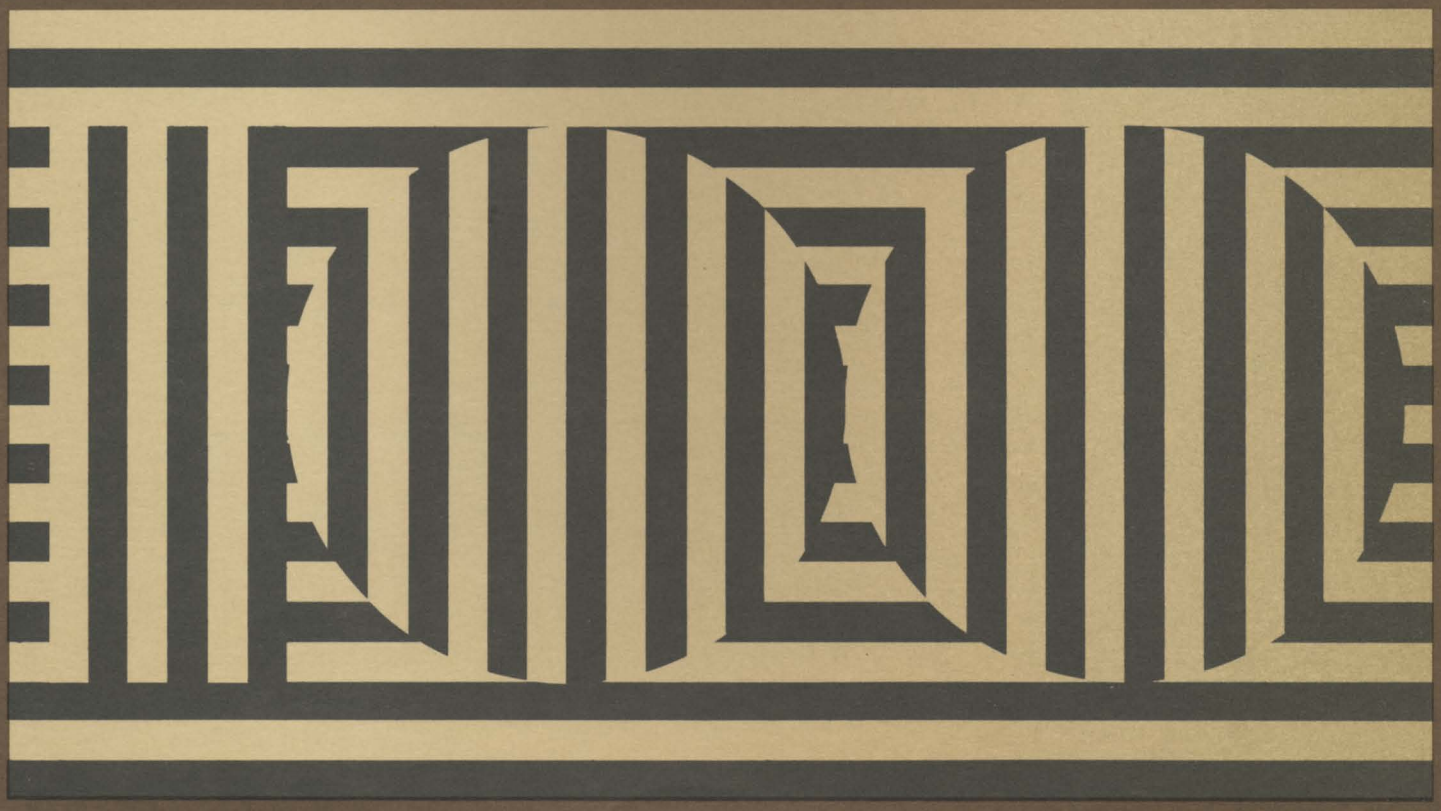
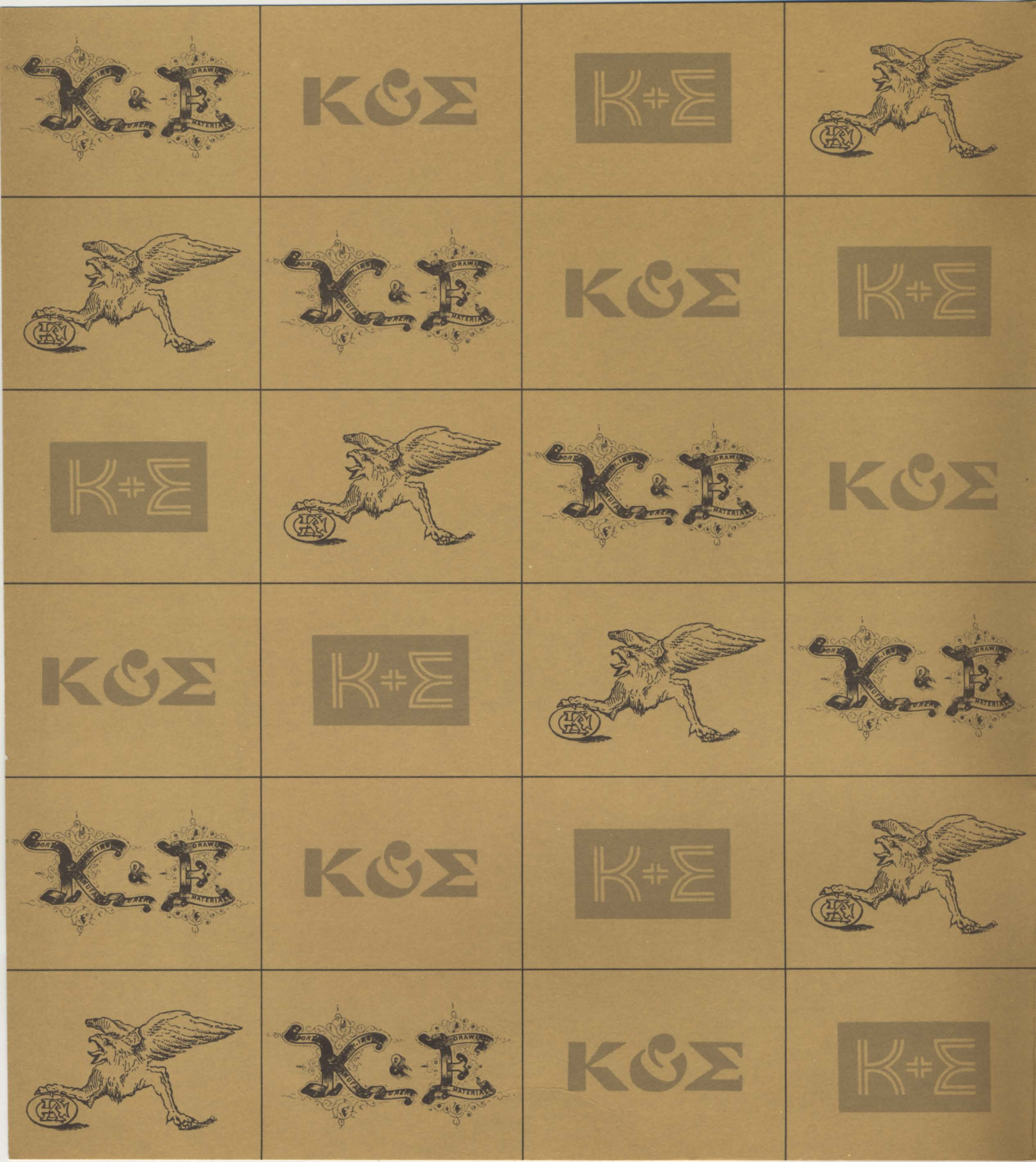
Partners in Creating ■ The First Century of K+E 1867 ■ 1967

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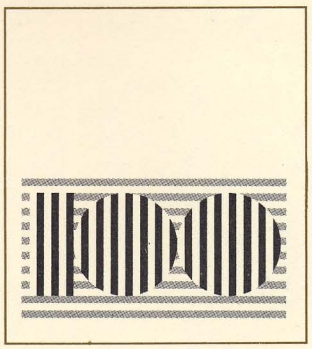
Partners in Creating / The First Century of K+E 1867/1967



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73
TAILORS
ROEMAET'S
FRENCH RESTAURANT
NAPOLEON
73
IMPORTING
TAILOR
TO ORDER
TAILORING
CO.
TO LET
Received from
Messrs Henffel & Esser
$5.50 for one months rent
in advance.
Perry & Mell

A New Idea

It was a few weeks after midsummer, 1867. In a tiny office at 79 Nassau Street in lower Manhattan, two young men were opening a business. William J. D. Keuffel and Hermann Esser were starting out to sell drawing materials and draftsmen's tools.

William Keuffel

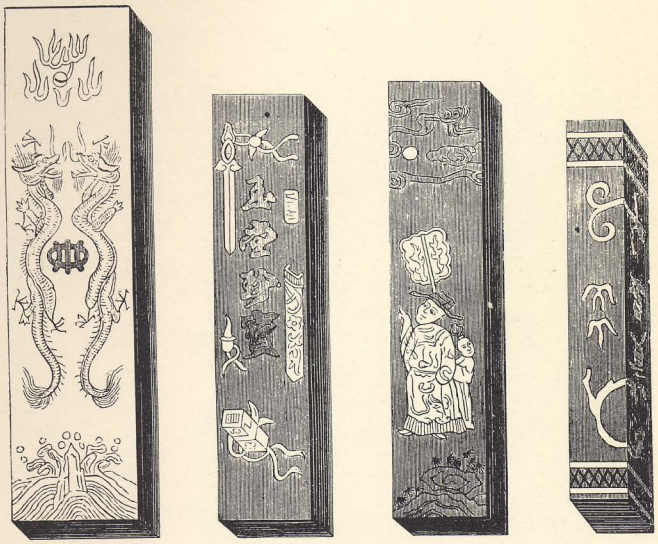
Hermann Esser

Their first month's rent, paid in advance, was $5.50. Such space as this sum commanded was soon crammed with exotic materials and instruments needed by engineers and architects. There was an assortment of finely machined ruling pens, compasses, and dividers. There were protractors of horn and nickel silver, trammels of rosewood and mahogany, ink in small glossy cakes from India and China, and even triangles and curves cut from recently invented hard rubber.

Here was a new idea. Until then, drafting tools and engineers' supplies had always been sold with more commonplace articles by hardware and mill supply dealers. No company had ever tried to specialize in them.

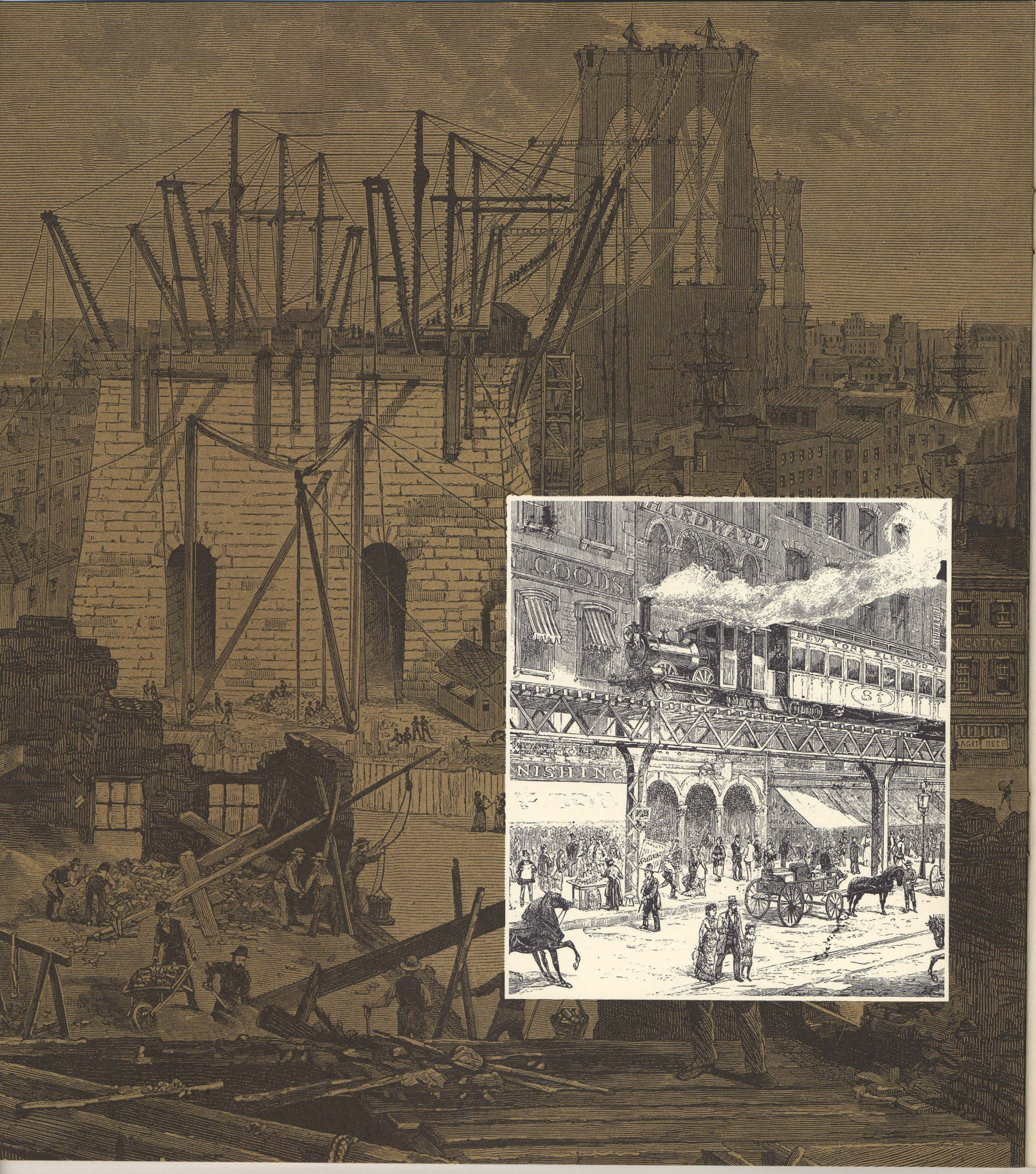
Despite their limited capital the partners were convinced they could make a success of the venture. They were energetic and young — only 22 and 29 that first summer. William Keuffel was the elder. A newcomer to the United States, he was still learning the language and ways of the country. He had an advantage, however, that few men in New York except his own partner could match. He had trained for a dozen years in the hardware business in Magdeburg and Hannover, two of the most advanced industrial centers of Europe. His partner, though younger, also knew the business well and after three years in the United States was accustomed to the hard-driving New York commercial world.

