest strength."

Conversations in offices, in the halls, even in the cafeteria, centered around new discoveries. "There was a lot of conferring, especially during coffee breaks and lunch," says Cohen. "That's where we got the chance to interact, to socialize about technical matters with those working on other projects. Some important ideas came out of those conversations."

Management was similarly participatory. The involved parties usually retired to Parker's office and emerged with a memo summarizing the consensus opinion. "You knew you had a say," says Cohen, "and you'd better have a say, because you knew that you'd be asked."

At ERA, the excitement of discovery fueled long hours of labor. "There

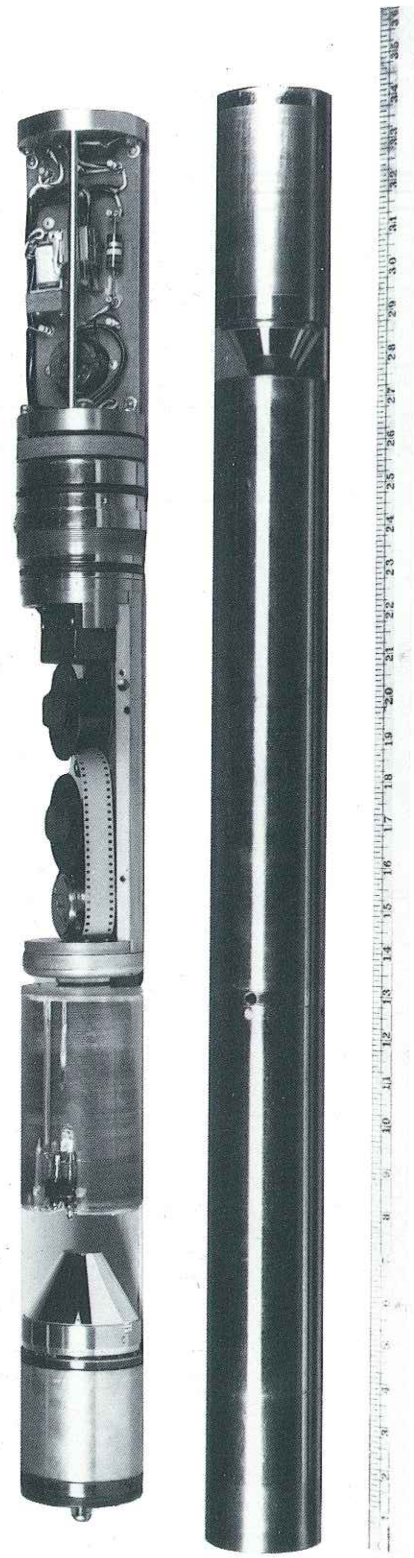




Top: ERA's first magnetic storage drum.

Above: ERA's magnetic storage drum, circa early 1950s.

Opposite: Engineer Earl Joseph programs the ERA 1101 computer.



One of ERA's offbeat inventions, the bore-hole camera and casing.

Opposite: ERA computers were designed not only to be reliable, but modular. Plug-in chassis that could be removed and opened like suitcases made for easier maintenance.

wasn't much respect for the clock," says Headley. "Sixty-hour weeks were not uncommon." Energy levels in the lab, both among the younger engineers and their older mentors, were high. "It was like being an explorer," says Joseph. "You were traveling in new territory. You didn't mind working long hours."

The ERA work ethic did not discourage the ERA party ethic. "We were never really a spit and polish group," admits Patterson with a chuckle. After those momentous occasions, for example, when early computer components were loaded into a cushioned railroad car (with one or more armed Marines inside) and sent to the customer, the company's more extroverted souls celebrated with a rite that came to be known as a project party. These parties, recalls Headley, "were convivial affairs, usually held in a hotel, that reflected the spirit of accomplishment and were not without liquor and craps." Parker, it is said, was skilled in both pursuits.

Gatherings that encouraged a different sort of pouring—concrete—were also popular among those workers who were building homes. "We were all friends and helped each other out away from work," says Kotz. "There were a lot of younger fellows, a lot of young families just starting out—so many that it was not unusual to see someone passing out cigars every day."