The tempo of that world was quickening. The end of the Civil War had released the country's energies. Construction projects of all kinds were mushrooming, creating a need for more and better engineers' and architects' instruments. William Keuffel had the knack of foreseeing such developments before others did, and he was an optimist. From the start, the young firm planned its stock of drafting supplies to meet a swiftly rising demand.



Ornate cartons of India ink . . . among the first imports.

On this street, four flights up, the partners started in business for a month's rent of $5.50.

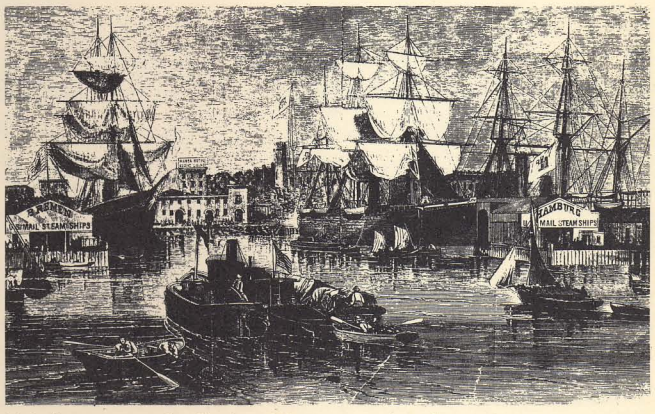

HARDWARE
GOODS
NEW YORK ELEVATED
NISHING

A Changing America

NEW YORK WAS AN IDEAL PLACE for young Keuffel and Esser to begin. At that time it was a ferment of engineering and architectural enterprise. New York was headquarters for the country's boldest industrialists — the railroad builders. They were breaking records, and sometimes other men's backs or fortunes, to double the country's track mileage between '65 and '73. Manhattan itself was being transformed into the Gotham of J. P. Morgan and William Randolph Hearst — a melting pot that would soon stream underground in subways and shoot skyscrapers toward the clouds. The first multi-family dwelling with enough light, ventilation, and heat to be called an apartment house, as distinct from a tenement, went up on 18th Street in 1869. The next year, the first passenger elevator in a major building began running at 120 Broadway. New York's permanent high-rise boom was underway.

Brooklyn already was a commuters' town, the "bedroom of Manhattan." Less than half a mile from 71 Nassau Street, where the new firm soon moved into larger quarters, the first pier of Brooklyn Bridge was beginning to rise in 1870. Meanwhile, a revolutionary new transportation system was pushing uptown from the Battery. It was the awesome El, an entire railroad on stilts. The first section of elevated track was demonstrated to a somewhat nervous public in July, 1868. By 1870, the El was running as far as 30th Street, under steam power. Fearful mothers still refused to take their children aboard, but already there was talk of reaching 110th Street, and transportation buffs were preaching the need for a subway.

For that matter, it would have been easier and pleasanter for the partners to stay at their homes across the river in Hoboken. The town had some of the graciousness of an earlier day when it was the resort of rich and famous New Yorkers. John Jacob Astor, no less, had built a villa fronting the Hudson there, and the summer colony had been ornamented by such literary lions as Washington Irving and William Cullen Bryant and even a former President, Martin Van Buren. Hoboken's distinction as a resort was so secure that nobody thought it funny to name one of its recreation areas the Elysian Fields. On those grounds, in fact, baseball had its start as an organized sport, in a contest between Hoboken's Knickerbocker Giants and a New York team, about 20 years before Keuffel and Esser started in business.



Hoboken, across the Hudson River, was a bustling port.

Hoboken already had its industrial side, too. Under the auspices of Col. John Stevens, the chief landowner and developer, it had seen the first successful American railroad demonstration, a locomotive running on a circular track. Stevens also had sponsored the world's first regular steam ferry, the "Juliana," to connect Hoboken and New York. By the late sixties, waterfront activity was transforming the town into a shipping and manufacturing center.

New York City, an exciting place in the 1870's, as work began on the Brooklyn Bridge and Third Avenue "El".

Under Way

GETTING THE BUSINESS STARTED in its cramped New York quarters wasn't easy. Customers had to climb four flights of stairs, and there was no show room. But the partners knew their business. If their customers couldn't or wouldn't come to them, Messrs. Keuffel and Esser would go to their customers. Each armed himself with a large basket of assorted drawing materials and instruments. Day after day, they carried their products into the office of every architect, builder, and engineer they could find in Manhattan. It was hard, exhausting work. But by pounding the pavements and making call after call, the partners began to establish a clientele. Their products were the best, and purchasers found the firm kept its promises.

The partners soon invented a new way to attract customers. Although they lacked a show room, in 1868, little more than a year after founding their enterprise, they brought out a catalog.

Never before had a catalog been devoted exclusively to draftsmen's materials.

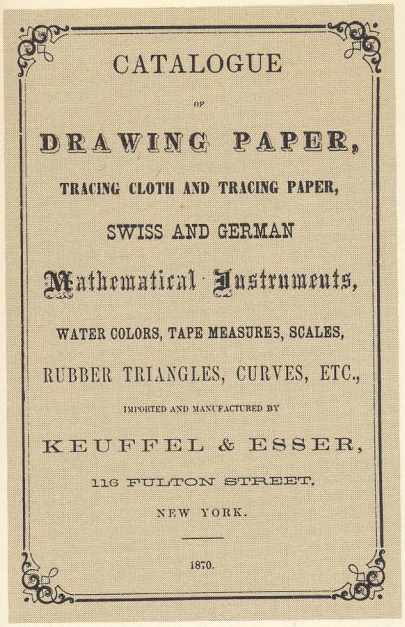
Twenty-four pages in length, the K&E publication created a stir in the hardware trade. The new firm was acquiring a solid reputation. Before long, K&E tools and materials were being used to draw the plans for many of the important construction projects dotting Manhattan. One of these was the Brooklyn Bridge itself, destined to take another 13 years in the building.

In 1870, the year that work on the Bridge got under way, K&E took another major step. Already, at this early stage, the partners realized that soon the growing, vibrant industrial society around them would require precision instruments produced in abundance *within* the United States — not abroad. They foresaw that their imports from Europe would have to be supplemented — and eventually replaced in large measure — by products of their own manufacture. Accordingly, they moved to larger quarters at 116 Fulton Street. Here there was room for William Keuffel to start making the firm's own hard rubber draftsmen's curves and triangles, which he painstakingly cut by hand. William Keuffel's first manufactured items, surprisingly enough, won an award for excellence at the American Institute in 1869. It was the start of a long tradition, maintained by strict quality standards, for every subsequent enlargement of the company's product line.

The new department of K&E began to grow almost at once, and manufacturing became a primary activity of the company. With it came an increasing range of design, development, and ultimately research activities. Within a year the first venture into manufacturing outgrew its original quarters and required additional space at No. 3 Dutch Street.

By 1872 the young business was in urgent need of a retail store with a spacious show room. The store opened in 1873, at 111 Fulton Street. It was soon relocated at No. 119, where for the next four years it occupied the entire ground floor between Fulton and Ann Streets.

By 1875 the partners had to concede a point to Horace Greeley: they transferred their manufacturing operations west across the Hudson to an old loft building at Third and Grand Streets in Hoboken. Three years later, the firm reached another milestone: its own four-story office building and show room at 127 Fulton Street. And then, in 1880, came the biggest step of all. K&E built an entire three-story factory at Third and Adams Streets in Hoboken. It was an early example of what was to become a familiar trend, the flight to the suburbs.



CATALOGUE

OF

DRAWING PAPER,

TRACING CLOTH AND TRACING PAPER,

SWISS AND GERMAN

Mathematical Instruments,

WATER COLORS, TAPE MEASURES, SCALES,

RUBBER TRIANGLES, CURVES, ETC.,

IMPORTED AND MANUFACTURED BY

KEUFFEL & ESSER,

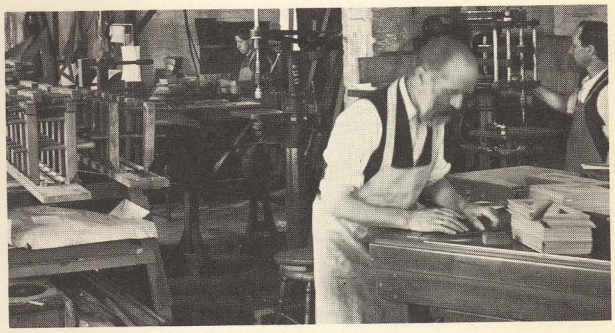
116 FULTON STREET,

NEW YORK.

1870.

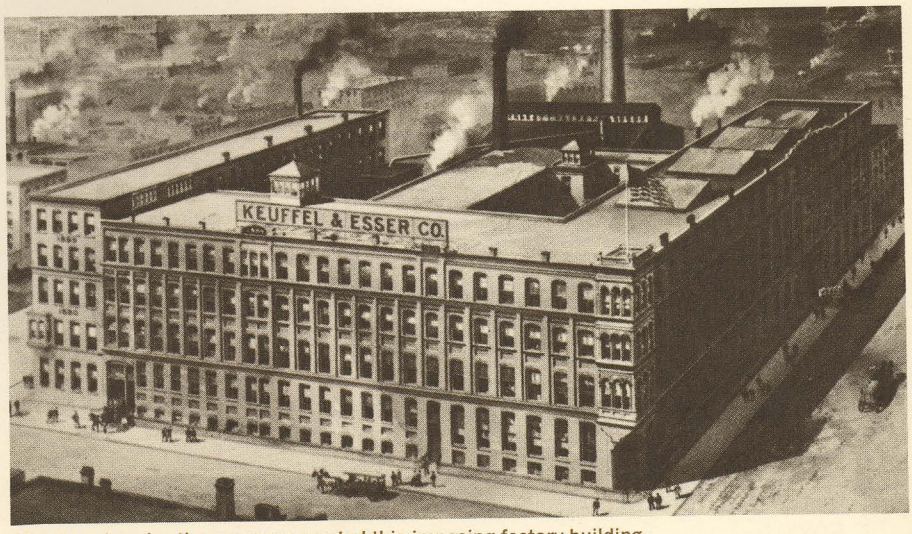
One of the first editions of the K&E catalog.

An early drafting room in the 1870's.



Employees shared a devotion to precision.

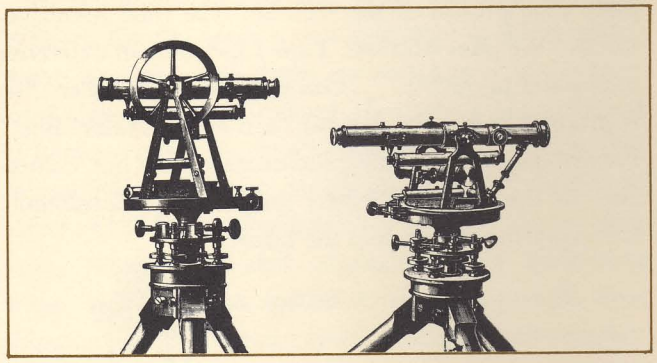
Hard rubber curves and triangles, the first K&E manufactured items, won excellence award in 1869.



After two decades the company erected this imposing factory building to house its manufacturing operations.

Breaking New Ground

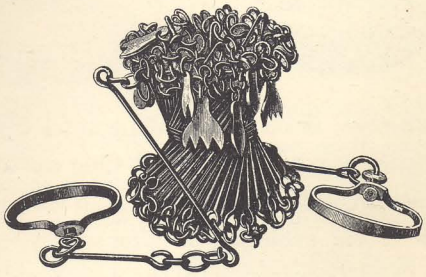
THE RANGE OF TECHNICAL INSTRUMENTS handled by K&E grew until, in 1876, it swelled the fifth edition of the catalog to 123 pages. One section listed a new category: surveyors' compasses, levels, transits, and theodolites. To most laymen today,



surveying is an occult art; but in 1876 its terminology, at least, was familiar to anyone who owned land or a share of stock in a railroad. All through the '70's and '80's, the advance guard of railroads through the plains and mountains west of the Mississippi was the surveying crew. By the time K&E added surveyors' instruments to its product line, the Union Pacific and Central Pacific lines had been joined to create a coast-to-coast railway. Yet there was more for surveyors to do than ever, on railroad lines and elsewhere.

A billion acres of public domain lay west of the Mississippi, and 160 of them were available free to any citizen who hadn't fought for the Confederacy. They were his, if he just lived on them or farmed them for five years. As expected, news that the U.P. and C.P. lines had linked up, at Promontory Point, Utah, in 1869, touched off the longest sustained land rush in American history. The push for land created a tremendous demand for surveying of new farms, mines, grazing lands and timber tracts. Town surveying was badly needed too. Wherever the railroads went, they sowed cities. Farm and town population together soared to nearly 17,000,000 persons west of the Mississippi by 1890. In 20 years the population of California doubled, Texas' trebled, Kansas' quadrupled. The process went on and on as the new century approached, and over a million new farms were laid out between 1890 and 1900. Back East, immigrants were pouring in from Europe. The populations of Chicago, St. Louis, Cleveland, and Pittsburgh had each doubled in the first ten years after the Civil War and were continuing to expand.

Surveyors had to meet strict standards regardless of hazards to their health and equipment. Where fences were few, there was always a chance that some stray cow would kick over a transit, and it was extremely unlikely, on the treeless and rockless prairies, that a pit or a mound marking a corner could last through the first ploughing. Nor, until the 1870's, was a surveyor's life made any easier by the fact that the best linear measuring device available was the old Gunter's chain.



It was not a restful contrivance, with its hundred iron or steel links to be dragged up hill and down dale. Its construction was ingenious, to be sure; each link measuring 7.92 inches, and joined by a metal ring to its

(Top) Making Gunter's chains . . . the device that measured the West.