Neither in this closeknit atmosphere were practical jokes uncommon; bolstered by the available scientific talent, they were also effective. Clover recalls that one mischievous soul slipped under John Coomb's new Chrysler—his pride and joy—and surreptitiously installed a mechanical device known as a stepping switch. The result? Every 25th time Coombs stepped on the brake, the horn honked. "We'd sit around at lunch and ask John how his car was," says Clover, "and he'd shake his head and say, 'That darn car is driving me bananas.'"

ERA's engineers also applied their skills to an intriguing assortment of offbeat inventions encouraged as a supplement to Navy contracts. "Our primary aim was to find some products through which the company could generate some capital," explains Norris. "None of them really sold too well, which was not surprising, considering the small amount of money that ERA had available to put at risk in development."

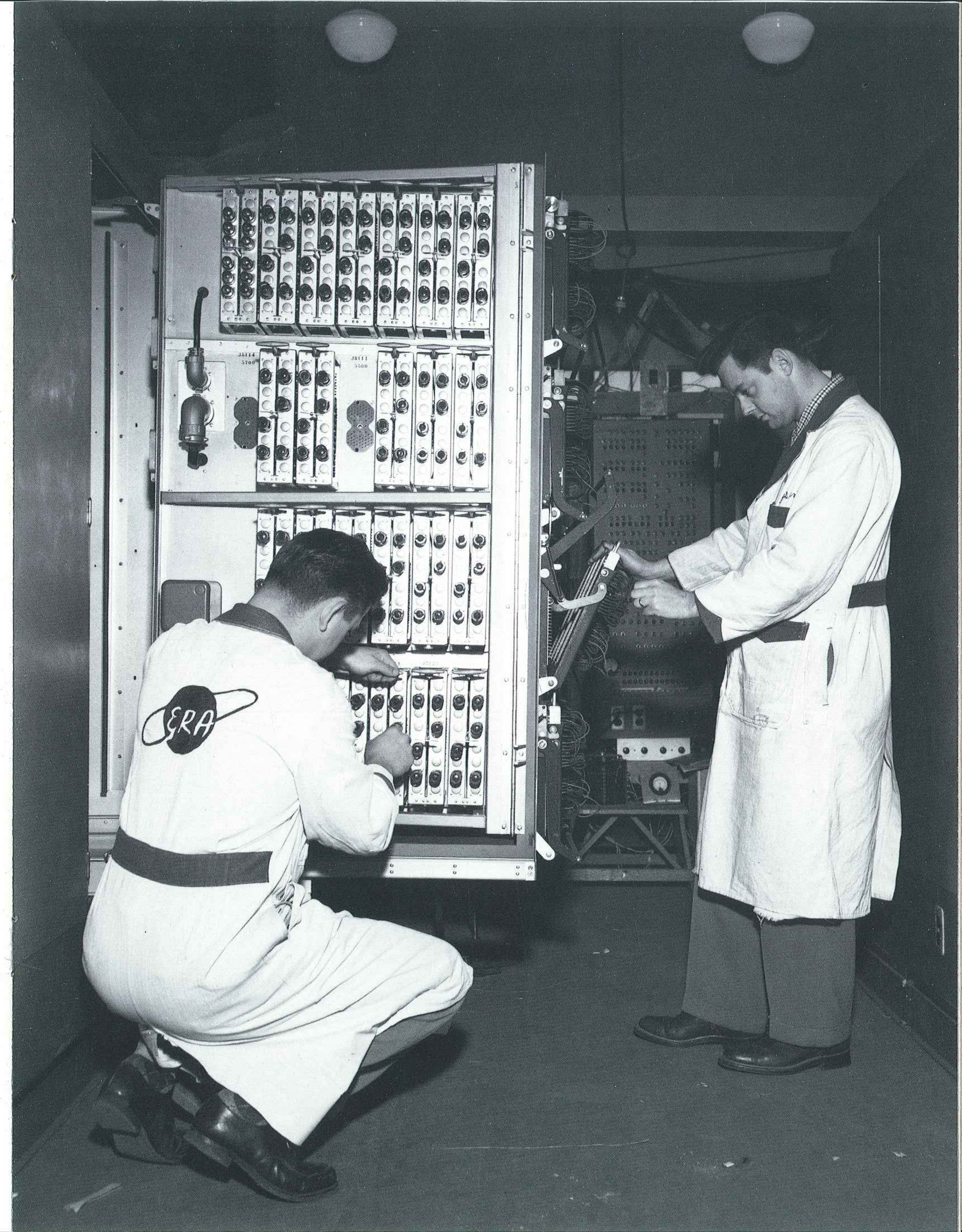
Among these products were the GasPorter, a truck that refueled light and medium aircraft (several were sold to airports in Europe) and the Honeywagon, built on a Willys Jeep chassis and designed to siphon the septic tanks of passenger planes. ERA's bore-hole camera, developed for the Army Corps of Engineers, was encased in a stainless steel tube and produced a continuous 360-degree photograph; it was intended to make possible more detailed inspections of underground surfaces.