(Bottom) A big day in railroading — the Promontory Point meeting of 1869 — launched a boom in surveying.

neighbors, so that a chain of a hundred links measured 66 feet between the outside ends of the terminal handles. That length fitted nicely into both the mile (80 times) and the acre. But there were 600 wearing surfaces between the links and connecting rings. As the surfaces wore away with use, the chain lengthened.

Engineers and surveyors wanted something better, and in the '70's, they got it. The improvement was the continuous steel tape. It was lighter, could be wound on a reel, and its variation in length had a measurable relationship to temperature, provided it wasn't stretched or kinked by careless handling. Early steel tapes had their markings impressed on small brass plates soldered or riveted to the steel. The K&E Catalog of 1876 listed several types of steel tapes, including "Fine Steel Tape for very accurate measurement. Largely used on valuable grounds in the cities of New York and Brooklyn." This tape, the ancestor of today's K&E City Engineers' steel tapes, came equipped with a spring balance, spirit level, and thermometer for adjusting all measurements to standard tension and temperature.

By the nineties, K&E was making steel tapes with markings etched in relief on the steel. One was exhibited at the Chicago World's Fair of 1893, and was described in an article on the evolution of mine surveying equipment in the 1898 *Transactions of the American Institute of Mining Engineers*. It was 500 feet long, 0.2 inch wide, and graduated at every foot. The attention paid to this tape indicates that K&E was leading the industry with a product of superior characteristics. (Yet today we take a steel tape for granted.)

In addition to steel tapes, K&E also made and sold woven linen tapes and metal reinforced or "metallic" tapes—but 1887 literature for K&E Excelsior brand measuring tapes somewhat loftily warned that the company disapproved of the metallic type then manufactured. "We offer Metallic Tape Lines only in deference to popular prejudice. . . . Our improved 'All Linen' line is stronger and more durable than any 'metallic' line." Present-day woven tapes, incidentally, are not vulnerable to the same criticism; they have dimensionally stable plastics woven into the fabric.

Wherever people were heading, surveying crews preceded them.

The Day the Slide Rules Arrived

HERMANN ESSER, who was prone to see gloomy possibilities where his partner was all cheer and ebullience, often found his patience sorely tried. He would never forget the day the slide rules arrived.

After the first factory was safely launched in 1880, William Keuffel made a trip to Europe to select instruments and materials from manufacturers in Switzerland, Germany, and England. Hermann Esser remained at home to guide the firm's growing activities. The first shipments of William Keuffel's selections began to arrive at 127 Fulton Street in New York — fine drawing tools, precisely divided protractors and measuring scales, brushes, pens, special draftsmen's pencils. One shipment gave Hermann Esser an unpleasant surprise. It contained, to all appearances, a set of engineers' scales, or "rulers," but they were like none ever seen before in the K&E showroom. The central section of each rule slid back and forth between the two outer sections. What good was that arrangement for laying off lengths on a drawing? Even worse, the graduations were not equal. This was too much. His partner had completely lost his judgment!

Hermann soon learned otherwise. The device, of course, was a slide rule, and its strange graduations were not for measuring lengths, but for computations. Virtually no one in the United States in 1880 would have known how to use one. Only a few university professors had ever heard of them. In Europe they were better known and had undergone a revolutionary improvement at the hands of a young French artillery officer, Amedee Mannheim.

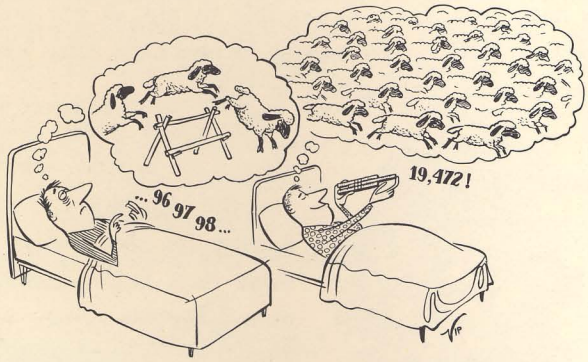
K&E made the Mannheim type of rule available in the United States, and in 1886 began importing instruments with the scales engraved on white celluloid bonded to mahogany. Good legibility, plus the Mannheim scale arrangement, resulted in an upsurge of interest in the slide rule. In later years, a professor at Washington University, Calvin M. Woodward, recalled in an article for *Engineering News,* that he had never seen a slide rule at all before the 1870's but that by the '80's some engineering students already were being required to use it.

The real popularity of the slide rule began after 1890. William Cox, a well-known instrument designer, invented the duplex type of construction, which permitted scales to be placed on both the front and back faces of the rule. A dual indicator, with a glass-enclosed hairline on each face, made it possible to use all the scales together. K&E began making its own slide rules, using Cox's duplex construction, in 1891.

Mahogany tree.

For many years thereafter, a major K&E activity was the acquisition of mahogany for slide rules. In those days before modern materials-engineering was known or dreamed of, quality of materials depended on meticulous selection of what nature produced. The supervisor of the K&E woodworking department would visit the Hoboken and New York City docks to inspect incoming cargoes of logs. Those he considered acceptable he branded with the K&E mark. The chosen few were then brought to the factory, sawed into slabs, and subjected to a five-year long seasoning process.

But more important than materials, which were to remain virtually the same for half a century, were the scale arrangements. The duplex rule continued to evolve. Engineering students in the 1930's, and for over three decades thereafter, learned to use and roll off the tongue that wonderfully complicated trademark, the LOG LOG DUPLEX DECITRIG.® And the slide rule reached a new stage of development in 1962, when K&E introduced the DECI-LON® Slide Rule, with new and more powerful scales for computation, made of a new amazingly durable synthetic. The slide rule had entered the space age.

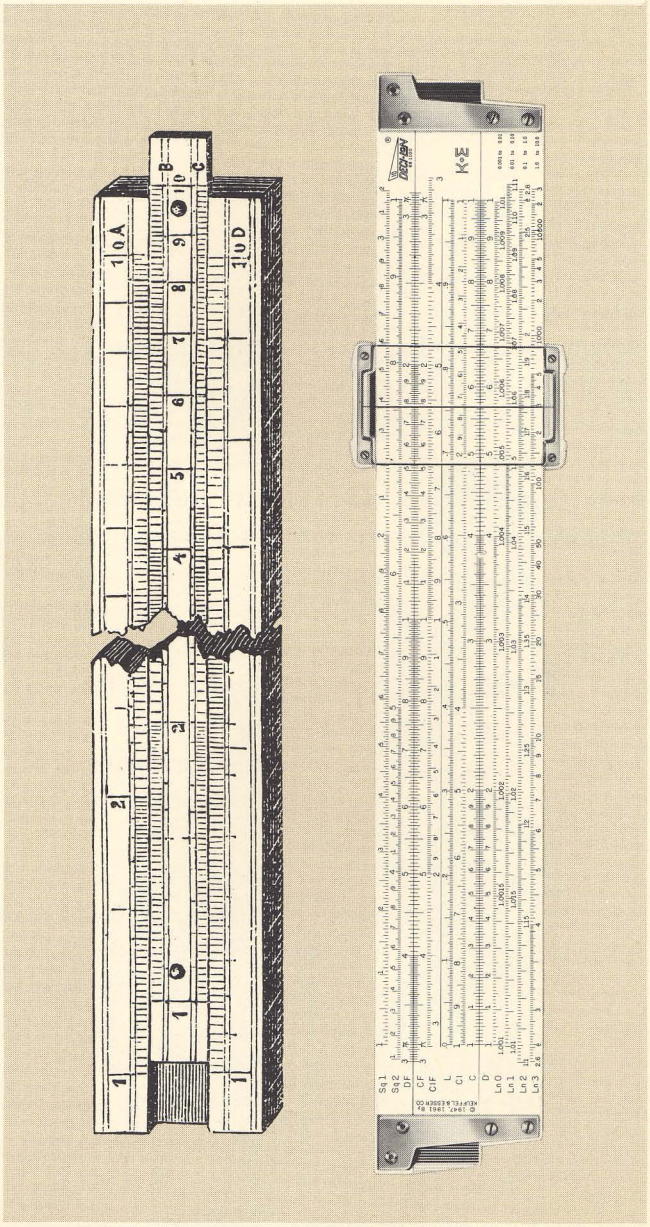


EFFORTLESS ANSWERS: Four generations of engineers, students, scientists, business men have figured their answers quickly on K&E slide rules.

Foremost among these, the most modern engineers' rule today, the Log Log Duplex Decitrig® is chosen in colleges and schools, in labs and offices, over all other slide rules. Its scale arrangement, consistent as a piano keyboard, makes it simple to teach, learn and use. K&E makes many types of slide rules, at all prices, 20-inch for the desk, 10-inch standard length, and 5-inch convenient for the pocket. See your K&E dealer or write to Keuffel & Esser Co., Hoboken, N. J.

KEUFFEL & ESSER CO. New York, Hoboken, N.J., Detroit, Chicago, St. Louis, Dallas, San Francisco, Los Angeles, Seattle, Montreal.

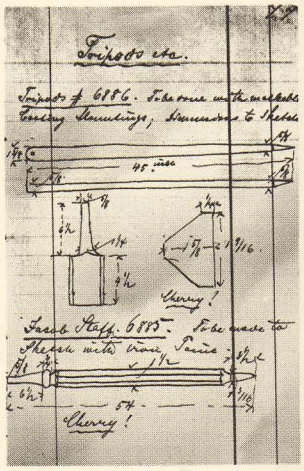
K&E advertisements of the mid-1950's suggested the fringe benefits of becoming a slide rule expert.

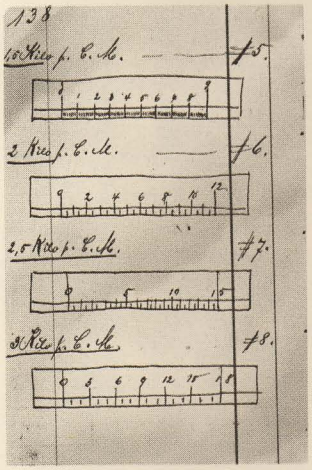


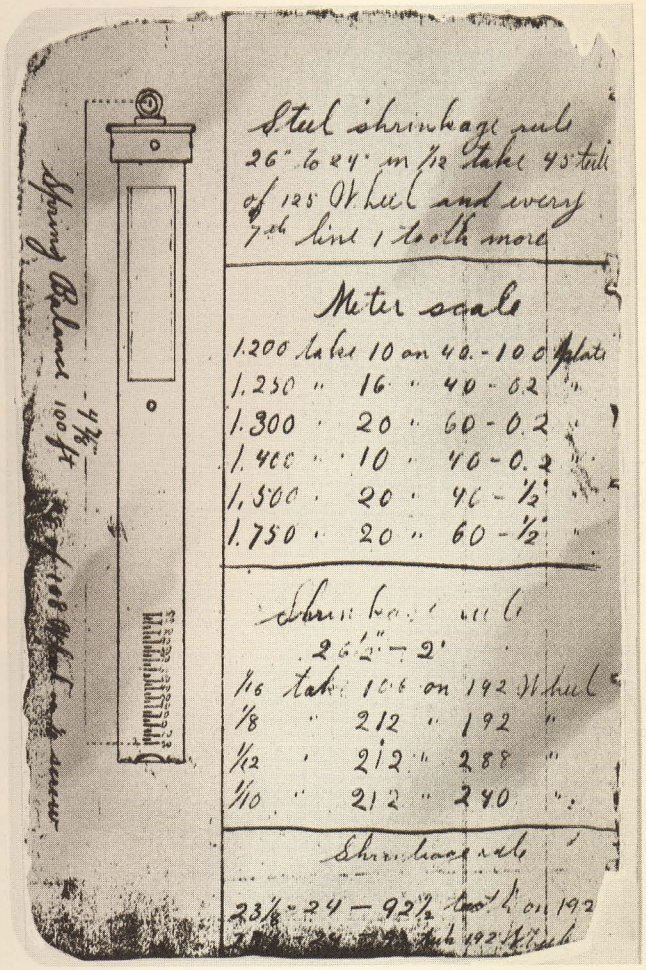
One of the earliest slide rules, made in the 1880's and one of the newest, the DECILON, introduced in 1962.

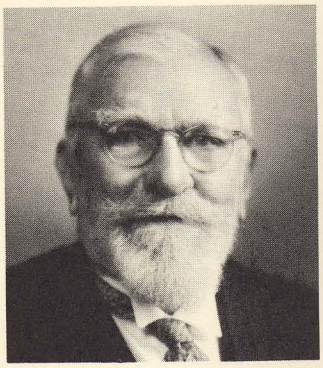
From William Keuffel's Notebooks

For many operations, the partners and their associates had to devise their own methods, which William Keuffel carefully recorded in a small, calf-bound ledger. One of the achievements of the manufacturing department was the design of ingenious dividing engines for graduating linear scales or circles on various instruments. William Keuffel's ledger, which has survived, records the settings of a machine probably used for graduating engineers' scales as early as the 1880's.





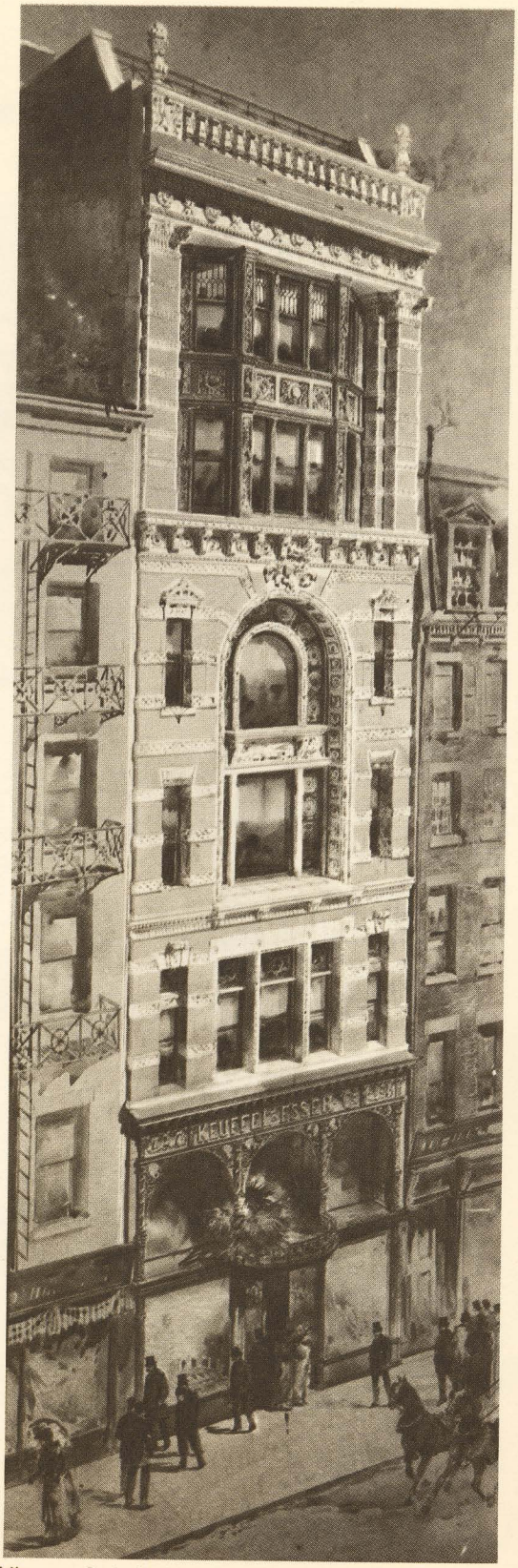




A Pioneering K&E Engineer

W. L. E. Keuffel, a second cousin of the company founder, became one of the guiding lights of K&E precision, and a beloved friend and counselor to generations of employees. As head of manufacturing, he helped develop many of the company's custom-built dividing and calibrating machines. For generations the "dividing rooms" were top-secret. Even a future K&E president (A. E. Busch) was once refused admission beyond their outer doors early in his career.

The first building at 127 Fulton Street, with blueprint racks showing on the fourth floor.



Rebuilt in 1892, the new headquarters building was 8 stories high, boasted an imposing show room.

Moving Out

As various problems were solved, the firm of Keuffel & Esser kept breaking new ground, figuratively and literally. Like the original factory in Hoboken, the four-story headquarters office at 127 Fulton Street in a few years proved too small. K&E was growing in every way: in sales, manufacturing, breadth of product line, and number of employees. Its name was known all over the United States and in Europe.

The partners had brought their enterprise a long way from the original little room, four flights up, in the old building on Nassau Street. To administer what was now a national and even international business required space for a sizeable office force.

At the insistence of William Keuffel, the company in 1892 took a bold step. It entirely reconstructed the four-story headquarters building at 127 Fulton Street and enlarged it to eight stories. The size of the new headquarters dismayed the more conservative executives. There was ample space for several times the number of employees the company had that year. William Keuffel cheerfully built for future needs—yet even *his* optimism underestimated the developments to follow. In the same year, 1892, it was necessary to add two floors to the manufacturing building in Hoboken.

Meanwhile, expansion also took place geographically. The first branch office began operations in Chicago, 1891; a second opened in St. Louis in 1894; and in 1900 K&E reached the Pacific with a branch in San Francisco. Again it was necessary to enlarge the manufacturing departments—they had to be considered in the plural by this time—with two additional factory buildings and the simultaneous conversion of an old iron works nearby.

With branches established from coast to coast, manufacturing departments steadily broadening their scope, a widening sphere of business reaching even overseas — the first K&E catalog in Spanish had appeared in 1892 — both partners might have rested from the increasing demands on their enterprise. They had trained able and hard-working successors who already were taking many responsibilities. W. L. E. Keuffel, a second cousin of William, supervised manufacturing; and both W. G. Keuffel and Carl M. Bernegau, William's son and son-in-law, were active in the business. Hermann Esser retired in 1902 to enjoy a leisurely old age. William Keuffel remained, if anything, more active than ever. His vigor was soon tested.

On December 8, 1905, fire broke out in buildings the company had taken over from a former iron works on Adams Street. Fire companies, called in even from Jersey City, could not save the old wooden buildings. William Keuffel reacted to this misfortune as if to an opportunity: why not rebuild the destroyed part of the factory far larger than it had been, using the most

advanced type of construction, reinforced concrete? It had been tried in only eleven buildings in the United States, but French engineers had achieved many successes with it.

Construction was still proceeding when fire again struck part of K&E. The first tremblors of a violent earthquake rocked San Francisco before dawn of April 18, 1906. Three days of fire and destruction left 700 dead and four-and-a-half square miles of the city destroyed, including the K&E branch office. A new San Francisco quickly rose from the ashes, however, and with it the K&E branch was soon rebuilt.

At almost the same time, in 1907, the new concrete, fireproof buildings in Hoboken were completed. They provided 152,500 square feet of additional floor space, room enough for many manufacturing operations as well as the general office, which had outgrown even the eight stories at 127 Fulton Street. K&E now had the best and largest factories in the world for manufacturing engineering and drafting instruments and supplies.

William Keuffel lived until 1908. His firm was thriving; it was contributing to technical and industrial progress wherever American engineers were at work. Admiral Peary used a K&E transit to survey the North Pole. Other products would be used in the vast construction required to cut a canal through the Isthmus of Panama. Unrest in Europe, however, threatened the growing prosperity of the new industrial society that had transformed both Europe and the United States since 1867. World War I was in the making, yet America still depended to a large degree on the craft secrets of the Old World. K&E would soon be called on by the United States Government to manufacture precision instrumentation in prodigious quantities.

Admiral Peary and the K&E transit he used to survey the North Pole. (The instrument is now preserved in the Smithsonian Institution.)

A National Emergency

In the summer of 1911, the National Bureau of Standards in Washington acquired a new research assistant in the field of optics. He was Carl W. Keuffel, the elder son of W. L. E. Keuffel. Carl Keuffel was fresh from the Stevens Institute of Technology in Hoboken, where he had graduated in mechanical engineering. He had come to the Bureau to do research while taking graduate studies in optics and mathematics at the Johns Hopkins University.

The Bureau, in those years, just before the First World War, was an extremely busy and sometimes worried organization. It was the only government agency with responsibilities reaching across the entire field of pure and applied science. It seemed to be the only agency equipped to advise the government about scientific and technical needs that might affect the national interest.

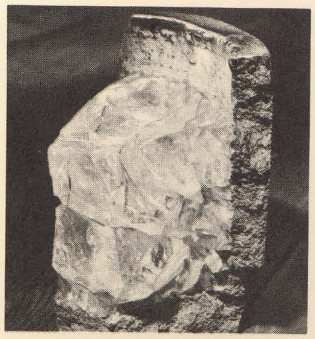
One area in particular worried its Chief, Dr. Samuel W. Stratton. Before coming to the Bureau, he had done research on light at the University of Chicago. No one knew better than he that the United States depended on European manufacturers for the entire supply of high-grade optical glass. What would happen should anything cut off that supply? Almost at once, the country would face shortages of optical equipment essential for scientific, technical and military uses.

When Carl Keuffel left the Bureau in 1913 to work at K&E, he retained his interest in optics. He also kept in mind Dr. Stratton's concern about developing sophisticated optical-glass technology in the United States. To create it would mean rediscovering the most tightly guarded trade secrets of German optical instrument makers. It meant, further, developing completely new formulae and equipment for using American sands and clays, which differed chemically from those available in Europe. The clays were important, because they would furnish new material for high-temperature crucibles. The sands, of course, would provide the glass melt.

World War I . . . technology began to gain momentum.

K&E already was making optical equipment for the U.S. Navy. More than ninety-five percent of the periscopes for American submarines came from K&E. When Carl Keuffel returned to Hoboken, the factory was also turning out eighty torpedo directors for the Navy, plus four more for the Argentine Navy. Carl Keuffel at once took a hand in the optical design of these specialized instruments.

By the Fall of 1914, Europe was at war, and Dr. Stratton decided the U.S. could wait no longer to start optical glass manufacture. He ordered furnaces and



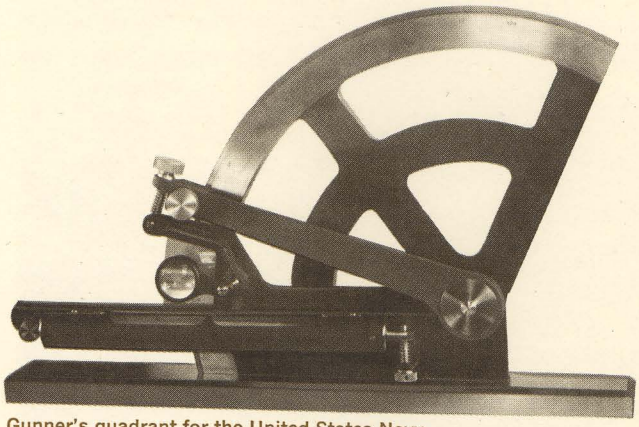
Fragment of the first optical glass melt.

apparatus for experimental glass manufacture at the Bureau of Standards Laboratories in Pittsburgh. Within a year, data from the experiments were flowing to pilot facilities at a number of companies, including K&E. Carl Keuffel was assigned the responsibility for K&E's effort, and on January 4, 1916, achieved a successful melt. Reviewing the optical glass projects of this period, the office of the U.S. Navy Chief of Ordnance later commented in an official document:

"... optical glass was made by Keuffel & Esser in quantities sufficient to supply their own needs. Much credit is due Mr. Carl Keuffel, who, on his own initiative, and before we entered the war, erected a glass melting furnace, made suitable products, and produced some glass of good quality without outside help."

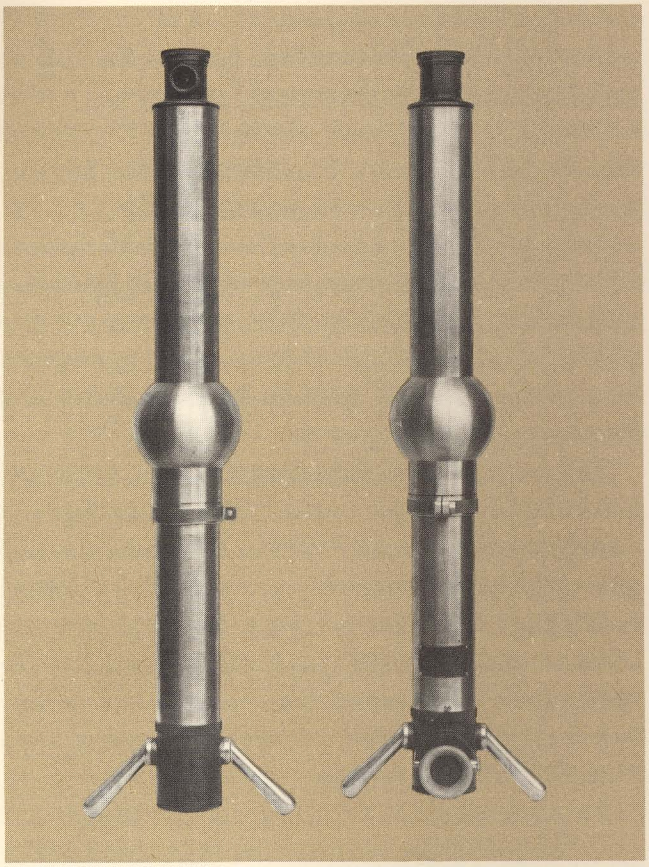
K&E, in fact, was already a leading manufacturer of specialized optical instruments in this critical period of the United States war effort. The war was perhaps the first in history to feel the impact of the world's new technologies. Every type of "hardware" — the tank, the long-range siege gun, the submarine, the torpedo, the high-speed surface vessel, the airplane, and the anti-aircraft gun—required new instruments for control, sighting, and navigation. Intricate optical instruments had to be designed and made virtually on a moment's notice. K&E was designing and manufacturing new optical equipment for the armed forces at such a rapid rate that there was scarcely time to keep engineering drawings up to date.

Every branch of the armed forces needed new optical instruments. The Corps of Engineers needed new types of transits. The new meteorological service, indispensable to the infant Air Corps, needed special theodolites for tracking weather balloons. The Navy needed new navigational and fire control devices. Bombardment aircraft had to be equipped with bomb sights to cope with the intricacies of airspeed, wind velocity, air resistance, and gravitation. Anti-aircraft batteries needed height and direction finders. Trench warfare created a need for periscopic observation equipment. Complex artillery firing required more precise fire-control instruments than had been known before.



Gunner's quadrant for the United States Navy.

K&E furnished many optical devices to fill these requirements. Before the war ended, K&E's optical department was turning out a variety of instruments needed by the Army and Navy. In addition to range finders, telescopes, gun sights, periscopes, and sextants, K&E designed and built a highly precise bench photometer for measuring the percentage of light transmission of telescopes. It was used by optical inspectors to check



Periscopes for the U.S.S. Wyoming, 1910.

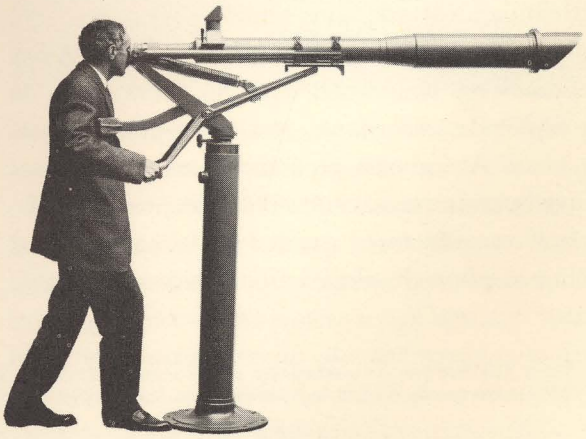
the quality of military instruments, and afterward continued in service in the K&E research and development laboratories.

In addition, at the request of the government, K&E began manufacturing ships' binnacles. Torpedoes were taking a heavy toll of shipping, and hundreds of new cargo vessels were needed to maintain the Allies' supply line across the Atlantic. K&E produced 1,050 ships' binnacles between April, 1915, and November, 1919.

Optical devices and ships' binnacles were not the only critical need for precision instruments that faced American industry during the war. The country also depended heavily on German and Swiss manufacturers for superior drafting instruments. K&E, of course, had long been a leading importer, as well as a manufacturer, of drawing instruments. The war abruptly cut off the European supply.