The company developed a system that recorded and tabulated the weights of railroad cars and contents—while the cars were in motion—and a machine that assembled candy bars. ("I don't know if we sold more than one of those," says Larry Pinska, then an ERA photographer, with a laugh.)

One product that was consistently profitable was the antenna coupler, a device used on the first 707 jet to automatically adjust antenna characteristics and improve radio transmissions and reception. ERA also built the aircraft accelerometer, which measured the G-forces in airplanes and missiles, and the self-recording accelerometer, a device for measuring and recording complex acceleration patterns.

The self-recording accelerometer was used by the Corps of Engineers in a series of underground dynamite blasts (the largest in history) in Utah in 1948 and 1951; nearly 100 ERA personnel monitored instruments used during the explosions. The blasts, set off by 320,000 pounds of dynamite, were intended to measure the effects of shock radiation and the corresponding building requirements of military installations. "We made some very important findings during that project," says Joseph.

The young ERA engineer also discovered that advanced technology, particularly in the field, is dependent upon human solutions. "We were getting



ready for a big shoot and some of the equipment stopped working," Joseph recalls. "One of the technicians said, 'Go kick it.' So I tapped it. Nothing. He yells, 'Hit it harder!' So I gave it a big whomp and it started working. And I found out why ERA hired me: big feet."

Meader, who headed ERA's St. Paul operations, resigned in mid-1950. Norris, who had headed marketing, then became director of both operations and marketing. Engstrom was headquartered in Arlington, where he worked closely with government scientists. Parker, who concerned himself primarily with finances and supervisory activities, split his time between St. Paul and Arlington, making frequent trips in his private airplane.

The company had by now demonstrated its technical prowess; its financial fortunes unfortunately lagged behind. Debt, which had at one time been substantially decreased, had risen to $280,000. "Our main weakness was always that we had too little capital," says Norris. (In that regard, ERA was not alone. For example, Eckert-Mauchly Computer Corporation had recently been taken over by Remington Rand Inc.)

By necessity, ERA began to look more strongly to commercial markets. Shortly after the Atlas I was delivered, ERA asked the Navy for permission to market it commercially and a modified version was cleared by the Navy. The commercial computer was dubbed the 1101 (for Task 13's binary equivalent). It was the original ancestor of Sperry's 1100 computer series, which is still in use today.

The 1101 was a binary machine that operated in parallel mode with a 24-bit word length, single address and drum memory; it weighed 17,500 pounds and occupied more than 400 square feet of space. The computer utilized 38 different commands and received its input by means of a photoelectric paper tape reader.

According to Cohen, ERA's engineers were especially confident of their equipment—like the 1101—because they were cautious in their promises. "If you figured in the laboratory that you could push some variable up to x, then in the specification you might call for half that," he says. For example, the 1101 utilized a number of conservative design components that avoided errors and safeguarded its performance—such as address tracks on the magnetic drum, permanently recorded in parallel channels.

The 1101 also introduced several original features. It was the first computer to use air-to-water cooling chambers and a false floor (called a plenum). The 1101 was also the first computer to use plug-in chassis of uniform size.

However, pioneering was a tough business. ERA officially announced the 1101 (cost: $248,000 f.o.b.) in December 1951 but made no commercial sales. It wasn't surprising, because the computer package included no operating or programming manual and few facilities for input/output. "ERA had delivered a breakthrough computer without having more than a general understanding of its potential application and without concern for what the customer might have to do to use the innovative machine," wrote Cohen and Tomash in their paper, "The Birth of An ERA."

This new market challenged ERA's capacities and exposed its few weaknesses, weaknesses ironically borne of a close involvement with the military. "We designed and built the best equipment around, but we came from a world in which we dealt with a customer with very specific needs, a

The ERA plant at 1902 West Minnehaha Avenue in St. Paul, with streetcar line in foreground.