To fill the gap quickly with high-quality instruments, K&E developed a design that permitted machine tools to substitute for many traditional hand-craft operations. The instruments had tubular shanks instead of flat or rectangular ones; the shape was functional, strong, and suited to machining by automatic screw machines. The result was the well-known MINUSA® — standing for "made in U.S.A." — line of instruments. MINUSA instruments averted serious production bottlenecks in industrial drafting rooms during the war years.

Twenty-five years later, in a still greater crisis, the style and the name would be revived to keep the nation's wartime engineers supplied with high-quality drawing instruments.



Ship's telescopes for the Argentine navy, 1911.

The Pace Quickens

All at once, after the armistice, the world was changed. In place of headlines about the Western Front, deadly flu, and starvation in Eastern Europe, newspapers gave their readers the latest about the flapper, low life in speakeasies and high-flying in the market, Gay Paree and Boca Raton, the boyish bob, College Humor and being "smart." In later years, these symbolized a time remembered as the Era of Wonderful Nonsense by people who had to face unemployment, industrial turmoil, and the renewed threat of war.

Throughout the twenties, the lessons learned in an atmosphere of crisis were to be applied to non-military instruments. As a result of wartime experiences, K&E became one of the most advanced and inventive instrument makers in the world. This led to one of the most important devices in surveying instrument design, the internal focusing telescope. Internal focusing greatly reduced the chances that dust, the greatest enemy of fine optical instruments, might penetrate where it could harm internal surfaces. It quickly became a standard design feature for transit and theodolite telescopes.

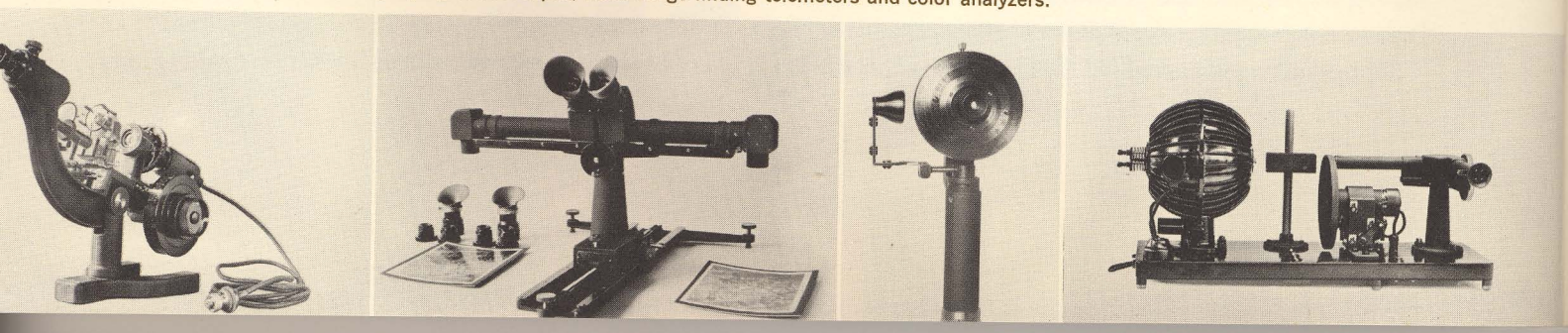
The twenties were not all froth and glitter. Away from Broadway, Hollywood, and the front page, in offices and industrial plants, another revolution was taking place. As industry grew more complex, manufacturing became more and more a science. Equally important, manufactured goods had to be marketed according to plans developed from facts and figures, rather than hunches and guesses.

At K&E, these trends led to greater emphasis on sales management. A network of branches and dealers in all the principal cities of the United States and Canada had been largely completed before the war, during the presidency of William G. Keuffel, who succeeded his father, W. J. D. Keuffel in 1908. The growth of the sales organization also reflected the joint influence of Karl Keller and Carl M. Bernegau, two sons-in-law of W. J. D. Keuffel who made outstanding contributions to the growth of K&E in the years after World War I.

The two men formed a remarkable team. Their gifts in administration, organization, and sales development were greatly needed. The list of K&E products soared after the war. It included more than five thousand items before 1930; just to catalog them required hundreds of closely printed pages. The customers who bought these products had to be served in every county and township of the U.S., as well as Canada, Latin America, and other countries abroad.

To assure efficient distribution of the thousands of specialized K&E products to even more thousands of engineers, surveyors, draftsmen, map-makers, scientists, and technicians — each with his individual requirements — required a vast effort of sales administration and training. Growth required capital, and prudent planning, with provision always in mind for a "rainy day" if it should ever arrive.

In the 1920's K&E became an increasingly sophisticated instrument maker, producing such advanced devices as (left to right) lensometers, magnifying stereoscopes, hand range finding telemeters and color analyzers.



Progress Despite the Depression

THE GREAT MARKET CRASH of 1929 started a shock wave that hit K&E as hard as other companies. For a while, business came to a standstill. Fortunately for the company, its financial policies had been prudent; there were reserves to maintain vitality even in what amounted to a state of suspended animation for many months. K&E's management used these resources to retain the many employees with years of service, and kept them busy as usual. One result was that the inventory of surveying instruments grew at an alarming rate. By 1933, it began to seem that K&E already had in its warehouse all the surveying equipment the country would ever need.

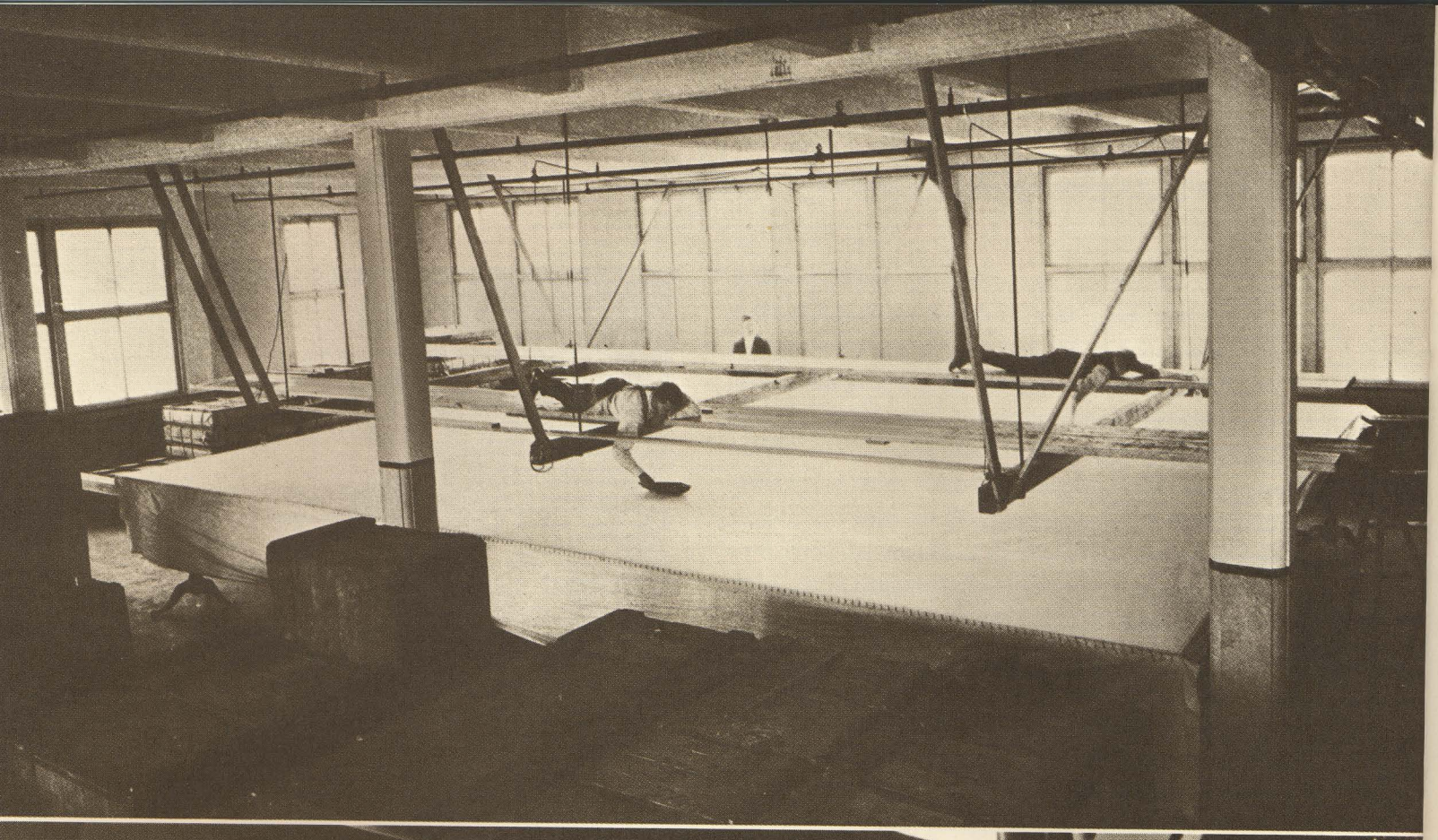
And then, in 1934, federal public works programs began to prime the pumps of industry. To everybody's surprise, the K&E factory was soon working again at capacity. It even became necessary to rent additional production space nearby.

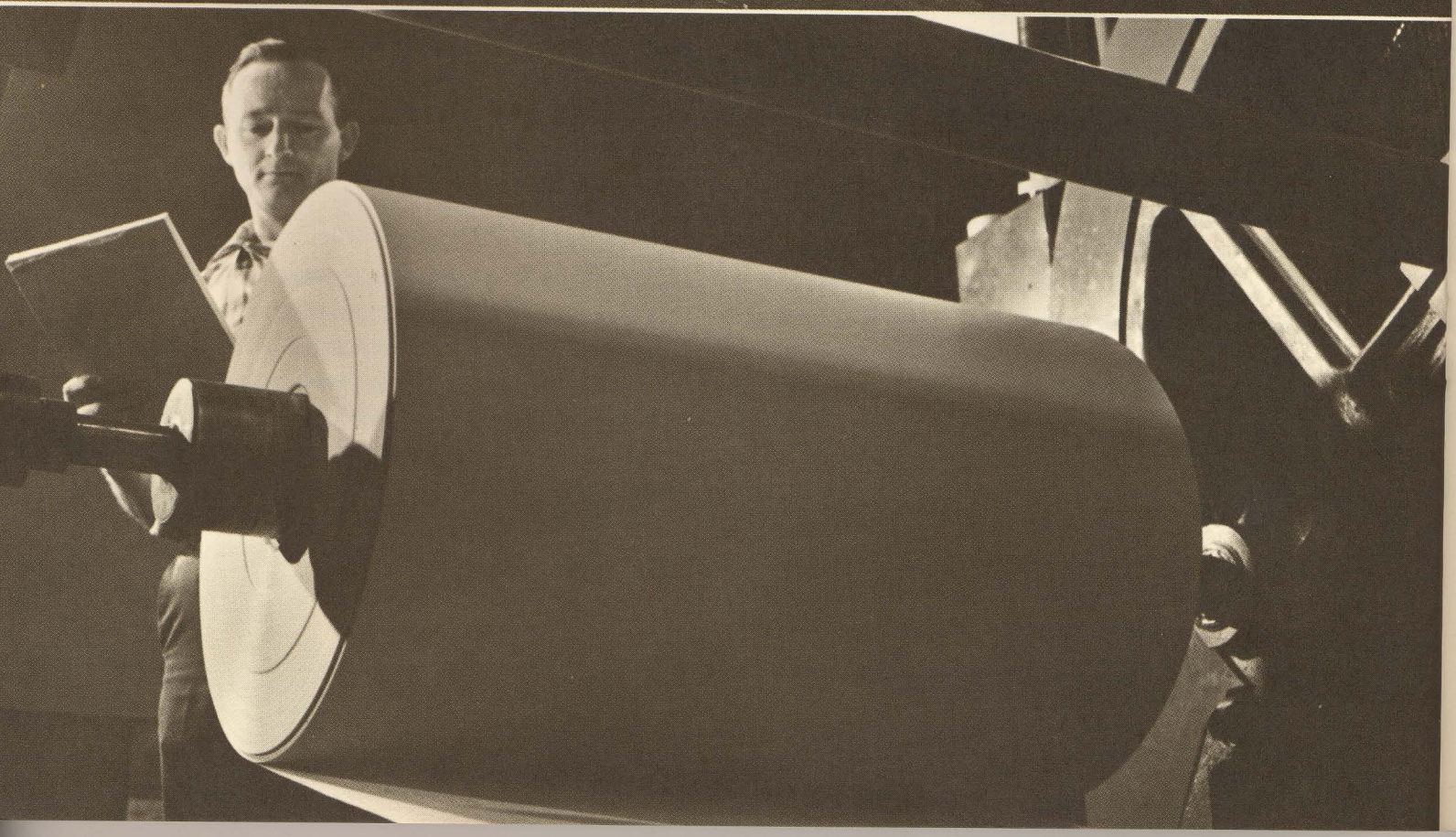
The depression years also marked a period of development in the allied fields of drafting and reproduction materials. K&E had from the start carried an extensive line of drafting supplies. And, when blueprints replaced manual "tracings" as a means of duplicating drawings, the company had devoted a great deal of attention to this new technique. The fifth floor at 127 Fulton Street had housed a large department for making blueprints.

In those days a blueprint was commonly made by placing a sheet of sensitized paper beneath a drawing on translucent paper, then clamping the two in a large wooden frame and exposing them to sunlight. On sunny days, K&E employees would roll blueprinting frames out on to special outdoor racks for exposure to the sun. On cloudy days, there were no blueprints made.

Soon, however the arc light was beginning to substitute for sunlight. And the electric blueprinting machine made its entrance, printing from paper fed on continuous rolls. And K&E had transferred its blueprint manufacturing to Hoboken. Early production methods were slow and cumbersome, requiring the sensitized solutions to be brushed over the paper surface by hand. K&E soon introduced machinery to coat the paper, and also improved the chemical composition of the coatings.

This was the beginning of a long term program, continuing to the present, to develop better drafting and





reproduction materials with special properties imparted by chemical coatings. K&E has become a sophisticated leader in coating technology, starting from its early days in blueprinting.

One of the major R&D discoveries in coating technology was to emerge from the K&E labs in the thirties. Until that time, the so-called "prepared" tracing papers had serious drawbacks. Unlike natural paper, which was translucent because of its thinness and fibrous structure, prepared tracing paper was made translucent by the application of oils or waxes. These transparentizing media gave the paper more light transmitting properties than any natural paper, but at a cost. The oils and waxes had an annoying habit of leaking out of the paper completely or turning yellow and opaque, making the drawing virtually impossible to reproduce.

In 1936, K&E put an end to these problems with the introduction of ALBANENE® prepared tracing paper. This was a fine-quality, 100-per cent rag paper, coated with a special kind of transparentizing medium. Not an oil or wax, it was a synthetic resin that remained inert with the passing of time, stoutly refusing to oxidize, turn yellow, or migrate. The thirty-one years since the introduction of ALBANENE tracing paper have seen it become the world's most widely used prepared paper, the standard by which all other papers are compared.

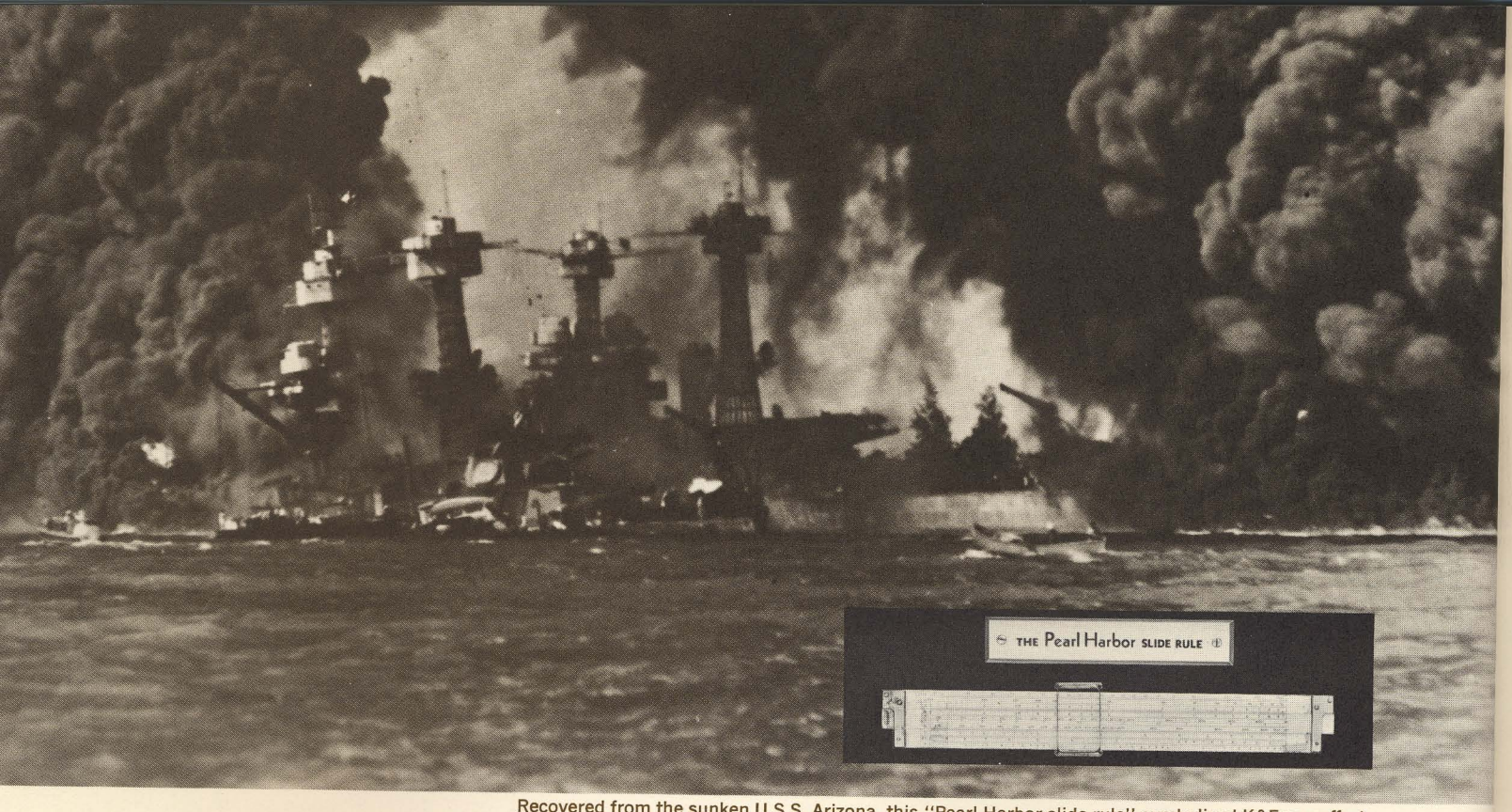
Other significant product lines were also introduced in the thirties, as the new emphasis on research began to pay dividends. Perhaps one of the most famous has been LEROY® lettering and symbol equipment, a technique for producing perfectly uniform, readable lettering using a simple stylus and scriber. LEROY equipment, because of its essential simplicity and versatility, has seen world-wide usage. K&E has a template library which covers virtually every modern language.

Another breakthrough to come out of the research labs in the depression era was the PHOTACT® line of photographic reproduction materials. These silver-halide products were tailored to the specific needs of industrial reproduction.

Diazo reproduction, today the engineering profession's number one reproduction method, also became an important K&E endeavor during this period. K&E launched the first of many achievements in diazo technology with its HELIOS® and ONYX® lines. Later to come were new high speed emulsions, audiovisual materials, and a variety of diazo products matched to the complex needs of modern industry.

None of these achievements was accidental. Each was the fruit of research, based on a growing awareness that science was becoming the essential ingredient in engineering discovery. By the mid-1930's K&E had several different chemical laboratories carrying on testing and research activities. In 1935 the labs were combined, moved to larger quarters, and furnished with the most advanced equipment obtainable. The success of this policy was marked by the rapid advances in coating and reproduction technology that soon followed.

Early methods of producing drafting and reproduction material were crude and time consuming. Today, coating machines apply sophisticated surfaces at thousands of yards an hour.



Recovered from the sunken U.S.S. Arizona, this "Pearl Harbor slide rule" symbolized K&E war effort.

Another War

PEARL HARBOR SWEPT EVERY OPERATION at K&E into a crash program — in one instance, quite literally. An early wartime project was to design a range finder for the Sherman tank. Without warning, one such mechanical monster came clanking up from the Frankford Arsenal one day and stood chugging quietly in front of a supplementary building where military work was being done. The structure had no entrance large enough for this steel giant, but the tank captain had a solution; his General Sherman punched its own entrance through the wall.

In the first months of war, there was great concern about possible air raids. "Remember Pearl Harbor" was more than the title of a popular war tune as far as the military services were concerned. To prepare for the worst, a buffer wall of foot-thick masonry was put up in front of the windows that lighted the K&E telephone switchboard room. It was hoped that this wall, ten feet high, would protect the telephone nerve center from blast and debris if a bomb landed in the street outside. Another precaution was to paint a broad brown stripe up the side of the K building and across its roof. The stripe was intended to look from the air like a street, so that the K&E plant would not be identified.

The war-time demand for K&E products was unprecedented. Slide rules and drawing instruments, in particular, seemed to be needed by every engineer and draftsman in the country. Colleges and schools were

ordering double and triple the quantity of rules they had ordered in previous years. The Army and Navy soon set up accelerated training programs which increased the demand even further.

The immediate demand for high-grade rules could be met because K&E had a large stock of seasoned mahogany blanks and was able to put production on two and three shifts. To meet the temporary training need, K&E greatly increased production of beginners' slide rules. Eventually the War Production Board took over the allocation of K&E's entire production of slide rules.

To a large extent, drawing instruments and surveying instruments also required emergency production measures. K&E was the only manufacturer able to move quickly into production of high-grade drawing instruments. The MINUSA® drawings and specifications of a quarter-century before were still in the company's files. They enabled production to get under way smoothly in 1939. The demand was so great, however, that a supplementary line, MERCURY® drawing instruments, also was manufactured in Chicago. The first MERCURY sample sets went out to K&E branches on March 25, 1941.

A great many special surveying instruments and similar devices also had to be made quickly. Interferometers, collimators, balloon theodolites, anti-aircraft gunsights, magnifying telescopes, bomb sight telescopes, drift meters, planimeters, and peep sights, as well as components and engineering assistance furnished to other government contractors, kept K&E engineers and craftsmen at work night and day. Every minute counted. To shorten the time required for meals, the Navy took over an area in one wing of a rented building and installed a cafeteria for K&E employees working on military projects. Lunch-periods were cut from an hour to 30 minutes.

Eight months after Pearl Harbor, K&E celebrated its seventy-fifth anniversary. The occasion was marked by a simple ceremony during the noon hour at which every employee was presented with a twenty-five dollar war bond. Then everybody went back to work.

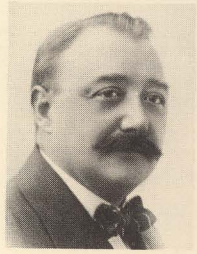
By the war's end, K&E had received the Army-Navy "E" award seven times for excellence and efficiency in production. Only 13 other plants, out of more than 85,000 engaged in war production, won the "E" as many times. Only five percent received the award even once.

After V-J Day, there was still no time to rest. K&E became involved in new technology on a broader and deeper scale than anyone might have predicted. New challenges and new opportunities, created in war-time, opened the prospect of greater growth for the company than ever before in its history.

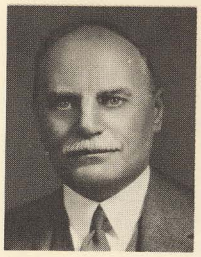
K&E wins an Army-Navy "E" award — one of seven the company received during World War II.

K&E Presidents... and Their Contributions

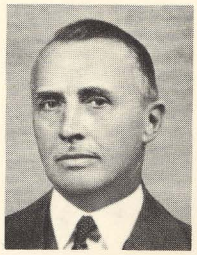
W. J. D. Keuffel— Co-founder of K&E with Hermann Esser, he accurately foresaw growth of technology following the Civil War. Always an optimist, he let this insight guide him and planned for swift expansion of the K&E product line. With Hermann Esser, he established a tradition of craftsmanship coupled with an innovating spirit in product design. He assumed the company presidency in 1902, following Hermann Esser's retirement.



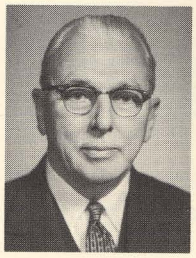
W. G. Keuffel—Son of the founder, he was president from 1908 to 1942. His business policies were founded on his father's motto: "The best; first, last, and always." As president, he headed a team of K&E executives who led the company successfully through the Depression and two world wars. In the same period, K&E expanded its product line to thousands of different items and its distributor network to scores of cities in the U. S. and Canada.



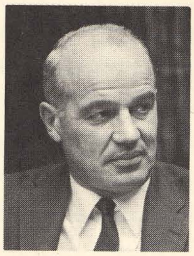
C. M. Bernegau—His influence stimulated company growth during the difficult Depression years. He became president in 1942, in a period of stresses brought by war. Under his leadership, K&E achieved true stature as an instrument manufacturer, and built a tough, resilient production team, tempered by the rigorous demands of war, ready to meet the new demands of peace.



Karl Keller— Becoming president in 1946, he set about reorienting the company to a new technical and industrial environment. Company operations were decentralized. Manufacturing functions were regrouped to take advantage of specialized facilities at a number of locations. At the same time, K&E initiated a long-term program of product diversification.



C. W. Keuffel—As president from 1950 to 1961, he gave impetus to an extensive research and development program. His scientific and engineering background enabled him to make valuable contributions to product design as well as R&D organization. Under his leadership, K&E became active in new fields such as miniaturization and optical metrology.



A. E. Busch—President since 1961. Keuffel & Esser Co. has experienced its most rapid period of growth under his presidency. It has been a period marked by emphasis on science-oriented technology, a diversification of product lines, a strengthening of marketing position in the United States and overseas. Perhaps the most significant event of all was his direction of the company toward public ownership in 1965, with the new attitudes and flexibility which this step created.

Into the Jet Age

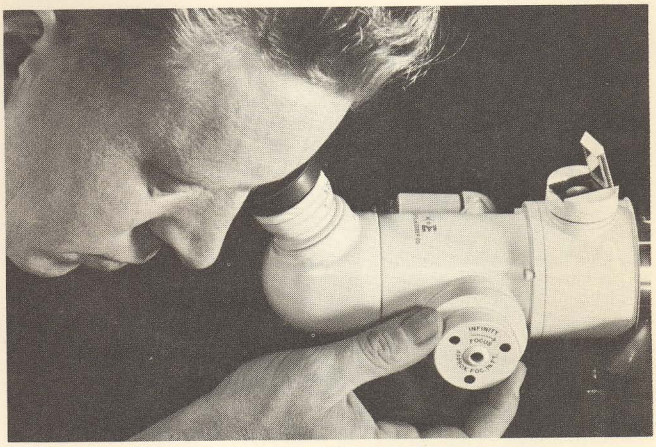
As the nation began to adjust to peacetime after World War II, a new era began. It was a radically different environment than any the world had ever known. Over 90 per cent of the engineers and scientists who had ever lived were alive at the moment. And they were shifting our technology into high gear, moving us into a fabulous period where speed and accuracy would grow respectively greater and more refined.

Out of wartime aircraft development came the wonderfully efficient jet airplane, pushing quickly up to the speed of sound and beyond. And with the jet plane, came the need for accuracies in design and assembly never before required. Length measurements were needed to an accuracy of one part in 200,000. Angles had to be read to one second of arc (the angle created between the top and bottom edges of a dime, standing on edge a mile distant.)

Keuffel & Esser, for most of its history a skilled instrument maker, saw in the new technology a need for a new breed of optical instrumentation. During the war, surveying instruments had been pressed into duty for alignment work in industry, replacing with an optical "line of sight" the former tightly stretched piano wire used to align large pieces of equipment, jigs, and fixtures. There was clearly a need for a more sophisticated line of equipment specifically made for this type of "industrial surveying." In the late 1940's K&E began to introduce items of what it was to call its Optical Tooling line. These were a series of powerful telescopic instruments which established a reference line of sight, from which measurements were made by optical micrometers using special targets and scales.