Navy ceremonies at the ERA plant were not infrequent and usually attended by the plant's civilian personnel.

customer that did its own programming," says Cohen. "We were very late in getting into programming technique. As such, there was a very embarassing gap in the reliability of our equipment and our ability to market it. That was always our Achilles heel."

Nor were ERA's finances sufficient to close its commercial gap. The company once again was growing but was still undercapitalized. Parker estimated that ERA needed between $5 million and $10 million to become a significant factor in the commercial computer industry. Parker's options were several. He chose a merger.

In December 1951 Parker announced the sale of ERA to Remington Rand Inc. Some ERA personnel, like Norris, never personally approved of the transaction. Others were merely caught unawares. "I was completely surprised," says Tomash, "but then I was just a young engineer. I had no idea of economics, no idea of the pressures of cash flow on management. I was just working away in my own world."

That a sale was imminent could not have been too surprising; Parker had been in contact with potential buyers such as IBM, Burroughs, Honeywell and Raytheon since 1948. That the buyer was Remington Rand could likewise not have been completely unforeseen. The company's interest in computers was widely known; it already owned Eckert-Mauchly and the RemRand Laboratories in Norwalk, Conn., recently stocked with former ERA personnel.

Remington Rand paid for ERA with 73,000 shares of its stock, worth about $1.7 million (a price determined by multiplying ERA's 340 engineers by $5,000). The amount was 85 times what ERA's founders had put into the company.

Parker was named a vice president of Remington Rand; Norris, who remained as general manager in St. Paul, and Engstrom, who stayed in Arlington, were named assistant vice presidents. "ERA will continue to operate as a unit," Parker announced in the company newsletter, *The Orbit*, "with no changes in responsibility or lines of authority."

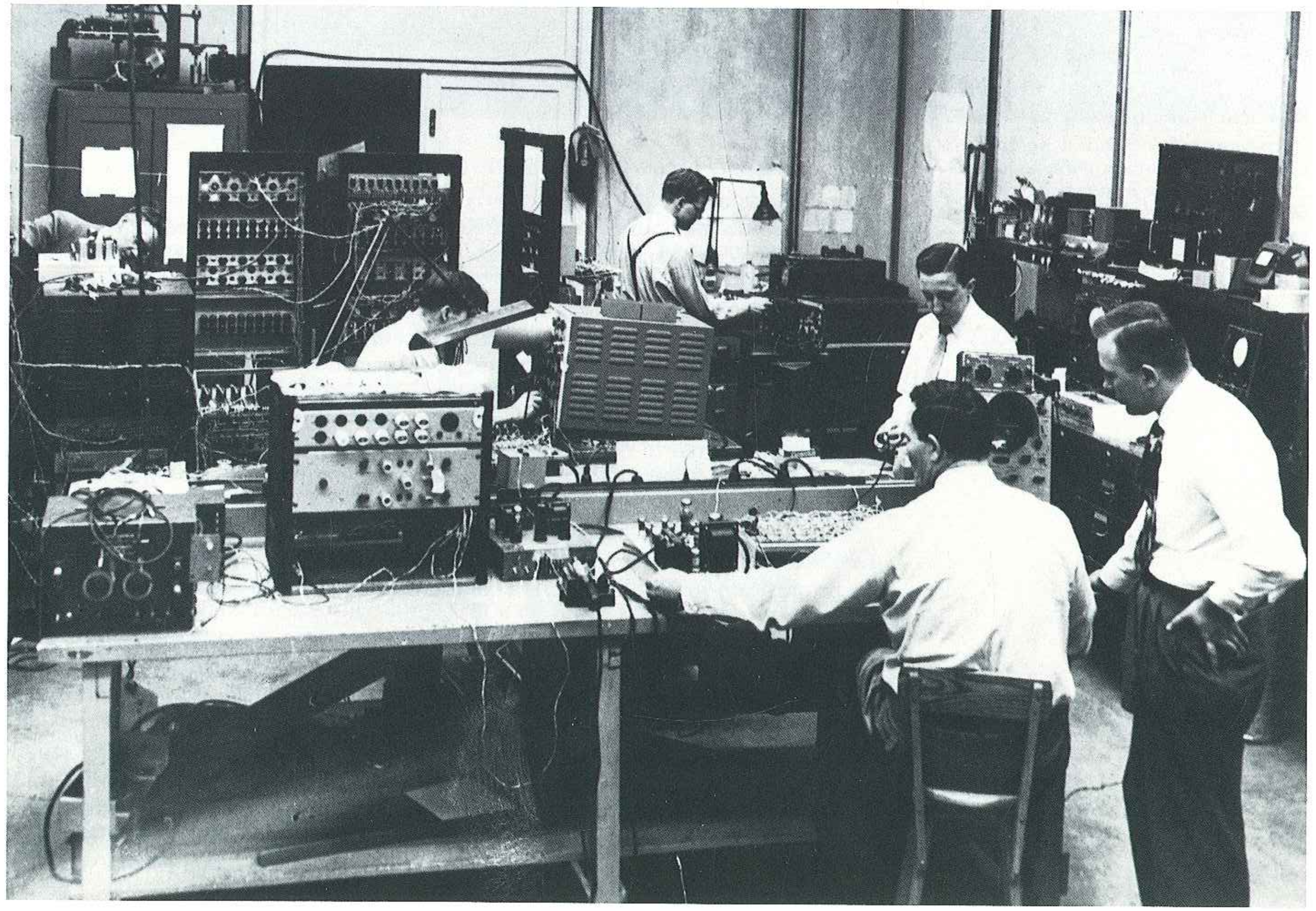
It was 1952. The computer age was taking off and the country was taking notice. According to the *Minneapolis Tribune*, at least 38 "electronic brains" were scheduled to labor for the government by the end of the year. "It is safe to say. . ." said the paper, "that a trainload of expert mathematicians working at top speed for a century could not match the results which the 38 machines will be able to achieve within a year or two."