Optical tooling and alignment equipment was to become one of the hardiest of the post-war K&E innovations, quickly establishing itself as a required working tool in any industry where the accuracies were of a high order, the distances lengthy, and the equipment to be positioned large. Optical tooling and alignment equipment was quickly adopted by the pioneering airframe industry. It also helped build the post-war generation of ocean vessels, put giant paper production machines into ideal alignment, and eventually helped in such prodigious alignment tasks as Stanford University's two-mile long, absolutely straight linear accelerator.

The Boeing 707 jet transport, one of the pioneering jet aircraft built with the aid of K&E optical tooling.

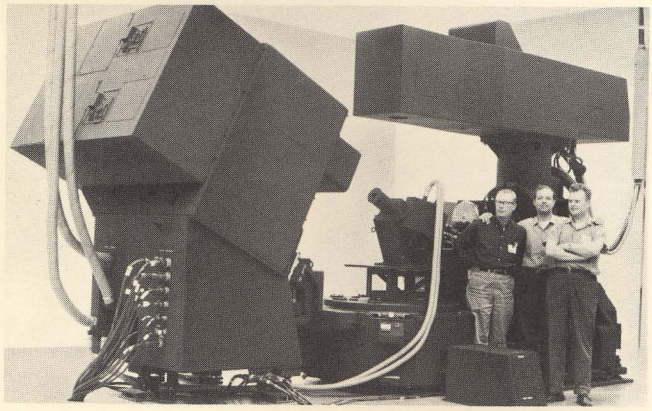


With optical telescopes, line of sight replaced the traditional piano wire methods, to erect and position huge jigs, fixtures and machinery.

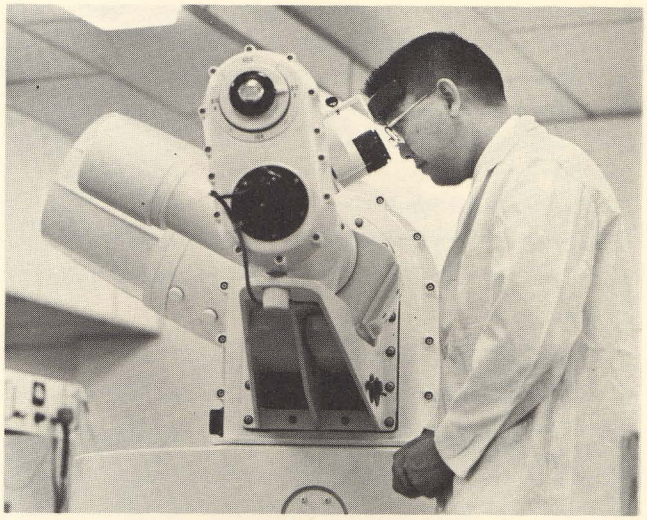
As K&E increasingly became a specialist in the fields of fine optics and industrial measurement, another evolution was to take place which would place the company in the midst of space age technology which began with the dramatic Russian Sputnik I in 1957 and sped to new achievements with each succeeding year.

In the year 1959, the company formed a new group of specialists known as the Optics and Metrology Division. Essentially an R&D team, the O&M facilities brochure described its role as "specializing in the development and manufacture of optical, mechanical, and electronic systems for the precise measurement of lengths and angles."

Out of this division were to come some significant advances in the state of the art of metrology. The list included such achievements as the Electronic Tilt-Angle Transducer, which measured and monitored angular deviation to 1/4 second of arc; the optical reference units for the Polaris missile-launching submarine; the optical monitoring system for the giant Haystack antenna.



Built for the Apollo program, the star simulator test complex (to which K&E contributed the optical-electronic systems) accurately reproduced starlight as it would appear in outer space.



A major research and development project of the 1960's was the K&E missile-tracking cinetheodolite.

A feat of major importance was the development of an ultra-high-performance cinetheodolite for missile tracking at the White Sands Missile Range. This unit will sight, track and film an object about the size of a basketball at distances up to 220,000 feet, with an accuracy of two seconds of arc.

Equivalent skill was demonstrated in the development of a "star simulator" delivered to the Air Force in 1965. This test complex was designed to duplicate the exact light frequency and intensity of guide post stars in space, thereby helping check out the star tracking units to be used in the guidance of manned space vehicles. The K&E optical-electronic complex would accurately duplicate here on earth operating conditions utilized to navigate in the outer heavens.

The post-war decades brought new sophistication and accelerated change to the job of the engineer. K&E called upon its resources to supply the needed tools.

The Growth of Systems

In the 20 years after the second World War, life for the engineer grew not only more exacting (as to accuracies) and more demanding (as to schedules), but vastly more complex.

There was a time when a single man could know virtually everything about a big engineering job. That time vanished with the new technology. Engineers had to invent a new way of dealing with such mammoth projects as a space program. They did it by thinking up a new way of thinking — and called it systems engineering.

Simply stated, it was a way of planning and dividing work to achieve orderly completion of extremely complicated projects. Systems analysis became a common working tool.

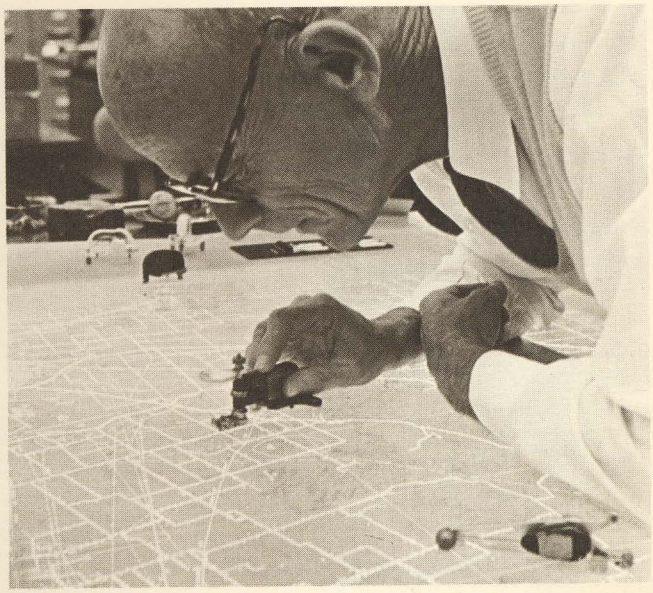
At K&E systems became a new way of looking at products and product lines. New ideas were considered in the light of how they fit in with existing systems, how they would smooth work flow on complex jobs.

As a result, several innovations were to emerge from the Research and Marketing groups, product systems which made life easier for the busy, deadline-burdened, modern engineer.

In the year 1952, K&E began experimenting with a new DuPont polyester film (Mylar®) that had excellent strength, water resistance, and dimensional stability.

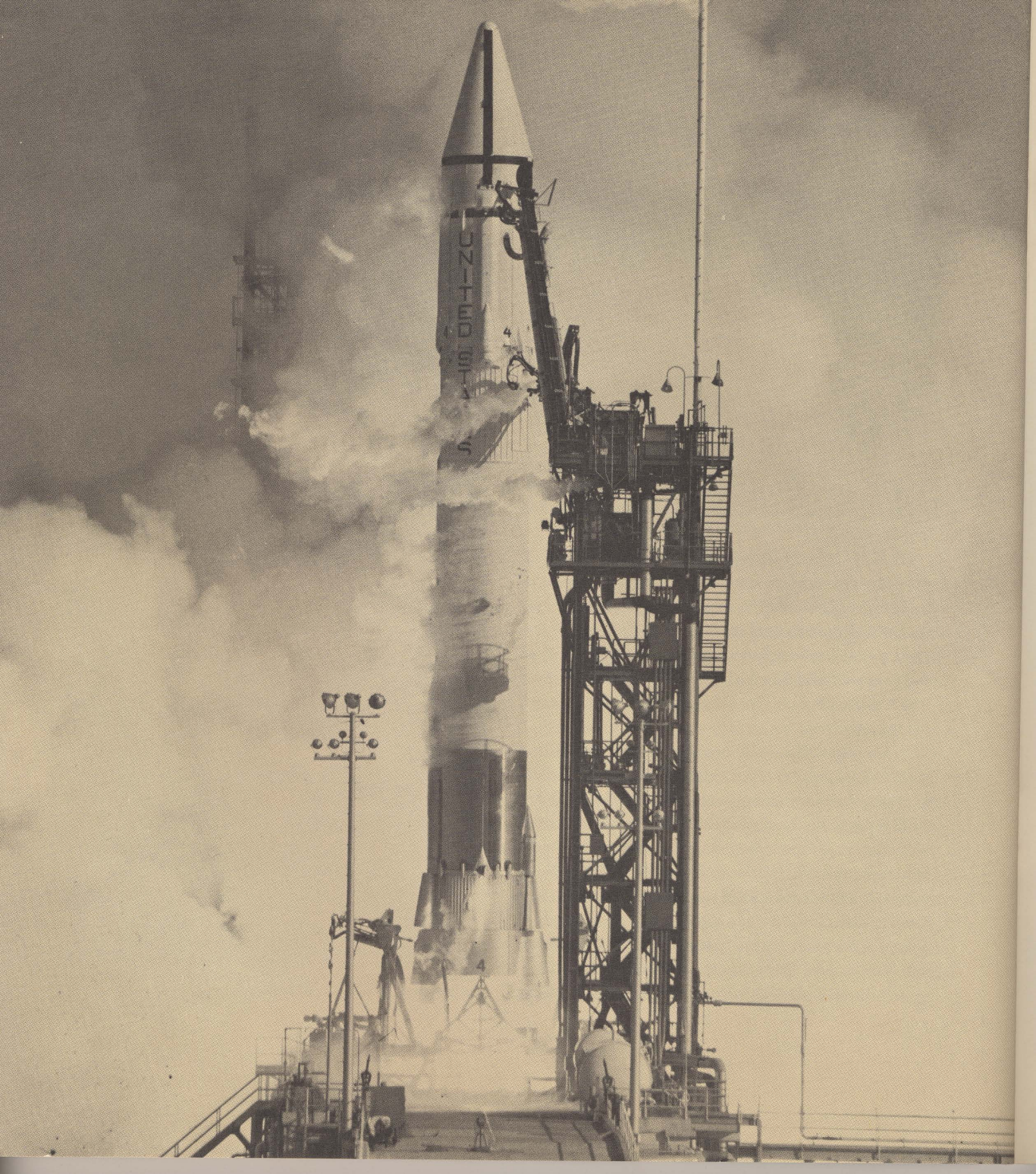
The problem was to bond working surfaces to this almost inert synthetic in such a way that they would adhere completely. K&E was the first to solve this problem, and introduced in 1954 a product line known as STABILENE® film.

And STABILENE was a *system* — not a single product, but dozens (later to become hundreds) of integrated, specialized drafting and reproduction surfaces.



STABILENE film began a new system for mapmakers . .

. . . soon was adopted by industry where it began to revolutionize the techniques of precision drafting.


UNITED STATES

K&E, following the new trend toward systems engineering, produced a complete microfilm system from camera to components.

It was a system that was to change completely the traditional methods of map preparation. Starting with such groups as the Army Map Service of the federal government, it soon became the standard method for the preparation of precise maps.

One surface in particular was to change the traditional methods of drafting and map-making more than any idea since pen and papyrus. This was STABILENE Scribe Coat film.

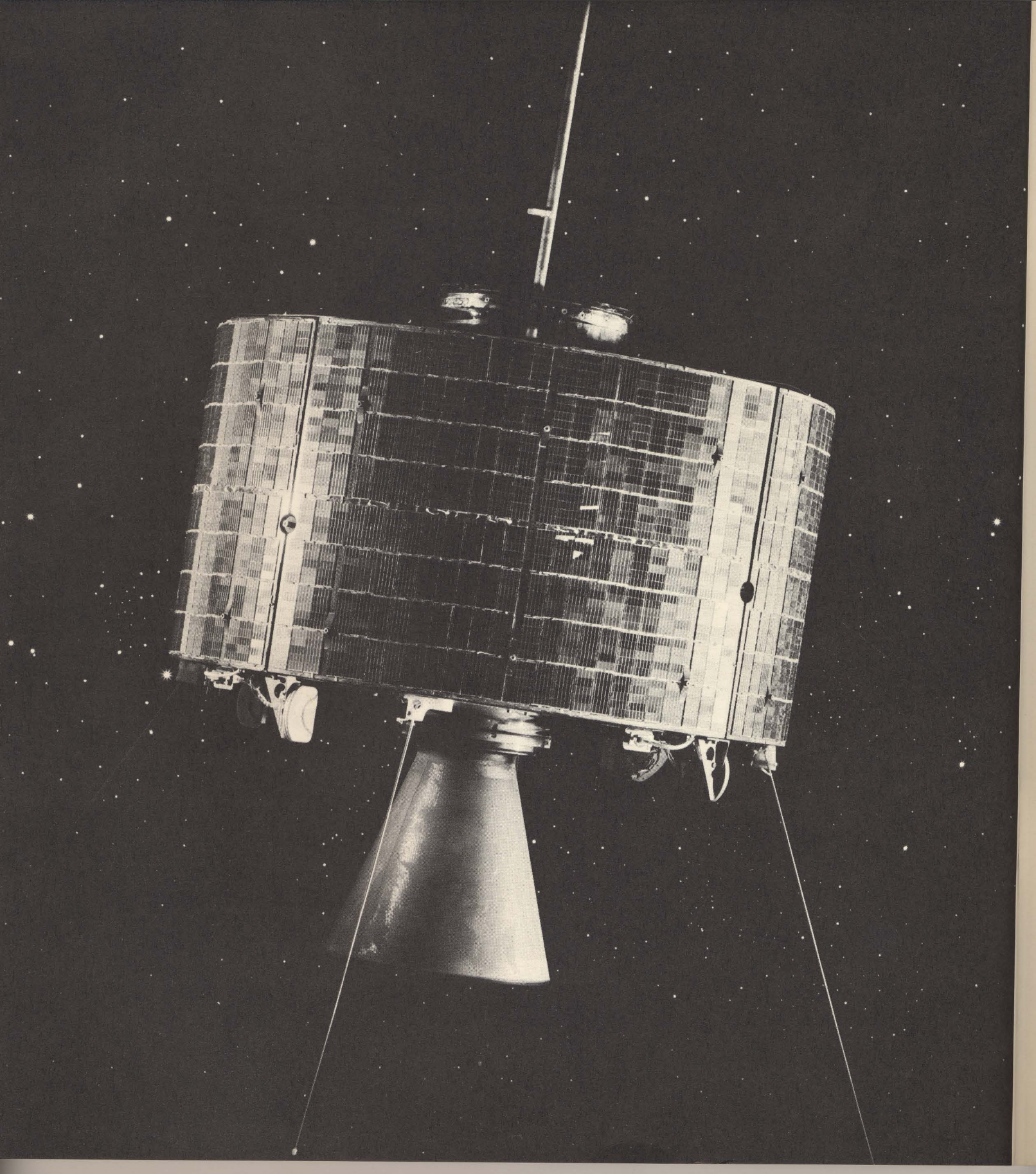
Scribe Coat film, in which a line is incised into the surface with a special scribing tool, led to a dramatic new idea in drafting technique — undimensioned drafting. All of the parts and components of a complex manufactured unit such as an airplane, were drawn exactly to size, relying upon the ultra-stability of STABILENE to maintain dimension to the thousandths of an inch. The result was such a perfect fit in assembly that engineers were amazed.

Today virtually every major aircraft manufacturer uses the STABILENE technique. Its use is so widespread in industry that every one of the government's standard industrial classifications is represented as a customer.

Within the fifties, K&E was to introduce another system with great practical value for the engineering profession — the MICRO-MASTER® 105 mm microfilming system. With its 4x6″ negative size, superb camera and projector optics, automatic features such as push-button focus control, and a full complement of accessory equipment, the MICRO- MASTER 105mm idea found ready acceptance from systems engineers, who were sold on its full range reproduction capabilities.

A systems approach to all product lines resulted in major growth for K&E during the fast moving years from 1945 forward, a time when Branch offices multiplied rapidly, plants were decentralized and added to, and the product line grew by thousands of items.

Enormously complex projects such as the missile and space programs fostered a new breed of systems engineer.



The "Global Village"

ONCE, IT'S BEEN SAID, only a handful of people understood Einstein's theory of relativity, yet in the sixties they teach it in Freshman engineering.

That observation attests to an important new trend in engineering, and of new attitudes and goals which were to transform K&E as it neared the end of its first 100 years.

The engineer through history was first and foremost a pragmatist, a practical man, working out his ideas by actual test, then improving them.

But the new engineer was more — he was scientist, mathematician, and an adroit manipulator of the most remarkable engineering tool of all time — the computer.

Under the presidency of Carl W. Keuffel, himself a scientist-engineer, and later under M.I.T. graduate Alfred E. Busch, K&E also began to move toward a strong science orientation. Theory joined practicality, with implications for an exciting new generation of engineering tools and materials.

The world grew smaller by the day. Communications satellites brought a new dimension to the immediacy of television. Knowledge itself, with the information output increasing by an order of magnitude each year, threatened to outrun man's ability to absorb it. A new challenge arose to classify and speed access to this vital resource, perhaps with global information networks.

In the words of one commentator on the sixties, we were all living in a "global village." For K&E, it was an environment of excitement, growth, and the challenge to change.

Perhaps the most decisive change of the young sixties was the company's decision to become a public corporation in September of 1965. From an exclusively family ownership, share-holders could now participate in K&E growth, and an entirely new audience could learn about the work of the 98-year-old youngster.

PROSPECTUS

290,000 Shares

Keuffel & Esser Company

Common Stock

($1 Par Value)

THESE SECURITIES HAVE NOT BEEN APPROVED OR DISAPPROVED BY THE SECURITIES AND EXCHANGE COMMISSION NOR HAS THE COMMISSION PASSED UPON THE ACCURACY OR ADEQUACY OF THIS PROSPECTUS. ANY REPRESENTATION TO THE CONTRARY IS A CRIMINAL OFFENSE.

Of the shares offered hereby, 250,000 shares are being offered to the public by the several Underwriters, who are purchasing 160,000 shares from the Company and 90,000 shares from a Selling Stockholder. The Company will not receive any of the proceeds from the shares being sold by the Selling Stockholder. See "Selling Stockholder." The remaining 40,000 shares covered by this Prospectus are being offered by the Company to its employees, as set forth under "Offering to Employees." The offering to employees is not underwritten.

Prior to this offering there has been no market for the Company's Common Stock. The price at which the Common Stock is being offered to the public was determined by negotiation between the Company, the Selling Stockholder and the Underwriters.

	Price to Public	*Underwriting Discounts and Commissions*	*Proceeds to Company(f)*	*Proceeds to Selling Stockholder(f)*
Per Share	*$26.00*	*$1.50*	*$24.50*	*$24.50*
Total	*$6,500,000*	*$375,000*	*$3,920,000*	*$2,205,000*

(f) Before deducting expenses payable by the Company, estimated at $110,000, and transfer taxes payable by the Selling Stockholder, estimated at $950.

The above table relates only to the 250,000 shares being offered to the public. The remaining 40,000 shares are being offered by the Company to its employees at a price of $23.40 per share. If all such 40,000 shares are sold, the Company will realize proceeds of $936,000 in addition to the proceeds shown in the table. No underwriting commissions are payable with respect to the shares offered to employees, and any shares so offered which are not purchased by employees will not be issued by the Company.

The shares of Common Stock offered to the public by the several Underwriters are offered when, as and if delivered to and accepted by the Underwriters and subject to their right to reject orders in whole or in part. It is expected that the certificates for such shares will be ready for delivery on or about September 21, 1965.

The First Boston Corporation

The date of this Prospectus is September 14, 1965.

Thus the company came to its Centennial year, 1967. Poised on the threshold of another 100 years, it was enjoying its most rapid growth period. A humble start had launched the company. A dogged determination to perform nothing but quality workmanship — no matter how insignificant the product — had sustained it. New strength and scientific discipline had toughened its sinews for the future.

A corporate citizen of the global village, K&E was ready and eager to move — into Century II.

Television satellites brought a new immediacy to communications.

Where We Have Been... Where We Are Going

As Keuffel & Esser Company reached the considerable age of 100 years, management paused to reflect briefly on roads already traveled, and on the horizons distantly ahead.

Certainly the century 1867-1967 was the period of greatest change in human history. And nearly every expert agreed that the next century would advance even more rapidly, as unbelievable as that seemed.

To help chart its future course, and to pay homage to the great engineering achievements of the past, K&E conducted a survey among engineering leaders, asking them to consider:

- The 10 most significant engineering events of the past 100 years . . . the turning points in the Age of Technology.
- The 10 events of a similar nature which would set the course of engineering in the coming century.

Members of the honorary National Academy of Engineering, deans of engineering colleges, editors of technical journals, and prominent executives and scientists considered these questions and recorded their answers.

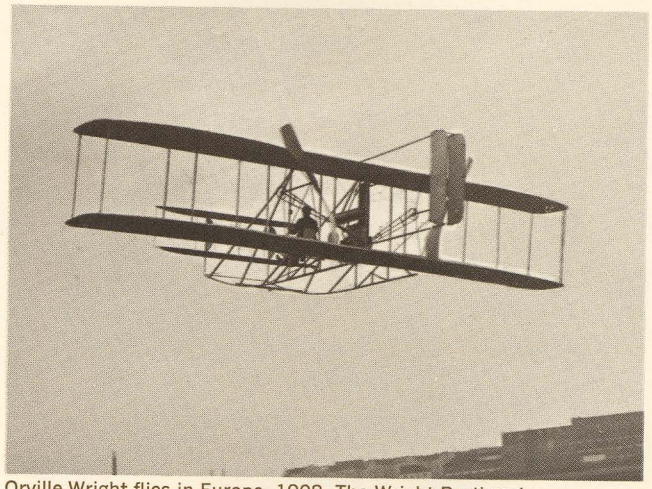
The results attracted national interest and were reported in the *New York Times* and dozens of other newspapers and magazines throughout the United States and Canada.

In viewing the past century, the engineering experts voted for a list of brilliant achievements. Each in its way profoundly changed the course of human events; and each, to the extent that its impact would be felt so strongly, was largely an unexpected occurrence. Here are the ten events, in order of ranking:

1. The Wright Brothers' first powered flight (1903); 2. The first nuclear chain reaction (1942); 3. The telephone (1876); 4. The internal combustion gasoline engine (1886); 5. The incandescent light bulb (1879); 6. The transistor (1948); 7. The computer: the differential analyzer (1930) and ENIAC (1946); 8. Television — the electronic scanner (1928); 9. The laser (1960); and, 10. Refrigeration (1873).

K&E could say: we have served the engineer every step of the way, and what a journey it has been!

From the forecasts of the next 100 years, a fascinating picture emerged of a new world of technological mir-



Orville Wright flies in Europe, 1908. The Wright Brothers' epic flight at Kitty Hawk in 1903 was voted the outstanding engineering achievement of the past century.

Underwater Towns and Sirloin 'Pellet' Meals Seen for Tomorrow

By DENNIS DUGGAN

World Of 2067 To Have Domed Cities, Undersea Farms, Electric Cars

The New York Times

NEW YORK — A century from now Americans will be eating synthetic foods, living in domed cities and commuting to work along computer-lined traffic lanes — if the crystal balls of leading engineering educators are flawless.

Synthetic Food, Domed Cities Seen in Engineers' Eyes

The Shape of Things to Come

THE NEW YORK TIMES, MONDAY, APRIL 24, 1967

Engineers Predict Domed City in 2067

By RICHARD D. LYONS

acles, many within reach in the next few decades. Among the events foreseen were:

- Immediate and drastic changes in the ways we travel over the surface of the earth — cities linked by ultra high-speed trains; automobiles powered by fuel cells or energy sources other than gasoline; the flow of traffic regulated by computers; automated turnpikes in which control of the vehicle is entrusted to machines.
- Control of weather and climate, including the development of a great many presently uninhabitable portions of the world such as the polar regions.
- Space travel, and colonization of the planets.
- A world powered by new energy sources, chiefly nuclear and solar. Perhaps even a solution of the mystery of gravity and the development of "anti-gravity" as a source of propulsion. The transmission of electricity by wireless methods, eliminating cables and wires.
- A vast, world-wide network of information libraries, electronically controlled, to provide immediate access to knowledge on any subject. The evolution of a useful world language to bridge barriers in communication.
- Control and creation of life. Great advances in the replacement of faulty human organs and other parts (hearts, lungs, kidneys, arms, legs) with man-made machines that do the same job.
- Great strides in the farming and mining of the ocean, including underwater colonization on a large scale.
- The computer becoming an even more useful servant of man, greatly expanding his mental capacities, with a vital effect on education. Eventual "man-machine symbiosis" in which the two intelligences are combined.

The engineering leaders in the survey were optimistic that the world's problems of food, conservation of resources, control of air and water pollution would be faced and solved. They were optimistic that man could live without war, and prosper on the earth. Perhaps out of a desire to bring the rationality of the scientist into human affairs, they foresaw that the technical community would play an ever more important role in society, a dynamic "new class" contributing to the social sciences and government as well as to industry.

K&E President Looks to the Future

"My sincere hope is that K&E today, and increasingly in the future, will be a company with an open ear for any new idea, with the brains and hands to make that idea into a practical working tool, and the zeal to take that product into the marketplace, even if it means outmoding present product lines.

"No matter what aspect of the future we consider, we can see opportunity. We can see a continuing, important role for the company that supplies the dynamic, inventive engineering profession with the tools and materials it needs.

"We have been that company for 100 years, and we intend to be that company for the next 100 years."

Alfred E. Busch, at Annual Meeting of Stockholders, April 27, 1967

Engineering Milestones	Year	K&E Growth
Dynamite (Nobel) Reinforced concrete (Monier)	1867	K&E founded
Mount Cenis Tunnel, first through Alps	1871	K&E starts manufacturing in Dutch Street, New York City
Refrigeration (Von Linde)	1873	K&E opens its first retail store
Telephone (Bell)	1876	
	1878	K&E headquarters building erected at 127 Fulton St., New York City
Incandescent light (Edison)	1879	
	1880	First K&E factory building erected
Brooklyn Bridge completed First "steel skeleton" building (Jenney)	1883	First slide rules imported
Parsons' steam turbine	1884	Second K&E factory building erected
Daimler's gasoline engine Electrolytic aluminum extraction (Hall, Heroult independently)	1886	
	1891	First manufacture of slide rules First K&E branch — Chicago
Diesel engine	1892	Headquarters at 127 Fulton St., enlarged to 8 stories First K&E catalog in Spanish
Wireless telegraph (Marconi) X-ray (Roentgen)	1895	
	1900	San Francisco branch opens Second and third factory buildings erected
Airplane (Wright Brothers)	1903	
	1907	K&E's new reinforced concrete factory buildings erected
Plastic (Baekeland)	1909	
Panama Canal completed	1914	
	1916	Optical glass made at K&E
Rocket (Goddard)	1926	

Engineering Milestones	Year	K&E Growth
Television — electronic scanner (Zworykin)	1928	
Differential Analyzer (forerunner of modern analog computer)	1930	
Radar (Watson-Watt)	1934	
	1935	K&E research and testing laboratories reorganized and enlarged
Helicopter (Focke)	1937	
Jet propulsion	1939	
	1941	K&E enters emergency wartime programs — greatly expands production
Atomic pile (Fermi)	1942	
	1945	K&E wins its Seventh Army-Navy "E" for efficiency
ENIAC, first all-electronic digital computer (University of Pa.)	1946	
Transistor	1948	
	1950	K&E active in optical metrology
Artificial satellite, Sputnik I (U.S.S.R.)	1957	
Atomic submarine, Nautilus (U.S.A.)	1958	K&E begins major expansion of R&D in optics, electronics, and chemistry
Laser (Maiman)	1960	New wing of K&E central chemistry laboratory opened
	1961	K&E enters in audio-visual field
		K&E increases activities in photogrammetry
		K&E intensifies international marketing activities
Mariner — Mars photography (U.S.A.)	1965	First public offering of K&E stock
	1966	Greatest sales and earnings year in history of company
	1967	K&E celebrates its centennial, breaks ground for new Home Office & Research Center

Architect's rendering of the new K&E Home Office and Research Center to be built in Morristown, N.J.

1867
INTO CENTURY II
1967

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Printed in U.S.A.