The article characterized ERA's 1101 "as the most reliable brain in the business." The government's only completely classified computer, it worked on a 24-hour schedule and only four percent of its calculations were "rejected for internal trouble." ERA itself reported that 10 of its large-scale computers—"as many produced by all other computer interests in the country combined"—were in operation.

Despite ERA's high standing in the burgeoning world of computers, its place within Remington Rand was less tenable. ERA was consistently profitable (estimates were that by 1954 it had earned back its purchase price) but did not coordinate well with Remington Rand's other divisions, especially Eckert-Mauchly (an unfortunate rivalry considering that the two divisions

Despite ERA's high standing in the burgeoning world of computers, its place within Remington Rand was less tenable.

ERA engineers worked closely together, in spirit as well as proximity.



After-hours activities such as golf and bowling leagues, choirs, plays—and the ERA softball team pictured above—enhanced the sense of camaraderie among ERA employees.

were responsible for most of the early computer-related inventions).

This failure was a direct result of RemRand's fragmented management style. The company's three computer divisions—Eckert-Mauchly, ERA and Norwalk Laboratories—were controlled by different corporate departments, which were in turn connected only by the head of the company, James Rand, Jr. "Rivalries definitely sprang up within the company," says Tomash.

Nor did ERA feel that it was properly respected by Remington Rand's top management (who knew little, if anything, of ERA's classified work). "I'm not sure that they had a clear idea of what they had bought," says Cohen. "They sometimes referred to our operation as 'the factory in St. Paul' or 'the St. Paul works.' They probably thought of us as little more than an engineering job shop."

That perception changed in late 1952 when ERA, at Cohen's suggestion, received clearance from the Navy and presented to the RemRand brass its proposition for a commercial computer: the 1103. The executives were impressed.

The 1103 was officially announced in February 1953. The computer was a modified version of the top secret Atlas II, which ERA would soon deliver to the Navy. It was also the first large-scale scientific machine to compete directly with (and judged technically superior to) IBM's well-publicized 701 computer.

The 1103 was a much more powerful machine than its predecessor, the 1101. A 36-bit parallel computer with a unique two-address logic, the 1103 utilized Williams electrostatic tube storage, a larger drum memory (16,384 words of storage and average access time of 17 milliseconds) and a strengthened repertoire of instructions. About 3,900 vacuum tubes and 5,000 diodes were used in the computer.

The 1103 was a quick success. Four machines were sold in just a few months to such customers as the U.S. Air Force and a company named Convair (which later became General Dynamics). Twenty 1103s were eventually built. "The computer had clearly marketable properties," recalls Cohen. But public consumers continued to make demands—pricing, rental and field service, customer training and support—that exposed the chasm between ERA's technical and commercial skills.

For example, the Speed Tally was designed for the John Plain Company of Chicago, a large mail order house; it was the first machine to apply high-speed electronic techniques to a record keeping business. Ten keyboard operators accessed the Speed Tally (also known in those less enlightened days as a 140 GP, or Girl Power, machine), which instantly provided inventory totals for any one of 39,000 stock records and produced printed tabulations at the rate of about 4,000 per hour. But despite a moderate marketing effort and some national publicity, only one Speed Tally was built.

It was ERA's engineering talents and performance for the government that ensured the company plenty of work, so much work that the company accumulated a healthy backlog (up to $8 million) of orders. The division developed a magnetic memory system in 1953 for the Civil Aeronautics Administration that according to the *St. Paul Pioneer Press* was intended to solve "flight control problems by storing and comparing the flight plans of as many as 2,000 airplanes" simultaneously.

ERA also built the Logistics Computer for the Office of Naval Research. The machine was a plugboard-programmed drum computer that rapidly processed voluminous amounts of data in repetitive arithmetical sequences; it was capable of adding a column of 1,000 numbers, each having a value of 1 billion, and arriving at a total of 1 trillion in a half-second.

There were several other important military projects, such as: the 1102 Data Reduction Computer, designed to process data from wind tunnel and engine test facilities; the 1104 Command Computer, designed for closed-loop control of the BOMARC missile; and the Athena Guidance Computer, a digital machine developed for the Air Force as part of its ground-based system for the Titan ICBM.

In November 1954 ERA made what is believed to be the first delivery of a computer with magnetic core storage, Task 32, to the Navy. The computer utilized a diode and magnetic core logic—a significant step in the effort to replace failure-prone vacuum tubes with transistors. (Credit for the company's pioneering work in transistors is usually given to an enigmatic young ERA engineer named Seymour Cray.)

A few months later, ERA and Eckert-Mauchly announced a joint plan to produce the UNIVAC II, an advanced model of the famed computer that had predicted Dwight Eisenhower's landslide in the 1952 presidential election. The UNIVAC II, Parker told the press, would utilize ERA's magnetic core memory, retain 24,000 characters and execute instructions at the rate of 8,000 per minute. It would be the most powerful business computer yet.

By mid-1955, ERA had cemented its reputation for ingenuity and reliability. ERA employees numbered nearly 1,500; plant space was almost 250,000 square feet, with plans for another 208,000 square foot facility.

It had however become clear that Remington Rand did not possess the sufficient capital (like ERA before it) or the management style to maintain leadership in an increasingly competitive computer marketplace. James Rand's response was predictable. In June 1955 Remington Rand, Inc. merged with the Sperry Corporation to form the Sperry Rand Corporation.

That fall, after a lengthy study, Sperry consolidated its new acquisitions—ERA, Eckert-Mauchly, the Norwalk Laboratories, RemRand's punchcard department and its computer sales department—into a single unit: the Univac Division.

The official ERA harmonica band.

By mid-1955, ERA had cemented its reputation for ingenuity and reliability.

ERA's home at 1902 West Minnehaha Ave. is today the site of Sperry's Defense Products Group Midway plant. But ERA's legacy encompasses far more than real estate. The company has passed on to Sperry its reputation for innovation and quality, and its insistence on reliable, practical technology—technology that works for the customer.

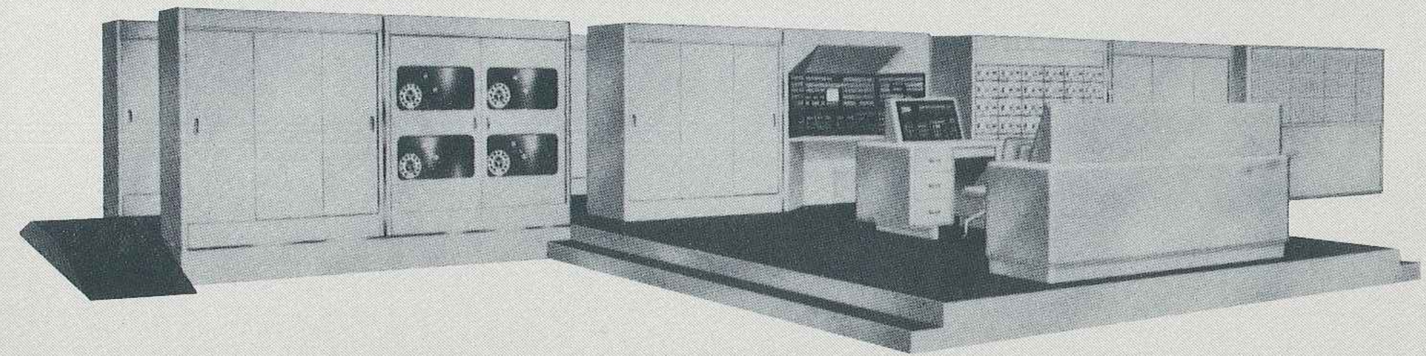
"You know, there was a lot of money available in the early days and universities were moving the computer technology," says Norris. "But that wasn't the bottleneck, the bottleneck was in making the technology work, making it useful." Adds Tomash: "There were many other brilliant machines around but they were never engineered so that they could actually be built. ERA showed that building these machines as products was practical."

Thus ERA distinguished itself by discovering answers that unlocked the elusive utilitarian secrets of a new technology. Forty years later, Sperry is carrying on that tradition in a new age.

Sperry, which merged with the Burroughs Corporation in the spring of 1986, is today the fourth largest employer in Minnesota with more than 13,000 people. Sperry operates the following major business units at 27 sites in the state: Information Systems Commercial Marketing, Information Systems Federal Government Marketing, Integrated Business Systems, Customer Services, Information Systems Products and Technology, Defense Products Group, and Systems Management Group.

Opposite: A 1952 ERA advertisement. Courtesy of the Charles Babbage Institute, University of Minnesota.

ANOTHER REMINGTON RAND ELECTRONIC DEVELOPMENT

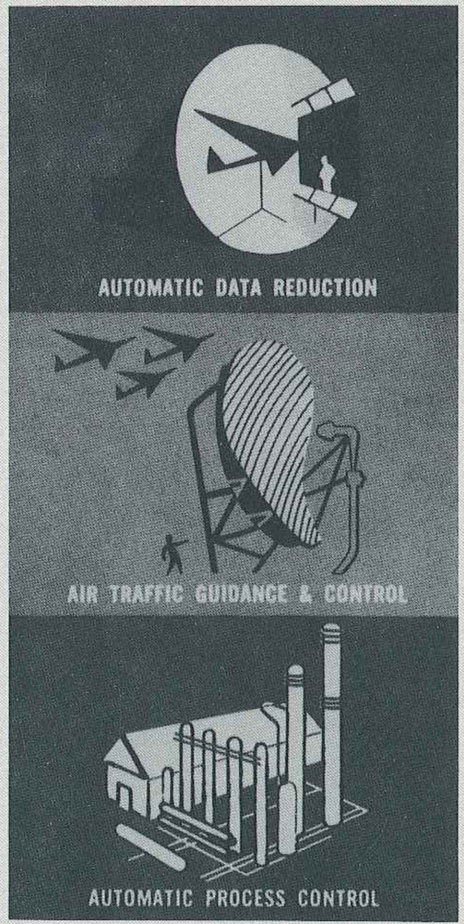


Remington Rand introduces the **ERA 1103** *general-purpose computer system*

ADVANCED LOGICAL AND ENGINEERING FEATURES

- *ACCOMMODATES WIDE OPTION OF DIRECT INPUT–OUTPUT DEVICES*
  - Punched-card equipment
  - Communications circuits
  - Punched-paper and magnetic tapes
  - Process-actuating mechanisms
  - High-speed printers
  - Graphic visual displays
- *FLEXIBLE DATA REPRESENTATION*
  - Alphabetic and numeric data in any code
- *INHERENT HIGH SPEED AND LARGE CAPACITY*
  - Coordinated electrostatic and magnetic drum storage
  - Magnetic tape storage
- *EFFICIENT, VERSATILE PROGRAMMING*
  - Powerful instruction repertoire
  - Flexible two-address logic
- *UNEXCELLED RELIABILITY*
  - Components of service-proved design
  - Preventive diagnostic features
  - Integral air conditioning
- *LOW DATA-PROCESSING COST*

High-speed computation



For complete information about the application of the ERA 1103 to your problems, write on your business letterhead to Room 1676, 315 Fourth Ave., New York 10.

Engineering Research Associates | DIVISION OF Remington Rand INC.

Z-TM-129